Monitoring and Mitigation Plan for the 2010 Astokh 4D seismic survey

INTRODUCTION

The planning for the 2010 Astokh 4D seismic survey represented a major investment of time by the Western Gray Whale Advisory Panel (WGWAP), Sakhalin Energy and the Seismic Survey Task Force (SSTF) of the WGWAP. The development of the final Monitoring and Mitigation Plan (MMP) was a result of five SSTF meetings and reviews at five WGWAP meetings. This was one of the most complete whale-focussed MMPs developed for a seismic survey anywhere in the world.

The fundamental rationale behind the mitigation component was:

(1) Design ahead of the survey:

  (a) Minimise the area surveyed.

  (b) Minimise the sound levels reaching the expected areas of highest density of whales.

(2) Measures during the survey:

  (a) Carry out the survey as early as possible in the season, *i.e.* when fewest whales are present.

  (b) Incorporate measures to stop the survey when needed to protect whales present.

During the early stages of development of the MMP it became apparent that there were very few data available on the effects of noise on gray whales, especially when feeding. It also became apparent that much of what is considered as 'best practice' mitigation has rarely, if ever, been properly evaluated. Monitoring was quickly recognised to be an essential component of the planning for the 2010 survey, both to evaluate the effectiveness of the mitigation component of the plan to see if practical changes were required and to ensure that future MMPs could be based on stronger scientific information than was available to the SSTF in drawing up the 2010 MMP.

The present document forms the basic skeleton for the MMP developed by the SSTF and is identical to Annex D of the SSTF-4 report. For details, refinements, modifications etc., the reader should consult the full series of SSTF reports which are available on the IUCN WGW website (http://www.iucn.org/wgwap/).

MONITORING (NUMBER, DISTRIBUTION, BEHAVIOUR)

The monitoring measures proposed here are *integrally related* to the mitigation measures proposed or likely to be proposed for future surveys. Indeed, most of the monitoring measures provided below are essential for implementation of the mitigation measures proposed for the 2010 seismic survey.

The monitoring measures fall into two categories:

(1) real-time (or near real-time) monitoring required to trigger appropriate action where sound levels approach or exceed defined thresholds (*i.e.* ***essential*** for mitigation);

(2) additional monitoring (involving the collection of some data that do not need to be analysed in real time) to obtain data on the effects of the seismic survey on whales, especially western gray whales, to add to the existing knowledge base, and to contribute to the design of mitigation strategies for future seismic surveys.

Acoustic monitoring (perimeter and within area)

Along the perimeter of the feeding area (the perimeter monitoring line)

(1) Real-time monitoring of acoustic levels using sea-bottom receivers will be undertaken during all periods of seismic source activity.

(2) A total of at least nine receivers will be positioned at 2500m intervals along the edge of the feeding area to ensure adequate redundancy. There will thus never be more than 5000m between active buoys (considered the range of reliable model-based interpolation of recorded sound levels).

(3) Receivers will be in place and verified to be functioning properly before activity starts and for the duration of the survey.

(4) There will be a direct radio link between the real-time monitoring acoustician and the Senior Marine Mammal Observer (MMO) on the active seismic vessel.

On the coastal side of the perimeter monitoring line

(1) All necessary efforts will be made to obtain archival acoustic data within the feeding area using bottom-mounted receivers.

(2) During the seismic survey, ≥ 3 acoustic monitoring buoys will be deployed in the feeding area on or near the 10m isobaths and near the centre of the field of view of the shore stations. Verification that these buoys are operational during the survey should be undertaken, at least at the start of the survey.

General visual monitoring (shore-based and vessel-based)

Note that whilst the monitoring below focuses on the area within the feeding area (*i.e.* on the coastal side of the perimeter monitoring line) near to the seismic operations, it is also important to maintain the observation effort throughout the rest of the area as in previous years. This is important for analysing and interpreting the data with respect to actual or potential effects of seismic surveys on the whales, and for maintaining the longer-term monitoring data series that will be a valuable resource when future seismic operations occur.

On the coastal side of the perimeter monitoring line (shore-based)

(1) Shore-based scan surveys will be undertaken by two teams at the five pre-existing vehicle scan observation points south of the mouth of the Piltun lagoon (*i.e.*, vehicle scan survey observation stations 9 to 13) to enhance the resolution of potential changes in whale density and distribution. The timing of scans will be scheduled to ensure the monitoring of whales pre-, during and post seismic line acquisition. Pre- and post surveys will be conducted 1 hour prior/post of the acquisition whilst 'during' scans will be conducted 1 hour from the onset of line acquisition. A third team will conduct daily surveys, weather permitting, at the eight pre-existing vehicle scan observation stations (numbers 1 to 8) using the same survey protocols as in previous years.

(2) Behaviour will be monitored by two behavioural monitoring teams. The location of behavioural platforms will be directly inshore of the seismic activity in areas that are expected to have the highest exposure levels. Scans conducted by behavioural monitoring teams will augment information on whale numbers collected by the shore-based distribution surveys.

On the coastal side of the perimeter monitoring line (vessel-based)

(1) Behaviour will also be monitored from a vessel platform. This will cover whales that may occur near or slightly outside the defined feeding habitat that are not being monitored effectively by shore-based teams (*e.g.* due to low station heights, onshore fog *etc*.). The monitoring location will be within regions of maximum predicted ensonification. The vessel type should be selected based on requirements of minimal sound output with an effective observation height (5-10m) to increase

the range of whale observations. Focal follow observations will be conducted from this platform to monitor respiration patterns and the general movement of the whales in the specified region. Extended focal follows should be conducted on whales displaying aberrant movements and/or behaviour to monitor potential long-term responses. The vessel will maintain a distance of at least 1 km from the whale being observed.

