External Independent Peer Review by the Center for Independent Experts

Research and Data Collection in Closed and Gear Restricted Areas in Support of Spatial Fisheries Management for Atlantic Highly Migratory Species

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Executive Summary

The National Marine Fisheries Service (NMFS) is mandated to conserve, protect, and manage USA's marine living resources based upon the best scientific information available. One of the tools used is closed areas for fishing and some of these are up for evaluation after having been established more than a decade ago.

NMFS science products, including scientific advice often require scientific peer reviews that are strictly independent of all outside influences. The present initiative was such a review process. It took place as a formal desk review process where I was one of three independent external reviewers. The public had access to all the documents. As a CIE reviewer, I participated in the review and we each produced own report without discussions with each other or with the NMFFS staff, except for clarifications during a 1-hour online meeting and by a few emails where all participants were involved.

Four closed areas for Atlantic and Gulf of Mexico Highly Migratory Species (HMS), including tunas, swordfish, billfishes, and sharks were considered. The aim of the closed areas was to protect some target species in the fishery as well as bycatch of protected fish, sea turtles, and whales. After having been in function for more than a decade there is a need to determine whether the measure is achieving its objectives, and whether the balance of associated costs and benefits over time is appropriate. The considerations included ensuring that closed areas remain appropriately placed to achieve ongoing conservation and management objectives, and conversely, that they do not unnecessarily prevent fisheries from attaining optimum yield from healthy fish stocks.

NMFS is currently developing a draft environmental impact statement [DEIS] to evaluate these four HMS closed areas, consider modifications to them, and improve the use of spatial management as a tool. A range of options to collect data in areas currently closed to fishing for HMS is considered. The effectiveness of the closed areas is assessed regarding whether the original objectives are still being met. Programs to facilitate data collection could assess the efficacy of closed areas, improve sustainable management of HMS, and optimize benefits to commercial and recreational fishermen.

It is a challenge to evaluate the effectiveness of those closed areas because of obvious reasons the fishery dependent data are scarce or lacking. Some of the alternatives developed under this action are quite innovative and based on a model that determine the spatial distribution of species based on sea surface temperatures, bottom temperatures, salinity, chlorophyll, and the like which are available from within the closed areas. A specific model has been developed: PRedictive Spatial Modeling (PRiSM), a species distribution and habitat modeling framework developed by Crear et al. (2021) – a peer reviewed scientific publication. The PRiSM model is not subject to this review, it is the application for meeting the purpose and need of the action which is reviewed here. The review considers whether the model is clearly explained and applied in a sound fashion.

All relevant documentation was made available on a cloud drive two weeks before the meeting. I went through the documentation. The documentation was of a high quality and spanned a wide range of relevant topics. An online meeting with the three CIE reviewers and key people behind the DEIS report chaired by Steve Durkee took place on July 20th, 2022, to clarify issues the reviewers had, and NMFS answered these in a satisfactory way.

Three reviewers worked independently of each other, and each produced a review report. The present report is my review report.

The development and use of the PRiSM model is a very innovative, scientifically sound, and (it seems) a robust way of obtaining inferences of the issue in question, the likelihood of unwanted by-catch in closed areas.

The methods are described clearly and in understandable language. It is clear how the PRiSM was applied. The caveats, limitations, and uncertainties in the approach are clearly described. However, it should be clearer that the scoring system was very focused on conservation aspects and not about a balance between fishing and conservation, and that impact on fishing will be a separate consideration. Some fish stocks have improved since the closed area were implemented and how this is dealt with might need a little improvement in clarity in the DEIS report in my judgement. Some minor suggestions for further improvements are given in the present report.

The PRiSM framework and the other analytical approach were applied in a logical and justifiable manner to develop the range of alternatives. When PriSM was used to characterize the impacts of each alternative, the characterization of ecological impacts was consistent with the PriSM results.

Generally, the ecological and socioeconomic analyses supporting the alternatives were logical and documented appropriately, but there seems to be a lack of an analysis of the fishing activity impaired when a new area/month (next to the existing one) was suggested to be closed in a revision of a closed area/month. From the online meeting we were informed that such analysis was still a “work in progress”.

Background

The National Marine Fisheries Service is mandated to conserve, protect, and manage USA's marine living resources based upon the best scientific information available. One of the tools used is closed areas for fishing and some of these are up for evaluation after having been established more than a decade ago.

