Pacific Scientific Review Group

A Regional Advisory Group for the National Marine Fisheries Service and Fish and Wildlife Service

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Janet Coit, Assistant Administrator
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Dear Assistant Administrator Coit and Regional Directors Morrison and Souza:

This letter conveys recommendations from the Pacific Scientific Review Group (PSRG) to the National Marine Fisheries Service (NMFS) and Fish and Wildlife Service (FWS) based on its virtual meeting 7-10 March 2023 and subsequent discussions. First and foremost, the PSRG gratefully acknowledges NMFS and FWS scientists and managers who prepared stock assessment reports and our NMFS liaison, Laura McCue, who participated in meeting presentations and discussions.

We are very appreciative of the responsiveness of NMFS to our previous recommendations and the consideration they were given and the time and care in the responses.

Our recommendations from our most recent 2023 meeting are as follows:

1) The PSRG recommends that NMFS and FWS consider revising the existing GAMMS document to accurately reflect current practices by NMFS in setting the value for Rmax in Stock Assessment Reports and to better inform the public regarding the use of abundance estimates derived from survey data that are over eight years old. We support the current practice of using a species-specific Rmax value in the stock assessment report for the western Pacific stock of humpback whales. We note that the current value of Rmax for this stock is 0.07, even though a stock specific estimate of Rmax is not available. The value of Rmax is one of the three key parameters in estimating the PBR for a stock (along with a minimum estimate of abundance [Nmin] and a recovery factor [Fr]). The following text related to when a default value or a stock-specific value for Rmax should be used is from GAMMS (2016): "*Default values should be used for Rmax in the absence of stock-specific measured values. To be consistent with a risk-averse approach, these default values should be near the lower range of measured or theoretical values (or 0.12 for pinnipeds and sea otters and 0.04 for cetaceans and manatees). Substitution of other values for these defaults should be made with caution, and only when reliable stock-specific information is available on Rmax (e.g., estimates published in peer-reviewed articles or accepted by review groups such as the MMPA Scientific Review Groups or the Scientific Committee of the International Whaling Commission).*" It is likely that this text should be updated, as some cetacean species have been observed to have annual rates of increase that exceed the 0.04 value assigned to cetacean stocks (e.g., humpback whale, beluga whale). Further, it is not clear to the PSRG why a stock-specific value for Rmax is always preferential to a species-specific value. Because the data required to estimate a maximum rate of population increase are substantive, it is not surprising that stock-specific estimates of Rmax are relatively uncommon. In addition, it is the product of Nmin, Rmax, and Fr that is used for establishing a threshold for anthropogenic removals from a given stock (i.e., PBR). Therefore, an adequately precautionary value for PBR can be implemented by the Agencies in managing marine mammal-fishery interactions without being conservative in the assumptions underlying all three of the parameters used to calculate the PBR, i.e., when the best available science indicates species-specific Rmax values that are greater than the default value are appropriate.

In addition, the PSRG has noticed that in the Stock Assessment Reports NMFS no longer lists a PBR as "unavailable", when reliable estimates of minimum abundance are more than 8 years out of date. For example, based on a summary of SARs for the Pacific Ocean region, we note that only 15 of 45 stocks currently have estimates of Nmin that are less than 8 years out of date. Furthermore, we note that only 3 of the PBRs for these 45 stocks are listed as "unavailable". It appears NMFS is using the third option in the GAMMS report concerning how to estimate Nmin, when survey estimates are out of date, but with very little rationale to support its use (as is required by the GAMMS report). That is, the scientific evidence for a determination that stock abundance is stable in the absence of abundance estimates over a period of more than 8 years needs to be included in this section of the SAR.

The following options are listed in the most recent GAMMS report:

- Determining a plausible distribution of the population growth rate, *r*, and using simulations to project the distribution of $\hat{N}$ to years following the survey, incorporating both uncertainties in the original abundance estimate, and in the assumed distribution of *r*. The selected distribution of *r* may be relatively uninformed (e.g., uniform across some plausible range) or potentially informed by indicators of trend available following the most recent survey.
- When a sufficient time series of abundance estimates is available, it may be reasonable to estimate the population trend (increasing, decreasing, stable) and the uncertainty in this trend and project the future population accordingly, assuming the past trend has continued to the current year.
- Using the most recent estimate of Nmin if population stability can be justified.
- Tailoring the methods of Wade (1998) to the actual survey frequency (e.g., 10 years) and other circumstances pertaining to estimating human-caused M/SI and PBR parameters for the stock, and identifying the appropriate recovery factor or percentile to use for Nmin rather than 20th.

