Peer review of 2009 stock assessment of North Pacific swordfish (*Xiphias gladius*)

Assignment undertaken for:

Center for Independent Experts

February 2010

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Executive Summary

Swordfish in the North Pacific are harvested multi-nationally, primarily using longline gear. The U.S. has a major fleet of swordfish longline vessels based in Hawaii and swordfish harpoon and longline vessels in California. An assessment of swordfish in the North Pacific Ocean has to be conducted by staff of the Pacific Islands Fisheries Science Center and collaborating scientists from members of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). The assessment was conducted within the ISC's Billfish Working Group during FY 2009.

Bayesian surplus production models were applied to assess the status of the North Pacific swordfish population under two alternative scenarios for stock structure. These were: (1) a two-stock scenario with stocks in the western and central Pacific (subarea 1) and in the eastern Pacific (subarea 2) and (2) a single scenario stock covering the North Pacific. The results indicated that the North Pacific swordfish population would be estimated to be a smaller and more productive stock under the single-stock scenario than as a combination of two stocks under the two-stock scenario. The MSY results suggested that the North Pacific swordfish population was fairly resilient to fishing pressures and that current biomass was close to the level of B_{MSY}.

Results of the swordfish assessment will be key to international management decisions of the Western and Central Pacific Fisheries Commission and its Northern Committee, and domestic management decisions by the Western Pacific Regional Fishery Management Council (WPFMC) and Pacific Fishery Management Council.

Dr Panayiota Apostolaki was commissioned to provide an independent review of the relevant stock assessment report (document entitled "Stock assessment of North Pacific swordfish (*Xiphias gladius*) in 2009" authored by Jon Brodziak and Gakushi Ishimura) in accordance with the SoW (see Appendix 2). The review was desk based and took place at Cefas, Lowestoft, UK over the period between 17th December 2009 and 19th February 2010. This document provides the outcome of that review. Comments on the assessment report are provided against the specific terms of reference (Appendix 2).

This reviewer regards the overall approach adopted for the stock assessment of North Pacific swordfish as valid and one that takes advantage of a range of technical tools to maximize the value of existing information about the biology and dynamics of swordfish. The method presented is a step in the right direction and the results of the calculation will be valuable for guiding management decisions. There is scope for improving the quality and broadening the range of information used for assessing the status of this stock. That will also support the application of methods that can capture a greater number of characteristics of swordfish biology and the fishery that targets this stock. Thus, although the current approach is appropriate, consideration of more elaborate population dynamics models and collection of the relevant input data are highly recommended. A summary of specific comments and recommendations under each ToR is provided below.

ToR 1. *Review of the assessment methods: determine if they are reliable, properly applied, and adequate and appropriate for the species, fisheries, and available data.*

The assessment methods used are properly applied and are well documented in the literature. The population dynamics model used is a simple one and does not capture some of the main features of the dynamics of North Pacific swordfish. This method is a valid step towards providing adequate information to guide management decisions in the short term. However, use of an age- and sex-disaggregated model for assessing the status of the stock in the future is recommended to ensure that the effects of fishing on stock size and structure are captured in more detail. The Bayesian component of the assessment model is used appropriately but some convergence problems indicate that the data might not be informative enough to support estimation of key parameters of the model. Relevant recommendations are provided below:

Recommendation 1.1. It is recommended that an age- and sex-disaggregated model is developed in the future and a stock assessment using such a model is undertaken every few years. Recommendations about further work needed to make that possible are provided under ToR5

Recommendation 1.2. A chain with more than 60 000 samples should be produced and the convergence tests need to be applied to the new chain to assess if problems with the estimation of the value of the shape parameter could be resolved.

ToR 2. *Evaluate the assessment model configuration, assumptions, and input data and parameters (fishery, life history, and spawner recruit relationships): determine if data are properly used, input parameters seem reasonable, models are appropriately configured, assumptions are reasonably satisfied, and primary sources of uncertainty accounted for.*

Generally, most of the assumptions and the parameterization used are appropriate and reflect well the availability (or lack) of information. In terms of model inputs, only one type of probability density function (pdf) was considered for each of the estimated parameters and there is not much evidence to confirm that that configuration was adequate. Of particular importance are the priors used to describe carrying capacity, the shape parameter and intrinsic growth rate and specific questions about the priors used for those parameters have been included in the main section of this report. Some clarifications are also needed about the assumptions used and configuration of the model. The single-stock and two-stock scenarios considered in the analysis are valid and, as the authors indicate, were chosen by the ISC Billfish Working Group. However, it is not clear why the area of the Pacific Ocean that is covered under the two-stock assumption is greater than that covered under the single stock scenario. Clarifications are also needed about how the catches were split between the two areas. The recommendations under this section are:

Recommendation 2.1 The calculations presented in the report do not provide enough information to understand the influence that the choice of the prior pdfs has on the predictions of the model. Additional exploratory analysis is needed to address this issue.

