Peer Review Comments and Responses
NMFS Biological Report, supporting document for revision to the critical habitat designation for the leatherback sea turtle.
9/18/09

Peer Reviewer #1 comments:

Scyphomedusae is not capitalized (only the Latin name of the Class Scyphozoa). This needs to be changed in several places. Contrariwise, Class and Order (as in Order Semaeostomeae) should be capitalized. This has been corrected in document

Jellyfish as food citation and information:
Doyle, T. K., J. D. R. Houghton, R. McDevitt, J. Davenport & G. C. Hays, 2007. The energy density of jellyfish: Estimates from bomb-calorimetry and proximate-composition. Journal of Experimental Marine Biology and Ecology 242: 239-252. This has been incorporated

Pg 13 genera need to be italicized. done

Pg 13 pH. Winans, A.K. and J.E. Purcell. In review. Effects of pH and temperature on asexual reproduction and statolith formation of the scyphozoan, *Aurelia labiata*. Hydrobiologia.
No pH effect on production of new medusae (ephyrae); statoliths were not decreased in number, but were smaller in low pH. This information and reference has been added

"Iglesias-Rodriquez et al. (2008) found increases in biogenic calcification". Do you mean decreases? No…according to this report, the statement is correct. There seems to be some disagreement among the experts, so we should treat these conclusions accordingly.

Houghton, J. D. R., T. K. Doyle, M. W. Wilson, J. Davenport & G. C. Hays, 2006. Jellyfish aggregations and leatherback turtle foraging patterns in a temperate coastal environment. Ecology 87: 1967-1972. This information and reference has been added

Table 1. Area 2. Oil spills misspelled
Why is fishing not included in 'activities' Fishing not considered to directly effect PCE's-need BRT comment on this

Area 2 off Washington and Oregon looks important and received a High value rating. I guess you cannot enlarge the proposed CH area. We might consider expanding Area 2 to the coastline…there are jellyfish, but lack of data on leatherback distribution here. Other reviewers also commented on this.

Peer Review #2 comments:

Pg. 12.. [Seems Tanya's data should be mentioned here because it reinforces the idea that Leatherbacks are selecting certain species for their energy content and that not all jellies are

equal in the eyes of a turtle. You can cite here thesis]. Graham's thesis and this point incorporated into document.

Pg. 14. Most leatherback sightings occur in marine waters within the neritic zone. The species may pursue prey as far as the extent of mean lower low water [seems this is a bit extreme, basicllly stating they can forage intertidally. The ramifications are that you have to protect intertidal areas because of Leatherback foraging, seems a reach and a bit problematic. Can't you at least call it higher high water?] (S. Benson, NMFS, unpublished) so the CHRT considered this as the shoreward extent of distribution in those specific areas with documented nearshore distribution. There seems to be some confusion on the tidal demarcation... Mean lower low water DOES NOT include the intertidal realm. We had this conversation early and Steve Stone recommended the following on 29 July...
"Scott - One quick edit that should be made (based on an e-mail exchange back in June) has to do with the intertidal extent of the specific areas. The report currently reads "Most leatherback sightings occur in marine waters within the neritic zone. The species may pursue prey as far as the extent of mean high water (S. Benson, NMFS, unpublished) so the CHRT considered this as the shoreward extent of distribution in those specific areas with documented nearshore distribution." I think we should change "mean high water" to "mean lower low water" (MLLW) based on your recent advice/observations about LT sightings".

We've changed it back to "mean lower low water", again.

Pg. 20/Table 2…I guess I did not realize how few turtles were seen in Area 2. Why is that, lesser prey and environmental features favorable to turtles and prey or because lesser survey effort or poor sighting conditions in that area?

Peer Reviewer #3 comments:

The 'primary constituent elements' identified rely mostly on knowledge of the distribution of the target prey, chiefly semaeostome mdeusae (such as *Chrysaora fuscescens*, *Aurelia* spp., *Phacellophora* sp. and *Cyanea sp.*). A good deal of general descriptive work has been conducted on the distribution of these species along the west coast of North America, but certainly much more is needed to characterize the temporal variability from seasonal patterns to long-term climate-linked variations. Moreover, it is ultimately the benthic polyp stages that contribute to seasonal and annual population variation of the adult medusae, and little information exists on their populations in open coastal systems including the California Current upwelling system.