2) The PSRG recommends that NMFS undertake a simulation analysis along the lines of Wade (1998) to determine an appropriate Fr value when the survey interval is between 8-12 years old. Estimates of minimum abundance older than 12 years should be considered unreliable, listed as "not available" in the Stock Assessment Report, along with the estimate of PBR. The PSRG is very concerned that the current practice when dealing with "older" survey estimates will simply default to option number 3 (i.e., use the most recent estimate of Nmin). The simulation approach suggested above could therefore be used to evaluate and recommend best practices for extrapolating Nmin beyond 8 years while properly accounting for uncertainty. For example, even under the assumption of "population stability", it may be appropriate to account for the increased uncertainty in some way (e.g. proportional reductions in Nmin). The PSRG also notes that estimates of trends in abundance for a majority of stocks of marine mammals in US waters are not available. In most cases this absence of trend estimates should not be interpreted as population stability, but rather as the reflection of data limitations. Further, where trend information is available, uncertainty is often such that the lower confidence limit of such a projection (for more than 8 years) will likely result in an Nmin determination that would be considered of no value (i.e., less than 0 animals). Finally, the PSRG believes that it is misleading to the general public to list in the Stock Assessment Reports estimates of minimum abundance that are over 8 years out of date, and certainly 12 years out of date.

3) The PSRG reiterates its recommendation for a more robust analysis of the survey time series (e.g., Bayesian state-space models) into the Pacific Northwest harbor seal stock assessment model. The use of the deterministic logistic growth model in this instance is highly concerning and has significant management implications in that the current approach does not permit the estimation of a declining or non-asymptotic trend. Furthermore, the model fitting methods assume 100% of the variation in survey point estimates around the deterministic logistic function is due to observer error, which is incorrect, and makes it impossible to account for temporal trends or other factors that may be influencing the observed variation in abundance (e.g., variation in prey abundance). Taken together, the associated estimate of K is likely to have greater uncertainty than current estimates, as well as being biased, making it inappropriate to use for management. The requested analysis, a hierarchical state-space model fit using Bayesian or maximum likelihood methods, should not be difficult to implement, and is likely to provide a reasonable fit given the duration of the time series. An additional option would be to use the extensive counts made from land to test for biases in aerial survey counts.

4) The PSRG recommends international coordination on NMFS' recovery plan for the North Pacific humpback whale DPS, and that the plan be submitted as a document to the IWC SC under the comprehensive assessment for North Pacific humpback whales. Given the cross boundary nature of the stocks being considered, international outreach is imperative. The PSRG urges NMFS to not only engage with the US territories and international scientists for review of the recovery plan, but to incorporate them directly into its development.

5) The PSRG recommends conducting additional sensitivity analysis or mark-recapture (MR) analysis of the CentAm/SMex-CA/OR/WA DIP of Humpback whales. The Bayesian analysis conducted appears to be well thought out and executed, but we have several questions about model structure and parameterization that could be evaluated via robust sensitivity analysis. For example, the uniform prior for sigma parameter (for space use) is likely inappropriate as it is included within the denominator of an exponentiated term and thus the transformed prior will be much more informative than intended – we would suggest applying something like a half-cauchy prior to the inverse of sigma^2 (precision), which will thus tend towards a non-spatial model in the absence of information on non-random space use. Evaluation of other model priors can be evaluated using simulations and sensitivity to each evaluated. We would also recommend incorporating all bias correction factors within the Bayesian model itself (i.e., by using priors informed by literature reported values or on simulations), rather than

applying these after the Bayesian model, in order to estimate a simple posterior distribution for abundance.

