Open Water Peer Review Panel
Monitoring Plan Recommendations Report Template

April 2014

After discussion and review of Shell's 2015 marine mammal monitoring plan for its proposed 2015 Chukchi Sea exploration drilling program, panel members have answered the questions below set forth by the National Marine Fisheries Service's Office of Protected Resources (OPR) and provide the following recommendations. Answers to, and recommendations based on, the specific questions were developed using the general monitoring requirements outlined in the Marine Mammal Protection Act (MMPA) implementing regulations and further guidance provided by OPR, which were included in the Instruction document and have been copied into this document below the questions.

Summary of Activities

Shell has proposed to conduct exploratory drilling at up to four drill sites at its Burger prospect in the Chukchi Sea, Alaska, during the 2015 open-water season (July through October). Drilling would occur 105 to 125.5 km from shore, in waters 43.7 to 45.8 m in depth. Shell would use two drilling units, the Noble Discoverer and the semi-submersible Transocean Polar Pioneer. Other acoustic sources associated with drilling include the construction of a mudline cellar at each drill site, dynamic positioning of supply and support vessels when tending to a drilling unit, anchor handling, ice management activities, and zero-offset vertical seismic profiling (ZVSP) using a seismic airgun array.

The objectives of the monitoring program, as stated in Shell's Marine Mammal Monitoring and Mitigation Plan (4MP), are to ensure that disturbance to marine mammals and subsistence hunts is minimized, that effects on marine mammals are documented, and that data is collected on the occurrence and distribution of marine mammals in the project area.

Questions

I. Will the applicant's stated objectives effectively further the understanding of the impacts of their activities on marine mammals and otherwise accomplish the goals stated below? If not, how should the objectives be modified to better accomplish the goals below?

The panel concluded that Shell's proposed exclusion zones, vessel-based monitoring, and aerial survey effort, as described in its mitigation and monitoring plan, will further the understanding of the impacts of its activities on marine mammals. However, Shell's proposed passive acoustics monitoring objectives do not include monitoring for negative effects of drilling activities such as spatial displacement. This particular effect might not be well documented by aerial surveys because this effort requires weather conditions to allow safe flights, which might not occur with enough continuity to detect subtle changes in marine mammal distribution. The deployment design of the multiple recorders proposed in the Burger array are equidistant to the noise source

locations, therefore the data will not allow evaluating the potential for changes in distribution due to the presence of noise (i.e. spatial displacement). The deployment location of the multiple recorders included in the regional array would not provide a fine enough spatial resolution to discern changes in distribution (through presence and absence of acoustic detections) due to the acoustic disturbance generated by the proposed drilling operations. The panel proposed the addition of the objective "evaluating the potential for spatial displacement" as part of Shell's passive acoustics monitoring plan. The panel discussed optimal deployment designs to allow proper evaluation of this additional objective and concluded that a radial approach would be most appropriate (see below).

The panel noted that Shell's proposed aerial and acoustic monitoring plans were not compatible and therefore insufficient to evaluate potential displacement behavior. Two alternative deployment schemes for the acoustic recorders are presented (Fig. 1), based on a radial approach that would facilitate comparison with aerial sightings. Recorders would be deployed in 2 perpendicular axes originating from the drilling locations. The distance between recorders should be twice the shortest detection range estimated for the species expected to be detected in this region. This would minimize the chances of false negative results (missing vocalizing marine mammals passing through the recorders). The length of each monitoring axis would be determined by the expected distance at which ambient noise levels would be reached. This would allow for monitoring outside the acoustically disturbed area and also account for behavioral response to the proposed drilling activities, as described by Dr. Susanna Blackwell in her presentation on bowhead whales.