NMFS science products, including scientific advice often require scientific peer reviews that are strictly independent of all outside influences. The present initiative was such a review process. It took place as a formal desk review process where I was one of three independent external reviewers. The public had access to all the documents. As a CIE reviewer I participated in the review and we each produced own report without discussions with each other or with the NMFFS staff, except for clarifications during a 1-hour online meeting and by a few emails where all participants were involved.

Four closed areas for Atlantic and Gulf of Mexico Highly Migratory Species (HMS), including tunas, swordfish, billfishes, and sharks were considered. The aim of the closed areas was to protect some target species in the fishery as well as bycatch of protected fish, sea turtles, and whales. After having been in function for more than a decade there is a need to determine whether the measure is achieving its objective, and whether the balance of associated costs and benefits over time is appropriate. The considerations included ensuring that closed areas remain appropriately placed to achieve ongoing conservation and management objectives, and conversely, that they do not unnecessarily prevent fisheries from attaining optimum yield from healthy fish stocks.

NMFS is currently developing a draft environmental impact statement [DEIS] to evaluate these four HMS closed areas, consider modifications to them, and improve the use of spatial management as a tool. A range of options to collect data in areas currently closed to fishing for HMS is considered. The effectiveness of the closed areas is assessed regarding whether the original objectives are still being met. Programs to facilitate data collection could assess the efficacy of closed areas, improve sustainable management of HMS, and optimize benefits to commercial and recreational fishermen.

It is a challenge to evaluate the effectiveness of those closed areas because of obvious reasons that the fishery dependent data are scarce or lacking. Some of the alternatives developed under this action are quite innovative and based on a model that determine the spatial distribution of species based on sea surface temperatures, bottom temperatures, salinity, chlorophyll, and the like which are available from within the closed areas. A specific model has been developed: PRedictive Spatial Modeling (PRiSM), a species distribution and habitat modeling framework developed by Crear *et al*. (2021) – a peer reviewed scientific publication. The PRiSM model is not subject to this review, it is their application for meeting the purpose and need of the action which is reviewed here. The review considers whether the model is clearly explained and applied in a sound fashion. NMFS states that "…*given the public interest, it will be important for NMFS to have a transparent and independent review process of the model's use in HMS management*".

The three reviewers worked independently of each other, and each produced a review report. The present report is my review report.

All relevant documentation was made available on a cloud drive two weeks before the meeting. I went through the documentation. The documentation was of a high quality. An online meeting with the three CIE reviewers and key people behind the DEIS report chaired by Steve Durkee took place on July 20th, 2022, during the review process to clarify issues the reviewers had, and the NMFS answered these in a satisfactory way.

The review was done in the context of the terms of reference provided for this review.

Summary of Findings for each ToR

Terms of Reference for the Peer Review

The reviewers will provide a scientific and management peer review of the following document:

Draft Environmental Impact Statement for Research and Data Collection in Closed and Gear Restricted Areas in Support of Spatial Fisheries Management for Atlantic Highly Migratory Species

The reviewers will provide input on the following questions:

1. Evaluate the *description* of the analytical approach used for each alternative.
    a. Are the methods clearly described and understandable in plain language?
    b. Is it clear how the underlying science, including PRiSM, was applied?
    c. Are any caveats, limitations, and uncertainties in the approach clearly described?

2. Evaluate the *application* of the analytical approach.
    a. Was the PRiSM framework and any other analytical approach applied in a logical, justifiable manner to develop the range of alternatives? Reviewers should refrain from making determinations or demonstrating preferences between or among alternatives in the document.
    b. To the extent that PRiSM was used to characterize the impacts of each alternative, was the characterization of ecological impacts consistent with the PRiSM results?

3. Are the ecological and socioeconomic analyses supporting the alternatives logical and documented appropriately?

Central for the Draft Environmental Impact Statement report is the use on the newly developed PRiSM model (Crear *et al.* 2021). It uses fishery-dependent observer data of species' presence–absence, oceanographic covariates, and gear covariates in a generalized additive model (GAM) framework to produce fishery interaction spatial models. Species fishery interaction distributions were generated monthly separately for two HMS (Highly Migratory Species) longline fisheries (pelagic longline fishery and a bottom longline fishery) and used to produce a series of performance metrics for HMS closed areas. PRiSM was used on bycatch species, including shortfin mako shark, billfish, and leatherback sea turtle in the pelagic longline fishery, and sandbar shark, dusky shark, and scalloped hammerhead shark in the bottom longline fishery. Model validation procedures suggest PRiSM performed well for these species. I think the development and use of the PRiSM (or a similar approach) is a very innovative, scientifically sound, and (it seems) a robust way of obtaining inferences of the issue in question, the likelihood of unwanted by-catch in closed areas.