6) The PSRG reiterates its encouragement to USFWS to move quickly towards coordination between regional USFWS centers to ensure standardized survey methods for sea otters in all regions, including WA and CA. The WA sea otter survey, like the CA sea otter survey, has traditionally been based on a single exhaustive count (census) of the entire range. In other regions, particularly SE Alaska, there is movement towards aerial photograph-based surveys: these new methods allow for optimized sampling of habitats, AI analysis of images to estimate abundance, and include image overlap methods for estimating detection/availability bias and uncertainty. These methods are more efficient than the current observer-based methods, allow for quantification of estimation uncertainty, and will also facilitate a future shift to long-range UAS platforms as this technology becomes more available and affordable. Additionally, the use of model-based estimates of abundance, informed by survey data and potentially other data sources and habitat covariates, can be used to estimate and quantify uncertainty in abundance estimates and trends. We note that model-based estimates have already been developed and published for the CA population, and this approach could be used as an alternative (or additional) basis for reporting status and trends, and would thus allow quantification of uncertainty.

7) The PSRG requests a briefing at its next meeting from NMFS Office of Science and Technology on how ship time requests to support NMFS marine mammal surveys are addressed. The PSRG is concerned that the four Science Centers preparing marine mammal stock assessment reports for marine mammals in the Pacific Ocean region have inadequate lead time to properly budget for and arrange the necessary logistics to support highly technical marine mammal survey cruises (e.g., hire or contract eight or more observers for extended periods, secure the necessary optical and acoustic equipment to carry out the surveys, and provide funding needed to cover travel and per diem costs). The PSRG is concerned that this lack of adequate lead time for survey planning could be a factor contributing to the lack of ship time made available to the marine mammal programs that service the Pacific Islands Science Center, the Northwest Fisheries Science Center, and the Southwest Fisheries Science Center. As possible, the PSRG would like this briefing to include the survey schedule for NOAA vessels or charter vessels in the support of marine mammal research programs in the Pacific Region over the next 3 fiscal years.

8) The Pacific SRG requests presentations at its next meeting from the Northwest Fisheries Science Center and the West Coast Regional Management Office about a) mechanistic links between inbreeding in Southern Resident Killer Whales and a declining population and b) management actions targeting inbreeding. The PSRG is concerned about the results of the effects of inbreeding on the Southern Resident Killer Whale (SRKW) population, specifically that the population growth is seemingly substantially limited by inbreeding, coupled with the documented declining population size of the SRKW population. The PSRG was left wondering about what the mechanistic links are between the ROH-based inbreeding coefficient (FROH) and decreased survival, and if links between FROH and reproduction have been explored? The PSRG suggests that some of the analyses may benefit from inclusion of samples from the NRKW population. While the PSRG acknowledges the importance of analyzing existing data, we are concerned about the lack of plans to engage in field research in the remainder of 2023 focusing on SRKW. This is particularly troublesome given the declining trajectory of the population and that lack of future field work would create gaps in important datasets to inform management.

9) The PSRG recommends that NMFS evaluate the potential biases in the data on whales it considers as having known outcomes for estimating survival of injured or entangled whales. NMFS currently uses a subset of whales injured or entangled which have known outcomes to either assign serious injury rate or in the future whether it should be counted as a mortality or not. However, depending on what it is based on, data on known outcomes may be biased. A known outcome being positive or

negative would be influenced by the likelihood of that known outcome being observed. Re-sightings of whales after entanglement would be more likely to be documented due to extensive photo-ID coverage but documenting death more problematic given many whales sink and never wash up after death. It is important any calculation of the probability of survival take these potential biases into account.

10) The PSRG recommends that estimates of long term average stochastic carrying capacity be compared to estimates using a deterministic population dynamics model for Eastern North Pacific (ENP) gray whales. The PSRG welcomed updates on the integrated population dynamics modeling for this stock. The synthesis of multiple data sources to better understand population dynamics is especially timely in light of the ongoing Unusual Mortality Event. Deterministic population dynamics models formed the basis for an OSP status determination for this stock following the 1999–2000 UME (Punt and Wade 2012). A comparison between stochastic and deterministic model parameterizations, given updated data, would aid in interpreting new estimates of interest to management.

11) The PSRG requests that NMFS provides additional information regarding the protocol and timeline anticipated to finalize a decision regarding the Makah waiver request to take ENP gray whales for subsistence purposes. The PSRG appreciated the update from NMFS West Coast Region staff regarding the status of finalizing the supplementary EIS regarding the Makah waiver request. Given it has been 18 years (2005) since the request was initially made to NOAA by the tribe, the PSRG would like a briefing at its next meeting regarding the status of the draft supplemental EIS, the next steps needed to finalize a decision regarding the waiver request, the scheduled timeline for these steps, and the scheduled timeline for the government's decision.