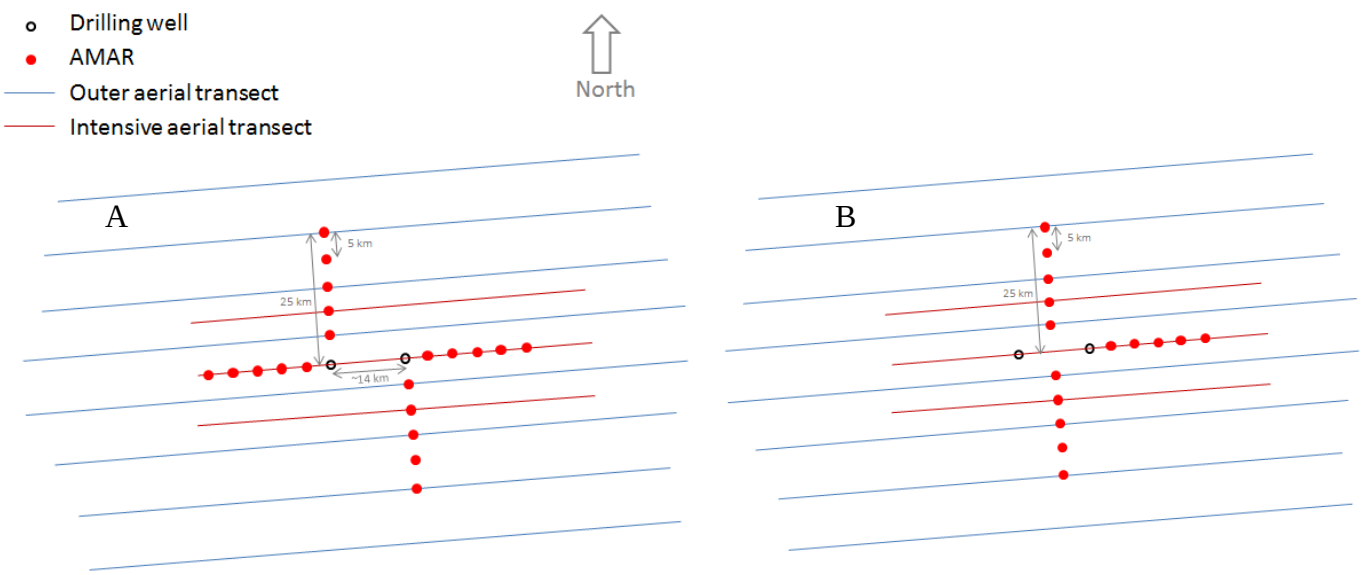

Figure 1: Examples of potential acoustic recorder deployment designs to optimize the evaluation of marine mammal spatial displacement. Panel A involves 4 axial deployment lines to independently evaluate effects of each drilling site, panel B involves 3 axial deployment lines but reduces the capacity to tease effects from each drilling site. Note that the orientation of aerial line transects has been modified to overlap with the axes of both drill sites. This allows for direct results comparison between sampling methods.

II. Can the applicant achieve the stated objectives based on the methods described in the plan? (Note: in the past, applicants have sometimes submitted a strong monitoring plan that would accomplish a good objective that supports NMFS' goals, but the stated objective has been oddly disassociated from the planned work or badly worded. As you answer questions I & II – keep in mind if the objective might just needed to be re-worded to better fit the planned work).

The panel concluded that the methodology described in the plan would only cover the stated objectives during good visibility day-light operations, where visual effort is most efficient. However, in the case of the VSP operations, the panel concluded that there was a risk of level A takes during low visibility periods (night time, heavy rain, fog) because visual observations are the only proposed monitoring method for this activity. In order to achieve Shell's monitoring objective, the panel agreed that VSP operations would need to follow an adaptive approach based on the presence of bowhead whales near the drilling site. See section III for further details on this adaptive approach.

III. Are there technical modifications to the proposed monitoring techniques and methodologies proposed by the applicant that should be considered to better accomplish the objectives?

In order to make aerial survey and acoustic monitoring results compatible to evaluate potential displacement behavior, the orientation of the aerial transects should overlap with the axis including both drill sites (as noted in Section I).

The panel recommended that Shell follow an adaptive approach for monitoring VSP operations. If a bowhead whale or other large whale has been sighted within 2,000 m of the drilling site during the 5 days prior to the onset of VSP operations, airgun activity should be avoided outside good visibility day-light periods. This recommendation is based on the higher risk that large whales may be near the airgun array but not able to be detected due to poor visibility. Additionally, during daylight hours, Shell should implement power-down or shutdown procedures if a bowhead whale mother/calf pair or an aggregation of 3 or more bowhead or gray whales are sighted within 2,000 m of the airgun array. The 2,000 m threshold distance is larger than the proposed 1,380 m 180-dB Level A exclusion zone for VSP operations and would provide an additional buffer for bowhead mother/calf pairs and potentially significant social aggregations of bowhead and gray whales.