This review is not about reviewing the PRiSM model. It has already been peer reviewed for a publication in a recognised scientific journal. This review is only about whether the model has been described and used correctly. However, there are some subjective elements in the model. For instance, on page 5 in the publication it states "*When two covariates were collinear, one of those covariates was removed. For example, maximum hook depth was not included in the PLL models because it was collinear with sea surface height*." Collinear is not black and white – it can be anything between 0% and 100%. Some decision on a threshold must be made. There is a lot of collinearity in PRiSM and applying it to new data like done in the DEIS report, such decision must have been made. These are not presented in the DEIS report, so it is not possible for me to review how these were done.

It is normally not good modelling practise to take a standard model (here a GAM) and "throw in a lot of parameters" and afterwards sort out things with AIC and the like. Selecting parameters and model structure should rather be a very long and very careful work building on the science available and common sense. The final models for the 6 species groups (Table 2 in the paper) are quite different from each other in the parameters used in the final version of the models and there are only weak links to the biology behind this or discussion of it. You get the feeling that a lot of the difference could be due to random noise. On the other hand, the verifications are quite convincing. But again, for the new models (for the additional closed areas) we do not see these verification values in the DEIS report. Even though I would expect them to be quite good, because of the way the model is used (with the same set of parameters – thus keeping any collinearity that exists) I would like to have seen them in (e.g.) an appendix in the DEIS report.

The objectives of the closed areas are normally not very precisely defined, and this is also the case here. This mean that the evaluation of closed areas after they have been implemented for some years is not an "exact science". Quite a lot of common sense and subjective judgements must be made by the scientists doing the evaluation. The scientists have to some extent to make assumptions of hidden objectives. At the same time the scientists should be unbiased, objective, and non-political. In the present DEIS report it seems from the selection of preferred options that there is an inclination towards being precautionary and rather erring on the conservation side than on the fishing opportunity side. I viewed the present DEIS report on that background.

Normally, for scientific work the data and methods should be presented so that the analysis can be repeated and checked by the public. However, here there might be an issue with data on individual vessels and confidentiality, that prevent data from being available to the public. Therefore, it is even more important than normally that diagnostics are well presented for the analysis. Maybe a special technical document could be an option to consider?

The approach of combining alternatives of a particular spatial management area ("A" Alternatives) with a data collection and monitoring alternative ("B" Alternatives), and timeline for evaluation ("C" Alternatives) into packages, is a good and pragmatic way of getting manageable alternatives options. Options that will reduce the many-dimensional issue in question and will likely make discussions and decisions of the way forward easier.

TOR1a. **Are the methods clearly described and understandable in plain language?**

Generally, the methods are clearly described and understandable in plain language. The Draft Environmental Impact Statement (DEIS) is well structured, well formulated and contains all the needed elements. I only have a few points which might be useful for the authors of the DEIS to consider.

The predictions were limited to the fishery domain, which is the area where 95 percent of the fishery occurs. The way the fisheries domain is obtained is not described in detail. It seems to be by use of some type of spline-smoothing over sea surface area, but how is it done precisely remain uncertain. The description in Crear *et al.* (2021) says *"This was done using the 95% kernel utilization distribution (KUD) …*", but gives no reference and it is not a method so well-known that a reference is not needed.

Within the fisheries domains high bycatch risk area maps were developed for each species and month. "High bycatch risk areas" are the areas where high probabilities of fisheries interactions are predicted to occur for a given species. It is stated that: "*In PRiSM, for each bycatch species, because there is an occurrence probability for each grid cell (each grid cell is a square with sides equal to 1/12°) for each month, the occurrence probability threshold was calculated from thousands of occurrence probabilities*". It is not clear whether any kind of smoothing was done or it was just the raw squares of 1/12° which would likely contain a mosaic of "holes" with non-risk squares among risk squares.

"Probability thresholds" are implicitly linked to a certain effort unit. It was not clear what that unit was. Was it the mean effort by day, the mean set size and soak time, or something else?

The approach is quite complicated with 4 different metrics that each need some "digestion" by the reader. I wonder whether simple illustrations of each of them would be useful for the reader.

TOR1b. Is it clear how the underlying science, including PRiSM, was applied?