Recommendation 2.2. The relevant calculations should be repeated using a higher CV for the prior for the shape parameter.

Recommendation 2.3 The report should include an explanation why the mean of the prior for carrying capacity under the single scenario is not equal to the sum of the mean of the priors used to describe the carrying capacity of each of the two stocks considered under the two-stock scenario.

Recommendation 2.4 The report needs to explain clearly why a prior for R with mean equal to 0.5 was chosen given that the values of R suggested by the other studies mentioned in the report were not equal to 0.5.

Recommendation 2.5 The report needs to provide the reasons why the area of the Pacific Ocean that is covered under the two-stock assumption is greater than that covered under the single stock scenario. Also, the catches used for each of the two areas (area 1 and 2) under the two-stock scenario should be presented.

Recommendation 2.6. The model predictions about the decrease in the size of stock 2 between 1951 and 1960 seem unrealistic given that the exploitation rate for the same period is almost zero. A re-examination of the results is recommended. If this decrease is not the result of an error, a detailed explanation of the conditions (or model assumptions) that have produced that result needs to be provided.

ToR 3. *Comment on the proposed population benchmarks and management parameters (e.g., MSY, Fmsy, Bmsy, MSST, MFMT); if necessary, recommended values for alternative management benchmarks (or appropriate proxies) and clear statements of stock status*

The population benchmarks used are appropriate and provide useful information about the characteristics of the stock and its resilience to exploitation. However, it is not possible to judge whether those are the best benchmarks for this stock. Management strategy evaluation could provide an insight into the robustness of chosen benchmarks as well as proposed management plans (and of the stock assessment methods used to support those plans); so, it is recommended that such an approach is considered for future assessments.

The benchmarks presented do not provide information about temporal considerations that could be part of management plans (e.g. time needed to reach equilibrium or for the population to achieve a certain increase in each size). Therefore, benchmarks such as the time it takes for a population to increase by 10% (for different fishing levels) or $F_{0.1}$ (if age-structured models are used) should also be considered. The results for current biomass relative to virgin biomass should be provided. In the absence of MSE and given the simple representation of swordfish dynamics, in the short term, benchmarks calculated using yield per recruit analysis (such as F_{40spr}) can also be considered to check whether there are significant differences between the results from the surplus production model and yield per recruit analysis. The recommendations below provide more details on additional benchmarks:

Recommendation 3.1 I would recommend that benchmarks, such as the time it takes for a population to increase by 10% (for different fishing levels) or $F_{0.1}$ (if age-structured models are used), are also calculated in future stock assessments.

Recommendation 3.2 For comparison, calculation of benchmarks based on yield per recruit analysis should be undertaken.

Recommendation 3.3 Use of management strategy evaluation to decide on appropriate benchmarks and management parameters is recommended.

Recommendation 3.4 The results for current biomass relative to virgin biomass should be provided.

ToR 4. *Evaluate the adequacy, appropriateness, and application of the methods used to project future population status*

The surplus production model used for the stock assessment was also used for the projections. The assumptions and configuration of the model were either identical or very similar to those used for the stock assessment so, the methods are appropriate and were applied correctly (but see comments about the stock assessment model above). The projections were done for the two-stock scenario assuming that the harvest rate would be similar to the one observed in recent years (but with some stochasticity added). This is a standard application of the model and approach used. Although the authors did projections only for the two-stock scenario, it is not expected that the results of projections under the single-stock scenario would change the general conclusions. The population was projected forward for only a few years, so the results of the calculations are relevant for informing short term management decisions that do not introduce major changes in the fishing pattern. If this is not the case, projections that cover a longer time period and a wider range of exploitation levels/patterns will be needed.