(2) Gray whale distribution will also be monitored from a vessel platform in the event of inclement weather (*e.g.* onshore fog) that prevents monitoring.

(3) The observation vessel will have a direct radio link to the Senior MMO on the active seismic vessel.

Within the proximity of the seismic related vessel(s)

(1) Experienced MMOs will be stationed on all vessels (*i.e.* seismic, scout and supply vessels) for the duration of the survey.

(2) MMOs will be limited to a maximum 2-hour continuous shift with a minimum of 1 hour between shifts.

(3) Single-point authority for operational shutdown will lie with the on-shift Senior MMO on the seismic vessel.

(4) All vessels and real-time acousticians will have direct radio access to the on-shift Senior MMO.

(5) MMO observation platforms should be located at the highest elevation available on each vessel with the maximum viewable range from the bow to 90˚ port/starboard of the vessel. Optimal locations might be on the 'flying bridge'. Use of the bridge should be avoided due to obscured views and potential distractions.

(6) An extended visual search (20 minutes) will be conducted prior to start-up of the seismic source.

(7) There will be a minimum of two MMOs on watch on the seismic vessel at any given time during ramp-up, shooting and for the 20 minutes before start of ramp-up.

(8) Occurrence and behaviour of whales will be documented in accordance with existing MMPP (Marine Mammal Protection Plan) and MMO procedures.

MITIGATION MEASURES

Timing of surveys

(1) The seismic survey will commence and be completed as early in the season as logistically possible. Logistics include ensuring that all mitigation and monitoring procedures are in place.

(2) The duration of the seismic survey will be as short as technically and logistically feasible. Logistics includes ensuring that all mitigation and monitoring procedures are implemented fully.

(3) Lines in Zone A (see definition below) should be acquired at the earliest possible opportunity given visibility, mitigation and monitoring requirements.

General design and conduct of surveys

The most stringent mitigation measures should be applied in Zone A as defined below. The monitoring measures defined above **must** be in place and operational for the acquisition of lines.

Definition and updating of A and B zones

(1) Initially, the survey area for which the additional mitigation measures are in effect (A zones) will be defined by the overlap of the 'feeding area' and the maximum shoreward extent of the 163 dB_{RMS} isopleths for that particular shot line.

(2) Before any lines are shot within the range currently predicted to exceed 156 dB_{SEL} at the perimeter monitoring line, received sound levels at the line will be compared with model predictions. If received sound levels exceed model predictions, then the model shall be retuned to match the observed levels. Based on the updated model predictions, shot lines for which an overlap is predicted between the 163 dB_{RMS} contour and the monitoring line will be reclassified as A lines, for which the additional mitigation measures specified below apply.

(3) The comparison between observed and expected sound levels at the perimeter monitoring line, and, where indicated, retuning of the acoustic model, shall be repeated at regular intervals during the survey.

(4) In the event that the 163 dB_{RMS} threshold is exceeded at any receiver on the edge of the feeding ground while shooting a B line, operations shall be suspended immediately or shifted away from the feeding ground until a recalibration exercise has been conducted as described above, and the lines have been reclassified accordingly.

Measures within the proximity of the seismic vessel – entire survey

(1) After more than 20 minutes of inactive source, ramp-up procedures will be adopted such that the individual air guns will be activated in a progressively larger combination over a period of several minutes (6 dB increments every 5 minutes over 20 minutes).

(2) The Senior MMO will initiate source shutdown if a gray whale is observed within defined exclusion radius of the source array.

(3) The Senior MMO will initiate a precautionary shutdown if a gray whale is observed to be on a course that will result in its entering the shut down zone.

(4) Low level single (smallest) gun operations will be conducted during line changes. Ramp-up procedures will furthermore be implemented 20 minutes prior to the sequential line acquisition. As long as the single gun operation is uninterrupted during the line change, this period will not be interpreted as 'source inactivity' for the purposes of clause (5) below.

(5) For operations in conditions that preclude effective visual monitoring of the defined exclusion radius of the source array (*e.g.* night, fog, poor visibility[1]).

(a) Prior to a seismic acquisition, the line of interest will have been surveyed (if necessary using a second vessel) at least 6 hours preceding the start time of acquisition of the line to ensure that no gray whales have been sighted in the vicinity of the line. If poor visibility hampers survey of the entire line, then the line will not be acquired.

(b) Operations will shut down for the night period if whales are sighted in the pre-dusk scan.

[1] "Poor visibility" means any conditions under which the estimated distance at which a gray whale can be reliably sighted is less than the defined exclusion radius. A prohibition on night shooting could increase the survey duration by up to 50%, which would be undesirable, both in terms of increased costs and in terms of extending the duration of the seismic survey into the period of peak whale abundance. The Workshop therefore agreed that night shooting or shooting during fog or poor light should only be conducted when the line has been surveyed (either by a separate "scout" vessel or while shooting an adjacent line) in good conditions during the preceding six hours and no gray whales have been sighted within this period. This would be the first time such a measure has been tried: the period of 6 hours, while considered practical to implement, remains, in the absence an analysis of the effectiveness of the measure for different choices of period, arbitrary.

(c) After more than 20 minutes of source inactivity, operations will not be re-commenced, due to the inability to conduct an adequate visual scan.

Additional restrictions for Zone A

(1) No acquisition during periods of poor visibility[1] or at night.

(2) No acquisition unless the feeding area perimeter line is within the effective sighting distance of a shore station or an additional vessel.

(3) No acquisition if any gray whales have been observed in Zone A over the preceding 6 hours.

(4) No acquisition if mother-calf pairs have been observed in Zone A in the preceding 12 hours.