The description of the application of PRiSM is to some extent referred to the paper by Crear *et al.* (2021). In Table 2, we find the various final models where (e.g.,) collinearity and the AIC criteria, have been taken care of:

Table 2 Information about the observed occurrence rate of each species in their respective fishery, as well as the best model covariates (with the exception of temporal covariates, e.g. year), deviance explained from the best model, and predictive performance metrics from the three validation approaches for each species

Species	Occurrence (% of sets)	Best model covariates	Deviance explained (%)	Validation approach	AUC	TSS
Billfish group	40	sst, ssh, chla, mld, vo, uo, sstsd, hook, bait, set hour	34.4	Random	0.85	0.56
				Spatial	0.81	0.52
				Temporal	0.82	0.51
Mako shark	27	lunar, bat, rug, sst, chla, ssh, mld, vo, sstsd, bait, set hour	20.3	Random	0.80	0.48
				Spatial	0.72	0.35
				Temporal	0.81	0.51
Leatherback sea turtle	6	bat, rug, sst, chla, ssh, vo, uo, set hour	14.1	Random	0.77	0.44
				Spatial	0.71	0.33
				Temporal	0.70	0.43
Sandbar shark	78	bat, bt, bs, sst, ssh, chla	49.0	Random	0.87	0.65
				Spatial	0.81	0.55
				Temporal	0.88	0.71
Dusky shark	23	bat, bt, bs, chla, btsd, sstsd, set hour set lat, set lon	38.3	Random	0.79	0.51
				Spatial	0.72	0.38
				Temporal	0.72	0.48
Scalloped hammerhead	29	bat, bt, bs, turb, ssh, btsd, sstsd, set hour, bait, set lat, set lon	47.2	Random	0.78	0.48
				Spatial	0.75	0.40
				Temporal	0.70	0.42

In the same paper it is stated that: “Data from the PLL observer program were considered from 1992 to 2018, …”. However, in the DEIS report it is stated in several places that also 2019 data were used. Apparently, new runs of PRiSM were done since the Crear *et al.* (2021) paper. At least the AIC criteria might have changed, and this might have implications for the selection of model covariates like the ones in Table 2 above for each species. It would be appropriate to show these new runs. Luckily, it seems that the models are quite robust to minor changes in the model covariates selection and they are passing the validation criteria with a good margin. So, it is not likely that small variation in this aspect will change the metric 1 to 4 substantially.

On p. 27 the table below is presented. Several of the explanations are unclear. For instance, for Metric 1 it is stated as the number of months (which can be from 0 to 12, or 0 to 36 if it is not being averaged over 2017-2019), but the underlying metric is “average occurrence probability …”. If we look at appendix 4, it seems that it should be understood as the mean over 2017-2019. Some editing and tidying up seems to be needed to make it easier for the reader to understand the system. Maybe moving the text about “underlying metric” to the column “Metric” would help making it easier to understand.

Table 1. *Scoring of Options based on Metrics*

Metric	*Description of System to Score Options based on Metrics*
1	*Number of closure months where probability of fishery interaction inside closure > fishery occurrence rate outside closure (underlying metric: average occurrence probability based on fisheries data)*
	Underlying question: How does the probability of interaction inside the closed area compare to the areas fished outside the closed area?

2	*Number of closure months where ratio > 1* *(underlying metric: ratio that compares the median occurrence probability of high bycatch risk area inside the closed area to the median occurrence probability of high bycatch risk area outside the closed area)*
	Underlying question: Does the closed area protect the most at risk areas? How does the probability of fishery interaction inside the closed area compare to outside the closed area?
3	*Set a threshold percentage for each closed area, then the score is: Number of months > percentage threshold.* *List of threshold percentages (average % of high bycatch risk area across bycatch species in the current closed area during the current closure months):* *Mid-Atlantic Shark Closed Area: 18%* *Charleston Bump Closed Area: 2%* *East Florida Coast Pelagic Longline Closed Area: 1%* *DeSoto Canyon Closed Area: 8%* *(underlying metric: percent of high bycatch risk area that occurred inside the closed area for each month of the year for a given species)*
	Underlying question: What percent of total high bycatch risk area across whole fishery domain does the closed area protect?
4	*Set a threshold percentage for each closed area, then the score is: Number of months > percentage threshold.* *List of threshold percentages (average % of high bycatch risk area across bycatch species in current closed area during the current closure months):* *Mid-Atlantic Shark Closed Area: 48%* *Charleston Bump Closed Area: 31%* *East Florida Coast Closed Area: 15%* *DeSoto Canyon Closed Area: 28%* *(underlying metric: percent of the closed area that could protect high bycatch risk area for each month of the year for a given species)*
	Underlying question: What percentage of the closed area protects high bycatch risk area?