Recommendation 4.1 Projections that cover a longer time period and a wider range of exploitation levels/patterns should be considered in the future. Such calculations would preferably be part of a MSE analysis.

ToR 5. *Suggest research priorities to improve our understanding of essential population and fishery dynamics necessary to formulate best management practices*

As highlighted in the report, earlier studies have shown that model predictions are very sensitive to the values of natural mortality assumed. Therefore, research that will provide better estimates of natural mortality should be a priority. In order to facilitate development of more detailed population dynamics models, collection of information that more complex models would require should receive priority. Uncertainty about the reliability of variance estimates of annual CPUE indices has resulted in excluding such information from the stock assessment. Clearly, work needs to be done to increase the quality of CPUE (and associated variance). Options for collecting fishery-independent data are also worth considering. Sensitivity analysis and management strategy evaluation could be used to prioritize research since, they could help identify the model parameters that have the greatest effect on model predictions, calculate correlation among parameters, and evaluate whether the current population dynamics model supports development of robust management plans.

Recommendation 5.1 Research that will provide better estimates of natural mortality should be a priority.

Recommendation 5.2 Information about selectivity at length should be collected if it is not available already. Similarly, work on fecundity, stock-recruitment relationship and sex-specific growth is also recommended.

Recommendation 5.3 It is recommended that further work is undertaken to increase the quality of CPUEs and reliability of CV estimates. Consideration of other indirect methods to calculate CPUE is also recommended

Recommendation 5.4 Use of sensitivity analysis and management strategy evaluation to prioritize research and identify robust management plans should be considered in future analysis.

Background

Swordfish in the North Pacific are harvested multi-nationally, primarily using longline gear. The U.S. has a major fleet of swordfish longline vessels based in Hawaii and swordfish harpoon and longline vessels in California. An assessment of swordfish in the North Pacific Ocean has been conducted by staff of the Pacific Islands Fisheries Science Center and collaborating scientists from members of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). The assessment was conducted within the ISC's Billfish Working Group during FY 2009. Bayesian surplus production models were applied to assess the status of the North Pacific swordfish population. Input fishery data included nominal landings of North Pacific swordfish during 1951-2006. The results of the assessment supported the following conclusions:

- Swordfish exploitation rates are estimated to have remained below H_{MSY} throughout the assessment time horizon.
- There is a very high degree of confidence that the swordfish population was not experiencing overfishing in the final year (2006) of the assessment.
- Current levels of fishing effort directed at swordfish in the North Pacific are likely sufficient to conserve the swordfish stocks (or stock) while providing for a sustainable fishery.

Results of the swordfish assessment will be key to international management decisions of the Western and Central Pacific Fisheries Commission and its Northern Committee, and domestic management decisions by the Western Pacific Regional Fishery Management Council (WPFMC) and Pacific Fishery Management Council. An independent peer-review of the assessment is essential and thus, three CIE reviewers have been commissioned to provide an impartial and independent peer review in accordance with the SoW and ToRs listed in Appendix 2.

This document presents the comments of Dr. Panayiota Apostolaki on the report that describes the stock assessment of North Pacific swordfish. Further details on the reviewer's role and the review request of the Center for Independent Experts are presented below and in Appendix 2.

Description of the Reviewer's Role in the Review Activities

Dr Panayiota Apostolaki was commissioned to provide an independent review of the document entitled "Stock assessment of North Pacific swordfish (*Xiphias gladius*) in 2009" authored by Jon Brodziak and Gakushi Ishimura in accordance with the SoW (see Appendix 1). The review was desk based and took place at Cefas, Lowestoft over the period between 17th December 2009 and 19th February 2010. This document provides the outcome of that review.

Summary of findings

ToR 1. Review of the assessment methods: determine if they are reliable, properly applied, and adequate and appropriate for the species, fisheries, and available data.

Surplus production models have been widely used for stock assessments especially in data poor cases. The weaknesses and strengths of such models have been described in a number of publications (Hilborn and Walters, McAllister and Kirkwood, 1998, 1992, Prager, 2002). Although stage-specific processes that might affect parts of the population differently are not usually captured by such models, they are a first step for exploring the effects of fishing on fish populations. An important weakness of these models is that they could overestimate the ability of a stock to recover from exploitation since they cannot account for selective population reduction and that could lead to underestimation of such effects on the reproductive potential of the stock. This is an important point especially for stocks that are overexploited. So, the approach adopted for the assessment of North Pacific swordfish stock can be seen as the right step towards providing adequate information to guide management decisions in the short term. However, I would recommend that an age- and sex-disaggregated model is also used for assessing the status of the stock in the future.