My first comments are aimed at helping to emphasize the nature of certain frontal systems in defining Critical Habitat. My conclusion from having worked in this system is that the medusae (specifically *Chrysaora*) are closely linked to the physical structure of the water column and the dynamics of upwelling-related circulations. This creates areas of strong concentrating forces around, or just equatorward, of headlands/capes. I think you highlighted the nature of 'upwelling shadow' features like that found in northern Monterey Bay. Perhaps as you identify CRH associated with physical features, you could better argue that features do not necessarily need to

be fixed (in time or space) geomorphological features (e.g., a seamount or canyon), but can also be a relatively fixed (again in time and space) hydrographic feature. I did some work as part of my dissertation that showed that the 'upwelling shadow' feature itself was a quasi-persistent hydrographic presence in Monterey Bay that could last up to weeks, if not months, during the larger upwelling season. It is true when you say fronts in general are transient, but I believe enough evidence exists now, both from my own work and the work of others (i.e., PISCO group) that suggests this feature does persist longer than other coastal fronts of similar length scale (Graham 1993). I think this is an important point, because defining critical habitat in a fluid medium needs justification of persistence.

This point is similar to Suchman's comment. These reviewers appear to have misunderstood the points being made on the transient and ephemeral nature of offshore features. The document has been revised considerably to clarify and also incorporate this and other related comments on hydrographic features. The revised document does a better job of delineating the physical features that characterize the geographic boundaries of the proposed CH areas as suggested by the reviewer.

Another point relating to the persistence of the feature is the relationship between hydrographic seasonality and intra-annual variations of jellyfish. The evidence from Cynthia Suchman's work to the north and my work in Monterey Bay suggests that *Chrysaora* adults can be found year-round. Aggregations may be seasonal, but that is only related to the concentration and diffusion cycles as the seasonal upwelling patterns couple and uncouple with jellyfish populations. The fact that seasonality in foraging patterns of turtles may be linked to seasonality of hydrography (rather than of jellyfish populations) indicate that the physical features might be the target of defining the Critical Habitat.

Finally, there is also some good evidence that these hydrographic features are strongly influenced by ENSO (and perhaps PDO?) dynamics. I co-authored a paper with Bill Lenarz that took a look at ENSO-related influences on biological properties along central California. In this paper, I provided data from juvenile rockfish surveys that showed poleward and offshore re-distribution of *Chrysaora fuscescens* during ENSO events. Applying inter-annual and inter-decadal variability to the model you are promoting may be critical for adjusting the definition of Critical Habitat according to climate modes.

Relevant references:

Graham, W. M., 1993. Spatio-temporal scale assessment of an "upwelling shadow" in northern Monterey Bay, California. Estuaries 16: 83-91.

Lenarz, W. H., D. A. VenTresca, W. M. Graham, F. B. Schwing & F. Chavez, 1995. Explorations of El Niño events and associated biological population dynamics off central California. CalCOFI Reports 36: 106-119.

Cynthia Suchman's comments:

Very few data are available on distribution and abundance of jellyfish off the West Coast of the US. The authors of this working draft have correctly identified some of the key published

literature by Shenker, Graham, and Suchman. In general, what could be better clarified in the report is what we know about the specific habitat of Chrysaora fuscescens in surface waters off Oregon (inner shelf, cold upwelled waters). I am also preparing a manuscript with more information on seasonal development of jellyfish blooms off Oregon and Washington (highest abundances in late summer) and interannual variability (correlation with PDO and Columbia River streamflow; highest abundances during years with more upwelling and less streamflow). Although this paper has not yet been submitted for review, I am happy to share data and figures should these be of use to NOAA.