TOR1c. Are any caveats, limitations, and uncertainties in the approach clearly described?

Probably one of the most important caveats, limitations, and uncertainties in the approach is the limitation to only a few species or species groups in the PRiSM calculations. It is stated on p. 19, "*As a practical matter, NOAA fisheries did not attempt to develop and analyze alternatives considering all bycatch species due to the complexity associated with such a large scope, and the fact that optimization of the utility of the current closed areas is likely to be enhanced by the selection of certain bycatch species to be priorities. Further, the use of PRiSM was constrained by data availability*". The DEIS report states a reasonable list of criteria for the selection of species to do the PRiSM modelling on (p.20):

"The four principal criteria were:

1.Occurrence rate in the relevant gear type. A high rate of occurrence (with occurrence defined as at least one individual caught in an observed set) may be an indication that bycatch has not been minimized adequately; a relatively high rate of occurrence is needed for robust model results; and bycatch species with relatively low occurrence rates are relatively non-responsive to the use of spatial management as a tool (especially HMS species, which are highly mobile).

2.The overfished and overfishing status of the species.

3.The status of the species with respect to the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA).

4.Community importance or unique characteristics, such as a species that may be highly sought after in the recreational fishery."

These also reflected the original intent of the closed areas.

Billfish could have been split into each species or to two groups or more groups, but this would mean more work and being unpractical and with doubtful improvements in the overall results.

In total I find these dilemmas well described.

Another potential issue with the PRiSM approach is that closing of a large sea area to fishing can change the habitat (e.g.,) by changes of the bottom structure by lack of trawling (see e.g., Bear *et al*. 2013) or the amount of high trophic level fish in the area and thus the amount of forage fish in the area. This might be the case here. This will violate the assumption in the PRiSM model. For bottom shark DLL – a verification of this could be done using the R/V survey data within the closed area although this might not catch the large fish focused on in the current document. If for instance the abundance of species has increased by a certain factor it might be assumed that the likelihood of incidental by-catch of that species would increase maybe by that same factor or a function of that factor. I don't expect such a change in habitat to be large, however, because of the limited time of closure for some of the areas and the quite low fishing effort used. Maybe this could be discussed a little more in the DEIS report.

I think it would be interesting to include a consideration of the amount of fishing taking place in the areas to be included in the potential revisions of the closed areas. If it is a highly fished area that is going to be closed, it would shift the balance between conservation and fishing differently than if it is a lightly fished area. In the same line of thinking of course it would also be important to know

how much fishing can and will take place in reopened areas. This latter issue however is difficult to predict but maybe the PRiSM approach could be used also for this issue.

Maybe this (especially the fishing which would suffer from including of a new area into the closed area) could have been considered more in the DEIS report. We were informed at the online meeting that this is "work in progress" so it will be considered more, which is good.

TOR2a. Was the PRiSM framework and any other analytical approach applied in a logical, justifiable manner to develop the range of alternatives? Reviewers should refrain from making determinations or demonstrating preferences between or among alternatives in the document.

Given the caveats mentioned above I think the PRiSM and other analytical approaches like the bluefin tuna considerations were applied in a logical and justifiable manner to develop the range of alternatives.

The DEIS report states: *"…bluefin tuna fishery interaction probability maps were taken into consideration separately due to the unique nature of bluefin tuna as an incidental species in the pelagic longline fishery, which is successfully managed through the Individual Bluefin Quota (IBQ) Program.*" I think however, it would be good to expand a little on this explanation. Is it because there is no need to consider bluefin tuna in the context of the closed areas, is it because there are no bluefin tuna in the closed area, that there is plenty of space to fish bluefin tuna outside the closed area or what more precisely is the reason to treat bluefin tuna differently from the other species seems to be an open question?

TOR3. Are the ecological and socioeconomic analyses supporting the alternatives logical and documented appropriately?

Generally, my answer to this is question is yes. There are quite elaborate documentation and analysis supporting the alternative options for closed area borders and these are presented in a logical way.

However, I have a few points which could be further considered.