12) The PSRG recommends NMFS conduct further research and review of the demographic independence of the ENP gray whale Pacific Coast Feeding Group (PCFG) and provide an update to the PSRG on research underway or planned. This should include methods suitable for identification of internal or external recruitment. This recommendation has been made previously by the PSRG and NMFS has indicated it planned to examine things like maternity and relatedness of new recruits to the PCFG. The PSRG would like to be kept informed on the status and plans of research efforts underway or completed.

13) The PSRG supports NMFS' use of the data collected from leatherback turtle surveys to obtain estimates of abundance for harbor porpoise, as well as the proposed research to update the estimate of g(0) for harbor porpoise. The difficulty in securing funding for dedicated surveys and the appropriate overlap of spatial area for leatherback turtles and harbor porpoise, make this a good situation in which to leverage the presence of existing surveys to obtain abundance estimates that might not otherwise be possible. The continued development of the novel habitat-based density model, will be beneficial to NMFS, and further improved by the proposed estimation of the updated g(0), which would aid in the construction of a model capable of detecting trends in abundance.

14) The PSRG recommends NMFS continue to support and promote efforts to mark fishing gear in ways that will make it easier to assign observations of entangled animals to specific fisheries. Currently a high proportion of entangled whale documentation cannot be assigned to a fishery due to insufficient indicators of what fishery was involved. A unified multi-state strategy to promote gear marking would assist in assigning entanglements to the correct fishery.

15) The Pacific SRG recommends investigating the cause of a marked difference in abundance estimates of ENP stock of blue whale derived from line-transect surveys, species distribution models, and mark recapture data. Mark recapture data indicate a recovery of this stock while the other two methods point to a stable or declining trajectory. The differences are sufficient to require some sort of explanation or interpretation by NMFS of the relative reliability of the different survey and analytical

methods.

16) The Pacific SRG requests a presentation on considerations and challenges associated with the adoption of species distribution models (SDM) as the primary basis for assessing abundance and trends for many cetacean species. Over the last decade, statistical advances in the use of general additive models (GAM) have allowed for the application of SDM to survey data from many cetacean species in the Pacific (spotted dolphin, rough toothed dolphin, short finned pilot whale, sperm whale, pelagic FKW, etc.). Unlike more traditional "design-based estimates" based on distance-sampling line transect surveys, SDMs incorporate species-habitat relationships, including both fixed and dynamic oceanographic variables, and thus allow for spatiotemporal interpolation of densities that account for these habitat relationships. In many cases, this approach provides more precise abundance estimates than the traditional design-based estimates, and model-based estimates can also be generated for years in which surveys have not taken place, or for non-sampled (or poorly sampled) geographic areas.

While the PSRG appreciates these statistical advances, we are increasingly concerned about the broad application of this approach as the primary basis for assessing abundance and trends. We believe that there are a variety of implicit assumptions underlying the use of SDMs that have received insufficient attention, but which could potentially be leading to biased assessments for some species. Some of the associated pitfalls of GAM-based SDMs have been identified in the literature: for example, the extrapolation of density-habitat relationships to geographic areas that were not sampled during the survey (or interpolation to areas that were poorly sampled) can result in highly uncertain or biased estimates of abundance. Like any model, SDMs are limited by the data collected and the predictor variables considered – adding or removing variables from consideration can lead to dramatically different results. Careful examination of the sensitivity of abundance estimates to extrapolation and model uncertainty should be standard protocol.

Perhaps most concerning are unrecognized assumptions about the inclusion or exclusion of temporal effects in SDMs. Model-based assessments have been used to generate time series of estimates that are being used to assess trends as well as current abundance. Yet in many cases the underlying SDMs do not actually allow for temporal effects other than those associated with dynamics of the underlying environmental variables included in the model. In current SARs, the boilerplate text describing this rationale is as follows:
"Although a 'year' covariate was tested during model development, it was not selected as a significant variable. Despite not fully accounting for inter-annual variation in total abundance, the model-based estimates are considered the best available estimate for each survey year."