I note that the critical habitat proposed here does not include the Washington or northern Oregon coasts, although these shelf areas contain seasonal populations of jellyfish prey and are used by loggerhead turtles (as demonstrated by tagging studies).

Specific comments:

Discussion of upwelling and physical features on p.10-11. In general, I found it hard to connect this discussion with the critical habitat designation. Although it's a section very useful to set the stage for subsequent discussion of loggerhead habitat, I think it might help to be more explicit about the connection between important physical features and processes in the region and how these impact productivity. For example, state outright that the California Current is an upwelling system that experiences 1) high seasonal productivity related to wind stress and input of cold nutrient-rich water and 2) interannual productivity varies based upon larger-scale climate forcing such as the PDO or ENSO. And, superimposed upon regional productivity are local conditions – these are influenced by features such as banks (Heceta), eddies (from flow in the region of capes), etc. Smaller-scale features often result in hotspots of biological activity (cite the Suchman and Brodeur 2005, Ressler et al 2005, Reese 2005).

p. 10 paragraph 1. I think you mean to write that ENSO and PDO add variability to regional productivity (not local productivity). They act on larger, regional scales. Paragraph 2: I think you mean to write that offshore water is "warmer" offshore during the upwelling season (not cooler). I'd also change the wording of the second to last sentence to read " Warm PDO years are correlated with Columbia River flow." The PDO is an index, not a causative agent (from http://jisao.washington.edu/pdo/PDO.latest: "Updated standardized values for the PDO index, derived as the leading PC of monthly SST anomalies in the North Pacific Ocean, poleward of 20N"). Good point. Text has been revised as suggested.

p.11, sentence stating that frontal features aggregating jellyfish are 'ephemeral' in nature. I think this may be true for local distributions, but larger-scale aggregations of Chrysaora fuscescens along the inner shelf off Oregon are remarkably persistent during summer months and occur each year. Fine-scale vertical distribution may vary based upon wind conditions (from thermocline to surface), and fine-scale horizontal conditions may shift due to frontal structure around Cape Blanco, etc. I disagree with the general statement on p.12 that jellyfish blooms are "by nature patchy and transient." In fact, many blooms are remarkably predictable in space and time. It is true that finescale local distribution is patchy, but seasonal appearance within estuaries or coastal regions is very predictable. This section has been revised considerably to clarify that we refer to the offshore features.

p.12 paragraph 2. I'd specify that nutritive value is low per unit biomass (as nutritive value per individual is actually quite high, as scyphomedusae are large…). For specific information on typical gut contents of Chrysaora fuscescens in the California Current, see Suchman et al 2008. This reference has been added and incorporated into content text of document.

The depth information on turtles is very interesting, as data for Suchman and Brodeur (2005) came from surface trawls. Nothing has been published about depth distribution of jellies in the region, but we do know that they are present in surface waters each summer.

p. 15. Should be Suchman and Brodeur 2005 (not 2004). Note that densities of C. fuscescens are greatest in shallow, inner shelf waters, not throughout the region delineated as turtle habitat (to 2000 m isobath). corrected.

Comments on Draft Conservation Values table:
Aquaculture and Offshore Oil and Gas Exploration and Production: Infrastructure can provide substrate and habitat for benthic polyp stages of medusae.
Power Plants: although some scientists hypothesize that warmer water may lead to blooms of jellyfish, this hypothesis is still very speculative. In fact, in the Northern California Current, high densities of Chrysaora fuscescens are associated with cold water, both within shelf habitat and between years. It is possible that warm water associated with discharge from power plants might also cause declines in C. fuscescens populations. Also, note that in some regions (see papers by Uye, for example), power plant operations are stymied by clogging of intake pipes caused by jellyfish populations. Text has been revised to incorporate these points.

References

Suchman CL, Daly EA, Keister JE, Peterson WT, Brodeur RD. 2008. Feeding patterns and predation potential of scyphomedusae in a highly productive upwelling region. Mar Ecol Prog Ser 358: 161–172. added

Peer Reviewer #4 comments:

Peer Reviewer #4 suggested a number of references to be added, and some text edits. All were incorporated into the revised document.