The study of Wang (2007) showed that the status of the population that their model predicted changed significantly depending on whether a sex-disaggregated or a sex-aggregated model is used. Therefore, it is advisable that a stock assessment using a more detailed model is also undertaken every few years to ensure that the surplus production model does not fail to capture important changes in population structure that might be the result of age- or sex-specific fishing pressure. Furthermore, the current stock assessment report states that additional points in the catch and CPUE data series have become available and that would improve model fits. This is a valid point not only for surplus production models but more complex models as well. So, the use of an age- and sex-structured model is highly recommended.

The use of a Bayesian approach is an appropriate methodology and is used correctly. The main comment on this is related to the choice of priors. I have included details on that below (ToR 2). In terms of model convergence, some problems with convergence have been reported (shape parameter for stock 2), and it would be useful to check whether the Heodelberger and Welch stationarity test is successful for the shape parameter if a longer MCMC chain is produced. So, it is recommended that a chain with more than 60 000 samples is produced and the convergence tests are applied to the new chain to assess if problems with the shape parameter could be resolved.

ToR 2. Evaluate the assessment model configuration, assumptions, and input data and parameters (fishery, life history, and spawner recruit relationships): determine if data are properly used, input parameters seem reasonable, models are appropriately configured, assumptions are reasonably satisfied, and primary sources of uncertainty accounted for.

Generally, most of the assumptions and the parameterization used are appropriate and reflect well the availability (or lack) of information. In terms of model inputs, my main concern is about the fact that only one type of probability density function (pdf)

was used for each of the estimated parameters. Some clarifications are also needed about the assumptions and configuration of the model. Details are included below:

Prior pdfs: It is not clear why the authors chose to use a lognormal pdf to describe carrying capacity. Although such a choice is perfectly acceptable, it is very important to understand what effects it might have on the model outcomes. Will the model give similar predictions if a uniform pdf were used as a prior for the carrying capacity? The same comment is valid for the priors used for the other estimated parameters. The calculations presented in the report do not provide enough information to understand to what extent the choice of prior pdfs influences the predictions of the model. Some additional exploratory analysis is needed to address this issue.

Of particular importance is the choice of the prior for the shape parameter, S. The mean value of the distribution was set equal to 1 and CV was equal to 0.7. However, a change of 0.7 in the value of S results in a change in the value of B_{MSY} of 0.1K. Therefore, even if the value of S becomes 0.3 this will change the value of B_{MSY} from 0.5K to 0.4K. Similarly, a value of S of 1.7 will push B_{MSY} from 0.5K to 0.55K. Thus, although a CV of 0.7 appears large enough to provide sufficient flexibility, it is not so when it is considered in terms of the range of B_{MSY} values it will favour. Therefore, a higher CV is recommended.

Further, the mean of the pdf for carrying capacity for the single stock scenario was equal to 150 000 t, but the values chosen for the mean of the pdfs that describe the carrying capacity of each stock under the two-stock scenario add up to a higher number (150 000 t + 75 000t). The report does not provide an explanation why this sum is not equal (or very close) to the mean chosen under the single-stock scenario (see also relevant comment in the section below entitled *"Two-stock v one-stock assumption"*).

Intrinsic growth rate: The model does not use a spawner recruit relationship but uses the intrinsic growth rate (R) to describe population increase. On page 12, the report refers to an analysis similar to that presented in McAllister et al (2000) that suggested that values of R of approximately 0.9 to 1.0 were appropriate to use for North Pacific swordfish. However, the document referenced in that sentence (McAllister et al 2001) is not about North Pacific swordfish. Further, the explanation why a prior for R with mean equal to 0.5 was chosen, even though the analysis using life history parameters for North Pacific swordfish suggested a value for R of 0.9 to 1, was not clear. The argument put forward was that the mortality of swordfish in the Pacific was 75% higher than that of swordfish in the Atlantic, but an explanation of how that piece of information was used to decide on the mean value of R was not provided.