The so-called scope, i.e., the area of the closed area times the number of months it is closed, seems to give higher scores in the combined scoring metric the higher the scope is. As the question is to find the right or optimal balance between conservation and fishing this seems like a weak point in the aggregate score metric that it automatically gives a higher score the larger the closed area.

On p.121 it is stated: *"At the time of the closure, Atlantic blue marlin, white marlin, sailfish, bluefin tuna, and swordfish were overfished, and bycatch reduction was a component of rebuilding efforts."*

There could be more information presented on the current state of these stocks before and now, and of by-catch species. If the situation is better now, this would influence the decision about increasing or decreasing the closed areas, I would expect.

As one of the original aims with closed area implementation was to protect target species in the fisheries because they were overfished and overfishing took place, it might be useful to consider to what extent this is not so needed anymore. That seems to be the case (that it is not so needed anymore), and then I would suppose the "scope" should be reduced or otherwise reduce the area and time needed for a closure.

Somewhat outside the aim of this review I wonder whether there are any international agreements regarding biodiversity that could be considered. The area dealt with here, the western North Atlantic and Gulf of Mexico seems have extraordinarily many iconic species, six species of sea turtles, many whale species, many shark species, many billfish. Could there be a global biodiversity issue here which should be considered or are the various USA acts and regulations already taking well care of these?

Minor points:

p. 23. The text says "*Figure 1 presents a demonstration of the principle*". I suppose it is Figure 3, which is shown below:

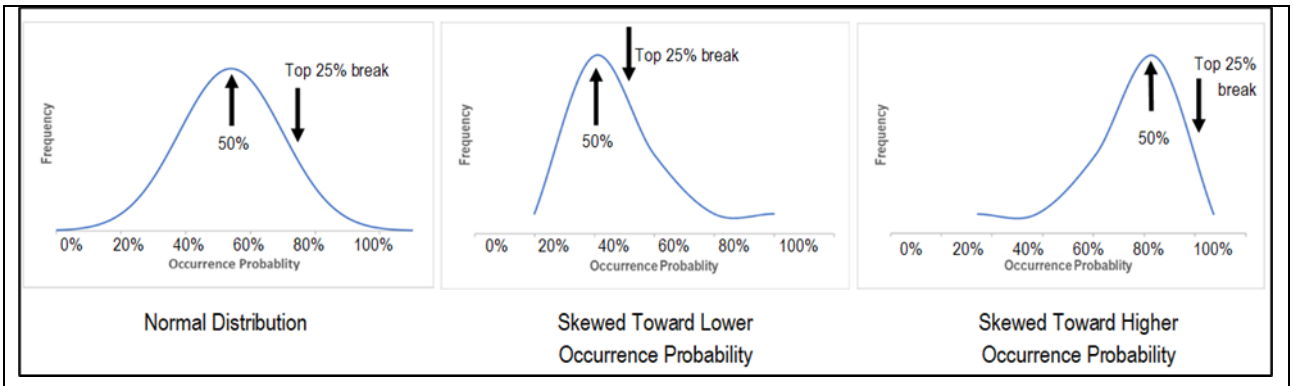

Figure 1. Demonstration of relationship between high bycatch risk area value and occurrence probability threshold.

This figure 3 is a bit imprecise even as just an illustration. The 50% median is not the peak of the curve in two of the cases, and the 25% in the right most curve seems rather like a 10% one.

p.24. "*An example of a high-risk map is shown below in* ***Error! Reference source not found.***." It should be Figure 4, I suppose.

P. 25. This paragraph:

Metric 1 (average occurrence probability inside/outside closed area by month)

For a given species and month of the closed area, metric 1 compares the average occurrence probability inside the closed area to the average occurrence rate from fisheries data collected by observers outside the closed area. In other words, how does the closed area compare to the areas fished outside the closed area?

For this metric as well as others it might be helpful for the reader to state that it is a mean over 2017-2019 for a given month (if that is the case).

Table 43. "*Gulf of Maine Atlantic salmon (Salmo salar*)" also have several DPS (distinct population segment) as each river have its own genetically distinct stock, some large rivers has even several stocks. This should be reflected in this table.

"4.11.6 Mid-Atlantic Shark Closed Area" seem to lack a paragraph about the effect observed since it was established, each of the other closed areas has such a description.

Conclusions and Recommendations

The development and use of the PRiSM model is a very innovative, scientific sound, and (it seems) a robust way of obtaining inferences of the issue in question, the likelihood of unwanted by-catch in closed areas.