An implicit assumption here is that the inclusion of temporal effects in the model – for example a linear or non-linear relationship between abundance and year, or perhaps a random effect for year – should be assessed as for any other habitat variable, using AIC (or P-values, or some other information criterion) to determine whether there is statistical support for inclusion of the effect in the model. Statistically speaking, this seems to reflect an appropriately conservative approach in deciding on which covariates to include in the model; however, for temporal effects, there are two problems with this assumption. First, time is fundamentally different from any other habitat covariate: while we do not know *a priori* whether a given habitat variable is related to abundance, we know with complete certainty that the abundance of ALL species varies with time A dynamic model that does not allow for variation over time is no longer a dynamic model. The second problem is more philosophical in nature: a statistically conservative approach to incorporation of time effects is not equivalent to a biologically conservative approach. For example, in the case of data poor species with sporadic survey data or few sightings, it is quite possible that a time effect may be evaluated and found to be statistically non-significant. The current approach - not including temporal effects if found to be "non-significant" – results in a time series of abundance estimates that suggest a stable population. However, in this example, it is very possible the population is not actually

stable, but could be increasing or decreasing – in essence, the potential for type-II error (assuming no effect when there actually is one) could be quite high. The detection of a "statistically significant" decline is known to take a long and detailed time series, which is missing for many relevant stocks, and the decline is often not detected until well after the point at which management actions might easily and cost effectively be implemented. In contrast, if a time effect were to be included in the model by default, it could result in the suggestion of a downward trend long before it becomes "significant", and also (potentially) to greater, but more realistic, uncertainty in annual abundance estimates. We recommend the inclusion of a time covariate in all abundance estimates for pelagic cetaceans to incorporate this additional source of uncertainty.

In short, we are concerned that the policy of "no time effect unless statistically significant" may be resulting in unrealistically precise annual estimates (with the uncertainty associated with temporal trends having been excised from the model) and seems to imply that population stability is the assumed default state. In some instances, there are even apparent increasing trends driven entirely by dynamic environmental variables (e.g. a positive relationship with temperature), which could further contribute to unrealistic or unjustified assessments of population status, particularly given the warming oceanographic conditions due to climate change.

The Pacific SRG believes that many of these concerns could be investigated through a rigorous simulation approach, similar to the simulation approach used to develop PBR calculation guidelines. Generating random data sets with known trends but very sporadic or limited survey data could help determine the most appropriate and biologically conservative approaches to inclusion of temporal effects in SDMs.

17) The PSRG recommends that NMFS manage mortality and serious injury for the pelagic stock of FKW with the following goals:

1. **Management should focus on both within the Hawaiian Islands EEZ and the area of US fishing operations outside the EEZ.**
2. **The area to be managed should minimize sources of uncertainty, including**
    a) **Areas of foreign fishing (unknown takes of pelagic FKW)**
    b) **Excessive extrapolation from the spatial distribution model (SDM)**
    c) **"No data" areas, where there is neither survey effort nor US pelagic FKW bycatch, such as the Johnston Atoll EEZ**
3. **The area to be managed should be consistent and predictable over time. Ideally the boundaries of the area should be determined by data on the known distribution of pelagic FKW, rather than any specific threat (e.g. the distribution of fishing effort)**
4. **Within the management area, all pelagic FKW bycatch (domestic and foreign) should be accounted for when comparing bycatch to PBR**

Additionally, in considering alternative options for defining a management area for bycatch of pelagic FKW, we recognized the following guiding principles:

1. There should be the reasonable potential to collect pelagic FKW abundance data for the entire management area for the purpose of calculating a PBR.
2. Because there is currently no information on social or population structure within the pelagic FKW stock, we believe a precautionary approach would be to minimize potential for localized depletion (e.g. depletion within the EEZ), until more is known about possible social/genetic structure.

Both of these principles should be prioritized for future research efforts including:

1. Expand the geographic scope of sighting surveys to estimate abundance to now include some of the areas with highest US fishing efforts outside the US EEZ which are not getting covered currently.