Two-stock v one-stock assumption: The single-stock and two-stock scenarios considered in the analysis are valid and, as the authors indicate, were chosen by the ISC Billfish Working Group. However, the report needs to include an explanation why the area of the Pacific Ocean that is covered under the two-stock assumption is greater than that covered under the single stock scenario. Clarifications are also needed about how the catches were split between the two areas:

a. Is the sum of catches in area 1 and 2 equal to the catches used when a single stock is assumed or is it greater because it includes catches taken in that part of the Ocean that the single-stock scenario does not cover?

b. If the catches are the same then what is the reason for extending the area that stock 2 occupies further south?

Model output[1]
Table 3.2: The model predicted that there was a decrease of more than 80% in the size of stock 2 between 1951 and 1960. However, the predicted exploitation rate for the same period is almost zero. This decline does not seem right. So, either the table needs to be corrected or an explanation is needed about what factors (or model parameterisation) could have led to such decline given absence of fishing and why such trends are acceptable.

ToR 3. Comment on the proposed population benchmarks and management parameters (e.g., MSY, Fmsy, Bmsy, MSST, MFMT); if necessary, recommended values for alternative management benchmarks (or appropriate proxies) and clear statements of stock status.

The population benchmarks used are appropriate and provide useful information about the characteristics of the stock and its resilience to exploitation. However, it is not possible to judge whether those are the best benchmarks for this stock. Management strategy evaluation could provide an insight into the robustness of chosen benchmarks as well as proposed management plans (and of the stock assessment methods used to support those plans) so, it is recommended that such an approach is considered for future assessments.

The benchmarks presented do not provide information about temporal considerations that could be part of management plans (e.g. time needed to reach equilibrium or for the population to achieve a certain increase in each size). Therefore, benchmarks such as the time it takes for a population to increase by 10% (for different fishing levels) or $F_{0.1}$ (if age-structured models are used) should also be considered. Presentation of the results for current biomass relative to virgin biomass will also be useful and is recommended.

I would also recommend the calculation of some benchmarks based on yield per recruit analysis. In the absence of MSE and given the simple representation of swordfish dynamics, in the short term, benchmarks calculated using yield per recruit analysis can be considered. Benchmarks such as F_{40spr} can be compared to estimates of fishing effort (from exploitation rates) found using the surplus production to check for significant differences between the results from the two methods.

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[1] *Minor points*: Table 2: The symbol used to represent the production model shape parameter should be *S* not *M*. Also, the terms *biomass* and *exploitable biomass* are used interchangeably throughout the text and tables/figures and that is confusing.

ToR 4. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status.

The surplus production model used for the stock assessment was also used for the projections. The assumptions and configuration of the model were either identical or very similar to those used for the stock assessment so, the methods are appropriate and were applied correctly (but see comments about the stock assessment model above). The projections were done for the two-stock scenario assuming that the harvest rate would be similar to the one observed in recent years (but with some stochasticity added). This is a standard application of the model and approach used. Although the authors did projections only for the two-stock scenario, it is not expected that the results of projections under the single-stock scenario would change the general conclusions. The population was projected forward for only a few years; so, the results of the calculations are relevant for informing short term management decisions that do not introduce major changes in the fishing pattern. If this is not the case, projections that cover a longer time period and a wider range of exploitation levels/patterns will be needed. MSE could be used to test the effects of considered fishing pattern on the status of the stock and short and long term catches.

ToR 5. Suggest research priorities to improve our understanding of essential population and fishery dynamics necessary to formulate best management practices.

As highlighted in the report, earlier studies have shown that model predictions are very sensitive to the values of natural mortality assumed. Therefore, research that will provide better estimates of natural mortality should be a priority. Given that a surplus production model was used for the current stock assessment, selectivity information for each fishery was not needed. However, such information is important if a more detailed model is to be used. Therefore, information about selectivity at length should be collected if it is not available already. Similarly, work on fecundity, stock-recruitment relationship and sex-specific growth should receive priority if such information is limited. Uncertainty about the reliability of variance estimates of annual CPUE indices has resulted in excluding such information from the stock assessment. Clearly, work needs to be done to increase the quality of CPUE (and associated variance). Options for collecting fishery-independent data are also worth considering.

Sensitivity analysis and management strategy evaluation could be used to identify the model parameters that have the greatest effect on model predictions, calculate correlation among parameters, and evaluate whether the current population dynamics model could support the development of robust management plans. Use of these techniques could help prioritize research and is recommended.