The methods are described in a clear and understandable language. It is clear how the PRiSM was applied. The caveats, limitations, and uncertainties in the approach are clearly described. There are however some subjective elements in applying PRiSM and these as well as collinearities and AIC selection of parameters could be documented in a technical document to make the work reproduceable for those having access to the basic data.

It could be made clearer that the scoring system was more about conservation aspects than about a balance between fishing and conservation, and that impact on fishing will be a separate consideration. Some fish stocks have improved since the closed area were implemented and how this is dealt with might need a little improvement in clarity in the DEIS report. Some minor suggestions for further improvements are given above.

The PRiSM framework and the other analytical approach were applied in a logical and justifiable manner to develop the range of alternatives presented. When PRiSM was used to characterize the impacts of each alternative, the characterization of ecological impacts was consistent with the PRiSM results.

Generally, the ecological and socioeconomic analyses supporting the alternatives were logical and documented appropriately, but there seems to be a lack of an analysis of the fishing activity impaired when a new area and month was suggested to be included in a revision of a closed area. From the online meeting we were informed that such analysis was still “work in progress”.

References

Beare, D., Rijnsdorp, A. D., Blæsbjerg, M., Damm, U., Egekvist, J., Fock, H., Kloppmann, M., Röckmann, C., Schroeder, A., Schulze, T., Tulp, I., Ulrich, C., Hal, R. V., Kooten, T. V., & Verweij, M. (2013). Evaluating the effect of fishery closures: lessons learnt from the Plaice Box. Journal of Sea Research, 84, 49-60. https://doi.org/10.1016/j.seares.2013.04.002

Appendix 1. Bibliography list of material provided.

Crear, DP, TH Curtis, S Durkee, and J Carlson (2021). Highly migratory species predictive spatial modeling (PRiSM): An analytical framework for assessing the performance of spatial fisheries management. *Marine Biology* 168:148. doi.org/10.1007/s00227-021-03951-7.

Draft Amendment 15 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan. 2022. Highly Migratory Species Management Division, Office of Sustainable Fisheries, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, Maryland 20910. Available on the NOAA Fisheries website for viewing and downloading: https://www.fisheries.noaa.gov/topic/atlantic-highly-migratory-species.

Appendix 2. Statement of work.

Performance Work Statement

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Center for Independent Experts Program
External Independent Peer Review

Research and Data Collection in Closed and Gear Restricted Areas in Support of Spatial Fisheries Management for Atlantic Highly Migratory Species

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

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

Scope

Spatial management measures such as closed areas and gear restricted areas are useful tools for the management of Atlantic Highly Migratory Species (HMS), including tunas, swordfish, billfishes, and sharks. Regulation of fishing behaviour in specific geographic areas may affect both fishing effort and catch and is often done to achieve specific management objectives such as reducing fishing mortality, bycatch, or bycatch mortality. As with any management measure, after implementation there is a need to determine whether the measure is achieving its objective, and whether the balance of associated costs and benefits over time is appropriate. The need to assess the effectiveness of the existing spatial management measures is particularly critical due to the static nature of those spatial management measures and the highly dynamic nature of HMS fisheries. Such reviews should include ensuring that closed areas remain appropriately placed to achieve ongoing conservation and management objectives, and conversely, that they do not unnecessarily prevent fisheries from attaining optimum yield from healthy fish stocks. However, the

ability of managers to evaluate the effectiveness of those spatial management measures is constrained by limited, or non-existent, fishery-dependent data collected from closed or gear restricted areas after implementation.

NMFS is currently developing an action (i.e., a draft environmental impact statement [DEIS] and proposed rule) to evaluate several HMS closed areas, consider modifications to them, and improve the use of spatial management as a tool, including methods to collect data from within closed areas. This current action considers a range of options to collect data in areas currently closed to fishing for HMS and begin to evaluate the effectiveness of the closed areas and determine if the original objectives are still being met. Programs to facilitate data collection could assess the efficacy of closed areas, improve sustainable management of HMS, and optimize benefits to commercial and recreational fishermen.

Some of the alternatives developed under this action are reliant on HMS PRedictive Spatial Modeling (PRiSM), a species distribution and habitat modeling framework developed by Crear et al. (2021). While the PRiSM methods themselves are not subject to this review, their application for meeting the purpose and need of the action are. Given the implications of this new modeling approach, it is important that the methods are clearly conveyed and applied in a logically sound fashion. Therefore, the CIE reviewers will conduct a peer review of the application of PRiSM and related analyses based on the Terms of Reference (ToRs) below. Given the public interest, it will be important for NMFS to have a transparent and independent review process of the model's use in HMS management.