2. Initiate efforts with the appropriate international fishery associations to provide for reliable estimates of foreign fleet bycatch in the area outside the EEZ used for PBR calculations.
3. Reevaluate the robustness and uncertainty associated with estimates of abundance in the SDMs. This could be done through the use of simulations, as well as by incorporating data from sighting surveys designed to provide a calibration for the SDM output especially for areas outside the EEZ.
4. Using appropriate methodology (telemetry tagging, genetic samples, photo ID mark recapture, etc.) to improve understanding of potential social and/or genetic structure within the pelagic FKW stock, to determine whether the population is open/well mixed or has internal structure (similar to insular FKW) that could allow localized depletion if bycatch mortality were spatially concentrated.

Considering the above principals, we believe maintaining separate PBR values for the U.S. Hawaiian Islands EEZ and for the larger area outside the EEZ is important, and that a single SAR for pelagic false killer whales include the following:

1. Pelagic FKW abundance, bycatch, and PBR for the portion within the U.S. Hawaiian Islands EEZ
2. Pelagic FKW abundance, bycatch, and PBR for the portion outside* the U.S. Hawaiian Islands EEZ, encompassing the area for which there are existing data on pelagic FKW occurrence, including past records of bycatch by the US fishing fleet.

*We recognize that item #2 above includes areas of foreign fishing operations, for which FKW bycatch data are not currently available but will need to be properly accounted for going forward.

18) The PSRG recommends NMFS reconsider the biases and accuracy of estimates of abundance of bottlenose dolphins in the Mariana Archipelago. Estimates and resulting interpretations presented at the PSRG in March 2023 did not seem to seem to be internally consistent in terms of the abundance, interchange with other areas, and other key parameters. These estimates should not be used in management until biases and assumptions can be better tested and validated.

19) The Pacific SRG reiterates its recommendations from 2018, 2019, 2020, 2021 and 2022 for implementing time-area closures within important resting bays to protect spinner dolphins. The PSRG notes that the time period for public comment on the proposed time-area closure rule (in addition to the recently implemented 50-yard no-approach rule) closed in December 2021, and has concerns on the lack of progress on finalizing a ruling on this matter.

20) The PSRG requests a presentation from the PIFSC regarding further updates to the newly developed methods for the estimation of long-term trends in abundance for the Maine Hawaiian Insular stock of FKW. The PSRG is in support of the proposed approach, but would like to see further simulations aimed at specifically addressing the effects of violating model assumptions: 1) the cluster is the largest source of variation in movement, 2) cluster membership is fixed and known without error and 3) tag inventory adequately defined space use. All of these can be incorporated into the current simulations, and would provide a better picture of the behavior of the approach as it relates to FKW, building even greater confidence in the use of the approach to assess trend.

21) The PSRG requests a briefing from NMFS and USFWS experts regarding the potential for comorbidity among toxoplasmosis exposure and other factors that could lead to the death of a marine mammal (e.g., avoidance behavior around fishing nets or vessels, foraging efficiency, predator avoidance, disease resistance). Our concerns are related to the potential for sub-acute toxoplasmosis infections to affect the behavior of an animal such that its ability to avoid entanglement and ship strikes could be compromised, as could an animal's ability to forage efficiently and avoid predators. This change in behavior could be mediated through changes in social interactions in social species (e.g., spinner dolphin), as well as changes in the behavior of more solitary animals (e.g., monk

seals). More generally, there are several ways that sub-lethal effects of toxoplasma infections could nonetheless have population consequences, and the PSRG would appreciate a summary of the range of chronic effects of toxoplasma exposure being considered (co-morbidities and co-infections, increased risk for other hazards, etc.). Additionally, the PSRG supports continued investigation into the relative frequencies of and exposure to different toxoplasma genotypes in the Hawaiian Islands, as different genotypes could have dramatically different outcomes in terms of infection severity.

22) The Pacific SRG reiterates their support of the use of passive acoustic methodologies to improve on SARs for elusive, yet acoustically identifiable species, but requests an update on methodological improvements. The Pacific SRG commends important progress achieved in implementing acoustic density estimates for rare or elusive species that can be readily identified using acoustic detection methods. We request an update on efforts related to the effect of duty cycle, possibly with a simulation approach and a variety of densities. While this was addressed theoretically in the written response, a demonstration would be useful. An update on ongoing work related to the influence of ocean currents on DASBR drift patterns and the assumption of random distribution is requested. We additionally recommend incorporating uncertainty into estimating distance from track-lines of DASBR drifters.

Sincerely,

John Calambokidis, PSRG Chair

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