Conclusions/Recommendations

The authors have made good use of the data available and applied a sound approach to describe and assess the response of the swordfish stock to exploitation. The benchmarks considered are appropriate and provide information that can guide management discussions. There is scope for improving the approach used and

developing the appropriate data sets and analysis that will make such improvements possible. Below, I have provided a list of recommendations for further action/work.

ToR 1

1.1 It is recommended that an age- and sex-disaggregated model is developed in the future and a stock assessment using such a model is undertaken every few years. Recommendations about further work needed to make that possible are provided under ToR5

1.2 A chain with more than 60 000 samples should be produced and the convergence tests need to be applied to the new chain to assess if problems with the estimation of the value of the shape parameter could be resolved.

ToR 2

2.1 The calculations presented in the report do not provide enough information to understand the influence that the choice of the type of the prior pdfs has on the predictions of the model. Additional exploratory analysis is needed to address this issue.

2.2 The relevant calculations should be repeated using a higher CV for the prior for the shape parameter

2.3 The report should include an explanation why the mean of the prior for carrying capacity under the single scenario is not equal to the sum of the mean of the priors used to describe the carrying capacity of each of the two stocks considered under the two stock scenario.

2.4 The report needs to explain clearly why a prior for R with mean equal to 0.5 was chosen given that the values for R that the other studies mentioned in the report are not equal to 0.5.

2.5 The report needs to provide the reasons why the area of the Pacific Ocean that is covered under the two-stock assumption is greater than that covered under the single stock scenario. Also, the catches used for each of the two areas (area 1 and 2) under the two-stock scenario should be presented.

2.6 The model predictions about the decrease in the size of stock 2 between 1951 and 1960 seem unrealistic given that the exploitation rate for the same period is almost zero. A re-examination of the results is needed. If this decrease is not the result of an error, a detailed explanation of the conditions (or modelling assumptions) that have produced that result needs to be provided.

ToR 3

3.1 I would recommend that benchmarks such as the time it takes for a population to increase by 10% (for different fishing levels) or $F_{0.1}$ (if age-structured models are used) are also calculated in future stock assessments.

3.2 For comparison, calculation of benchmarks based on a simple yield per recruit analysis should be undertaken.

3.3 Use of management strategy evaluation to decide on appropriate benchmarks and management parameters is recommended.

3.4 The results for current biomass relative to virgin biomass should be presented.

ToR 4

Several of the recommendations listed above are also relevant to this ToR.

4.1 Projections that cover a longer time period and a wider range of exploitation levels/patterns should be considered in the future. Such calculations would preferably be part of a MSE analysis.

ToR 5

5.1 Research that will provide better estimates of natural mortality should be a priority.

5.2 Information about selectivity at length should be collected if it is not available already. Similarly, work on fecundity, stock-recruitment relationship and sex-specific growth should receive priority.

5.3 It is recommended that further work is undertaken to increase the quality of CPUEs and reliability of CV estimates. Consideration of other indirect methods to calculate CPUE is also recommended.

5.4 Use of sensitivity analysis and management strategy evaluation to prioritize research and identify robust management plans should be considered in future analysis.

Appendix 1: Bibliography

Report reviewed
Stock assessment of North Pacific swordfish (*Xiphias gladius*) in 2009, *authored by* Jon Brodziak and Gakushi Ishimura

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Appendix 2. Statement of Work for Dr. Panayiota Apostolaki (CEFAS)

External Independent Peer Review by the Center for Independent Experts

Stock Assessment of North Pacific Swordfish

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract to provide external expertise through the Center for Independent Experts (CIE) to conduct impartial and independent peer reviews of NMFS scientific projects. This Statement of Work (SoW) described herein was established by the NMFS Contracting Officer's Technical Representative (COTR) and CIE based on the peer review requirements submitted by NMFS Project Contact. CIE reviewers are selected by the CIE Coordination Team and Steering Committee to conduct the peer review of NMFS science with project specific Terms of Reference (ToRs). Each CIE reviewer shall produce a CIE independent peer review report with specific format and content requirements (**Annex 1**). This SoW describes the work tasks and deliverables of the CIE reviewers for conducting an independent peer review of the following NMFS project.

Project Description: Swordfish in the North Pacific are harvested multi-nationally, primarily using longline gear. The U.S. has a major fleet of swordfish longline vessels based in Hawaii and swordfish harpoon and longline vessels in California. An assessment of swordfish in the North Pacific Ocean will be conducted by staff of the Pacific Islands Fisheries Science Center and collaborating scientists from members of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). The assessment will be conducted within the ISC's Billfish Working Group during FY 2009.

Results of the swordfish assessment will be key to international management decisions of the Western and Central Pacific Fisheries Commission and its Northern Committee, and domestic management decisions by the Western Pacific Regional Fishery Management Council (WPFMC) and Pacific Fishery Management Council. An independent peer-review of the assessment is essential. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. Each CIE reviewer's duties shall not exceed a maximum of 10 days to complete all work tasks of the peer review described herein. The CIE reviewers shall have the expertise, background, and experience to complete an independent peer review in accordance with the SoW and ToRs herein. CIE reviewer expertise shall include fish stock assessment, mathematical modeling, and statistical computing.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during a desk review of a report on the stock assessment of North Pacific swordfish, whereby no travel shall be required.

Statement of Tasks: The 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 (name, affiliation, and contact details) to the COTR, who forwards this information to the NMFS Project Contact no later 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 reviewer with the background documents, reports, foreign national security clearance, and information concerning other pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer 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 all 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 on where to send documents. The CIE reviewer shall read all documents in preparation for the peer review.

This list of background documents may be updated up to two weeks before the peer review. Any delays in submission of pre-review documents for the CIE peer review will result in delays with the CIE peer review process, including a SoW modification to the schedule of milestones and deliverables. Furthermore, the CIE reviewer is responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein.

Panel Review Meeting: The CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs. **Modifications to the SoW and ToRs can not 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 reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified in the contract SoW. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

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

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

1) The CIE reviewer shall review all background material and reports provided by the NMFS Project Contact as part of the peer review;
2) The CIE reviewer shall conduct an independent peer review in accordance with the ToRs (Annex 2);
3) No later than 19 February 2010, the CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and to Dr. David Die, CIE Regional Coordinator, via email to ddie@rsmas.miami.edu. The CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in Annex 2;
4) The CIE reviewer shall address changes as required by the CIE review in accordance with the schedule of milestones and deliverables.

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

16 December 2009	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
16 December 2009	NMFS Project Contact sends the CIE the background documents
18 December 2009 – 19 February 2010	The reviewer conducts an independent peer review
19 February 2010	The CIE reviewer submits a draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
5 March 2010	CIE submits CIE independent peer review reports to the COTR
19 March 2010	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be made through the Contracting Officer's Technical Representative (COTR) who submits the modification for approval to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the CIE 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 Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE reviewer to complete the SoW deliverable in accordance with the ToRs and deliverable schedule are not adversely impacted. The SoW and ToRs cannot 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. As specified in the Schedule of

Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (the 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) the CIE report shall have the format and content in accordance with Annex 1, (2) the 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 notification of acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE report in *.PDF format to the COTR. The COTR will distribute the approved CIE reports to the NMFS Project Contact and regional Center Director.

Key Personnel:

William Michaels, Contracting Officer's Technical Representative (COTR)
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NMFS Project Contact:

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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.

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, and Conclusions and Recommendations in accordance with the ToRs.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a detailed summary of findings, conclusions, and recommendations.

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

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

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The CIE independent report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include as separate appendices as follows:

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

Annex 2: Terms of Reference for the Peer Review

Stock Assessment of North Pacific Swordfish

1. Review of the assessment methods: determine if they are reliable, properly applied, and adequate and appropriate for the species, fisheries, and available data.
2. Evaluate the assessment model configuration, assumptions, and input data and parameters (fishery, life history, and spawner recruit relationships): determine if data are properly used, input parameters seem reasonable, models are appropriately configured, assumptions are reasonably satisfied, and primary sources of uncertainty accounted for.
3. Comment on the proposed population benchmarks and management parameters (*e.g., MSY, Fmsy, Bmsy, MSST, MFMT*); if necessary, recommended values for alternative management benchmarks (or appropriate proxies) and clear statements of stock status.
4. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status.
5. Suggest research priorities to improve our understanding of essential population and fishery dynamics necessary to formulate best management practices

Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

This section is not relevant to this review so, not information is presented here.