The specified format and contents of the individual peer review reports are found in Annex 1. The ToRs of the peer review are listed in Annex 2.

Requirements

NMFS requires three reviewers to conduct an impartial and independent peer review in accordance with this Performance Work Statement (PWS), OMB Guidelines, and the ToRs below. The reviewers shall have working knowledge and recent experience in spatial modeling, with applications to fisheries management and/or quantitative ecology. Each CIE reviewer's duties shall not exceed a maximum of 10 days to complete all work tasks of the peer review described herein.

Tasks for Reviewers

Each CIE reviewers shall complete the following tasks in accordance with the PWS and Schedule of Milestones and Deliverables herein.

1. Pre-review Background Documents: Review the following background materials and reports prior to the review:

Crear, DP, TH Curtis, S Durkee, and J Carlson (2021) Highly migratory species predictive spatial modeling (PRiSM): An analytical framework for assessing the performance of spatial fisheries management. *Marine Biology* 168:148. doi.org/10.1007/s00227-021-03951-7.

Approximately, two weeks before the peer review, the NMFS Project Contacts will send by electronic mail or make available at an FTP site to the CIE reviewer all necessary background information and reports for the peer review. If the documents need to be mailed, the NMFS Project Contacts will consult with the CIE on where to send documents. The CIE reviewer shall read all documents in preparation for the peer review.

2. Webinar: Additionally, approximately two weeks prior to the peer review, the CIE reviewers will participate in a webinar with the NMFS Project Contacts and other staff to address any questions that the reviewers may have regarding the ToRs or the review process. The NMFS Project Contacts will provide the information regarding the arrangements for this webinar.

3. Desk Review: Each CIE reviewer shall conduct the independent peer review in accordance with the PWS and ToRs, and shall not serve in any other role unless specified herein. Modifications to the PWS and ToRs cannot be made during the peer review, and any PWS or ToRs modifications prior to the peer review shall be approved by the Contracting Officer's Representative (COR) and the CIE contractor.

4. Contract Deliverables: Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the PWS. 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.

Place of Performance

Each CIE reviewer shall conduct an independent peer review as a desk review at their normal place of work as appropriate.

Period of Performance

The period of performance shall be from the time of award through September 2022. Each reviewer's duties shall not exceed 10 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.

Schedule	**Milestones and Deliverables**
Within two weeks of award	Contractor selects and confirms reviewers

Two weeks prior to the review	Contractor provides the pre-review documents to the reviewers. Reviewers participate in webinar.
July 2022	Each reviewer conducts an independent peer review as a desk review
Within two weeks after review	Contractor receives draft reports
Within two weeks of receiving draft reports	Contractor submits final reports to the Government

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 specified; and (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel

Since this is a desk review, travel is neither required nor authorized for this contract.

Restricted or Limited Use of Data

The contractors may be required to sign and adhere to a non-disclosure agreement.

Project Contacts

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Annex 1: Peer Review Report Requirements

1. The report must be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the application of PRiSM and related analyses is sound, reasonable, and logical, based on the data presented and relevant scientific information.

2. The main body of the reviewer report shall consist of a Background, 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:
a. Appendix 1: Bibliography of materials provided for review and any other materials relied on during the review
b. Appendix 2: A copy of the CIE PWS

Annex 2: Terms of Reference for the Peer Review

The reviewers will provide a scientific and management peer review of the following document:

Draft Environmental Impact Statement for Research and Data Collection in Closed and Gear Restricted Areas in Support of Spatial Fisheries Management for Atlantic Highly Migratory Species

The reviewers will provide input on the following questions:

1. Evaluate the *description* of the analytical approach used for each alternative.
    a. Are the methods clearly described and understandable in plain language?
    b. Is it clear how the underlying science, including PRiSM, was applied?
    c. Are any caveats, limitations, and uncertainties in the approach clearly described?

2. Evaluate the *application* of the analytical approach.
    a. Was the PRiSM framework and any other analytical approach applied in a logical, justifiable manner to develop the range of alternatives? Reviewers should refrain from making determinations or demonstrating preferences between or among alternatives in the document.
    b. To the extent that PRiSM was used to characterize the impacts of each alternative, was the characterization of ecological impacts consistent with the PRiSM results?

3. Are the ecological and socioeconomic analyses supporting the alternatives logical and documented appropriately?