The panel acknowledged that Shell has proposed to use a mitigation gun during VSP operations to avoid having to initiate ramp-up each time the geophones are repositioned in the wellbore. However, the efficacy of this mitigation procedure has not been evaluated and the use of a mitigation gun to avoid delays associated with ramp-up procedures has been criticized in other contexts (e.g. seismic surveys). The panel recommends restrictions on the use of a mitigation gun for more than 30 minutes during geophone repositioning. If repositioning takes longer than 30

minutes, then Shell should initiate standard ramp-up procedures prior to the use of the full airgun array.

IV. Are there techniques not proposed by the applicant (i.e., additional monitoring techniques or methodologies) that should be considered for inclusion in the applicant's monitoring program to better accomplish the objectives?

The passive acoustics deployment design should be redesigned to optimize the monitoring of marine mammal adverse effects such as spatial displacement. The panel has recommended two alternative deployment designs for considerations (see Section I).

The panel discussed the ideal positioning for temporarily inactive vessels, and recommended that vessels maintain quiet when stationary, i.e, vessels should be anchored with engines and depth sounder off (as appropriate from a safety point of view), preferably near an acoustic mooring to allow PSOs to scan for marine mammals. The visual monitoring conducted by PSOs close to an acoustic mooring could help validate data on presence of absence of marine mammals from acoustic detections, and also help ground truth detections of species for which acoustic signatures are lacking. This procedure would minimize disturbance of marine mammals while maximizing observation opportunities.

V. What is the best way for an applicant to present their data and results (formatting, metrics, graphics, etc.) in the required reports that are to be submitted to NMFS (i.e., 90-day report and comprehensive report)?

The panel recommended that visual monitoring results summarized in the 90-day report should include sightability curves for each species observed in the study area. This information is critical for future evaluation of mitigation procedures (e.g., realistic coverage of exclusion zones by PSOs).

Similarly, the concurrent collection of spatially overlapped visual and acoustic data could allow for a more detailed description of approximate acoustic detection ranges for the different species sighted and acoustically detected. This information could help improve the efficacy of future deployment designs. The panel recommended that Shell include this analysis in its final report.

Other considerations:
The panel highlighted the thoroughness of Shell's 4MP, in particular the various technology advancements being implemented, the acoustic modeling approach, and the Shell's commitment to data sharing.

Monitoring Plan Requirements
The MMPA implementing regulations generally indicate that each Incidental Harassment Authorization (IHA) applicant's monitoring program should be designed to accomplish one or more of the following: document the effects of the activity (including acoustic) on marine mammals; document or estimate the actual level of take as a result of the activity (in this case,

seismic surveys or exploratory drilling programs); increase the knowledge of the affected species; or increase knowledge of the anticipated impacts on marine mammal populations. As additional specific guidance beyond that provided in the MMPA regulations, NMFS further recommends that monitoring measures prescribed in MMPA authorizations should be designed to *accomplish or contribute to one or more of the following top-level goals*:

(a) An increase in our understanding of the likely occurrence of marine mammal species in the vicinity of the action, i.e., presence, abundance, distribution, and/or density of species.

(b) An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammal species to any of the potential stressor(s) associated with the action (e.g., sound, explosive detonation, or expended materials), through better understanding of one or more of the following: 1) the action itself and its environment (e.g., sound source characterization, propagation, and ambient noise levels); 2) the affected species (e.g., life history or dive patterns); 3) the likely co-occurrence of marine mammal species with the action (in whole or part) associated with specific adverse effects, and/or; 4) the likely biological or behavioral context of exposure to the stressor for the marine mammal (e.g., age class of exposed animals or known pupping, calving or feeding areas).

(c) An increase in our understanding of how individual marine mammals respond (behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, e.g., at what distance or received level).

(d) An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: 1) the long-term fitness and survival of an individual; or 2) the population, species, or stock (e.g., through effects on annual rates of recruitment or survival).

(e) An increase in our understanding of the effectiveness of mitigation and monitoring measures.

(f) A better understanding and record of the manner in which the authorized entity complies with the incidental take authorization and incidental take statement.

(g) An increase in the probability of detecting marine mammals (through improved technology or methodology), both specifically within the exclusion zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals.