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The International Environmental, Social and Health Impact Assessment (iESHIA) for Sakhalin Energy Investment Company's 4D-Seismic Survey at Piltun-Astokh and Lunskoye in the Sea of Okhotsk, Sakhalin Island, Russia

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The International Environmental, Social and Health Impact Assessment (iESHIA) for Sakhalin Energy Investment Company's 4D-Seismic Survey at Piltun-Astokh and Lunskoye in the Sea of Okhotsk, Sakhalin Island, Russia

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NON-TECHNICAL SUMMARY

Background

In Tokyo May 2013, Sakhalin Energy Investment Company (Sakhalin Energy) announced formally to the Western Gray Whale Advisory Panel's (WGWAP) Noise Task Force that it planned to carry out a 4D (time-lapse) geophysical seismic survey in the Piltun-Astokh area (350 km^2) east of Sakhalin Island, Russia in the summer of 2015. This is in the vicinity of a crucial, seasonal feeding area of the gray whale *Eschrichtius robustus.* These Sakhalin gray whales are deemed by the International Union for Conservation of Nature's Red List of Threatened Species™ to be Critically Endangered Western Gray Whales. Consequently, they are accorded higher levels of protection from risk of harm by national regulations and international standards. While the gray whales are the primary sensitive receptor, this document addresses also the appropriate wider environmental and social aspects too.

The planned seismic survey, at the same time, in 2015 of the, separate and more distant, Lunskoye oil and gas field (290 km^2) to the south was announced shortly afterwards and, largely because of its remoteness in relation to gray whale feeding and transit areas, may appear initially to have limited relevance in the context of this document. However, it will be carried out as part of the same overall activity and the same standards of risk management will apply.

Importantly, several other independent operators holding licences for exploration and development in the waters east of Sakhalin Island, plan to carry out their own seismic surveys in 2015. Exxon Neftegas Ltd (ENL) and Rosneft will be carrying out seismic surveys in the vicinity and at around the same time. The areas to be surveyed are not publically available but it is known that the Rosneft data will be acquired via the ENL survey and that Sakhalin Energy plan to mitigate the risk to the whales by working closely with ENL on survey timing.

Objectives of the seismic survey

Reservoir monitoring seismic surveys are required to contribute to efficient and effective production of hydrocarbons from the fields operated by the Company. Two of the main objectives of the Sakhalin Energy 4D Seismic Survey are: to undertake seismic monitoring of hydrocarbon production and water injection in the Piltun, Astokh and Lunskoye fields and to generate state of the art 3D images of the reserves. The data produced will allow for comparison with the results from previous surveys, as part of the management and planning process for future production wells, managed from existing facilities.

Compliance

Under an agreement with the investment banks (which comprise the Lenders to the Sakhalin II project), the Company is contracted to manage its activities, *inter alia*, to avoid, mitigate and minimise any risk to the environment and respective human populations' social welfare, safety and health. Although the banks are concerned largely with financing projects as a form of investment, at least two have signed up to the Equator Principles (http://www.equator-principles.com/) and these place environmental and social project risk management requirements on the Lenders. However, the Equator Principles and Common Approaches also require that the funded projects meet the World Bank/International Finance Corporation (WB/IFC) Performance Standards. This in turn puts obligations on the borrowing parties. Under the IFC Performance Standards, the borrower must first comply with national laws and international conventions. Where two or more standards/regulations apply to the same subject then the most stringent is adopted (except where this would lead to legal non-compliance). Under national legislation, Sakhalin Energy complies with the Russian Federation Environmental Impact Assessment process and submitted its documentation for State Environmental Expert Review (SEER) in February 2015. SEER approval was granted to the company for the survey in May 2015 (07.05.15 SEER positive conclusion was prepared and signed, 08.05.15 Russian Federation Ministry of Natural Resources and Ecology issued approval Order #388, 12.05.15 MNR&E RF send submission letter #ОД-08-01-32/775 with documentation). In practice, Russian Federation legislation, although not covering all of the elements pertaining (such as ecosystem services or some social requirements), is complementary to, or reinforces, the IFC Performance Standards.

As part of the compliance process, typically the Project develops an Environmental Social and Health Impact Assessment (ESHIA), an Environmental and Social Management System (ESMS) and an Action Plan (AP). In Sakhalin Energy the AP is referred to as the Health, Safety, Environment and

Social Action Plan (HSESAP). Importantly, the HSESAP is a component of the ESMS and is covenanted within the loan documentation. Therefore, it can't be changed without the Lenders' agreement. The Lenders and their independent environmental consultant (LIEC) agree the contents of the HSESAP with the Company to ensure compliance with the Performance Standards. The LIEC then monitors the project to ensure compliance with the HSESAP. This document is a key component of that process and procedure.

Survey Description

Technical Design

A vessel in 8-streamer configuration will be deployed for the survey. Streamer separation will be 100m, resulting in a 700m wide tow, which is deployed to a pre-plot already established from the 1997 and 2010 surveys. Cable length will be 4,500m. A support vessel will be present and operating to the same mitigation principles.

The source will be an airgun array operating with two sub-arrays spaced 9m apart. The output of this airgun array was modelled by the 'Nucleus' software package, which is the industry standard. This modelled 'signature' will also be used in seismic data processing for 'de-signature' – which is the step that reduces the imprint from the source wavelet in a deterministic fashion (Appendix IV

: Acoustic Footprint Modelling by Jasco Ltd). The source array will be towed at a depth of 6m (± 1m), which is an important parameter for the eventual output 'signature'. Source volume will be 2888 cu in.

This source has a markedly smaller safety radius than the originally proposed design, comparable to or smaller than the 2620 cu in source used in 2010. In the light of that and the SEER requirement for a 2000m radius exclusion zone around the source, the Company produced this statement:

"After studying the conclusion of the State Environmental Expertise Review (SEER) for the 2015 4D seismic, Company decided to cancel the Sound Source verification test planned at the beginning of the Piltun-Astokh survey. The reasons for cancellation were as follows:

'JASCO modelling has previously indicated that the 180dB RMS per pulse sound level would be at a radius of 1400-1600m around the source. Company set the exclusion zone at 1600m based on this modelling. However, the SEER conclusion has prescribed a 2000m exclusion radius around the source. This is significantly larger than what we anticipated based on the modelling, but it is a directive from the applicable Regulator, overriding any modelling/field calibration work. Therefore the sound source verification test adds no practical value at this point in time. Conducting the test does however require significant effort from the Contractor and Company's Marine Logistics department and requires coordination with the seismic vessel. Moreover, the operation of deployment and retrieval of equipment is not without risks. On balance Company saw no reasons to continue with the SSV test.' "

ENL's Survey

Details of ENL's survey are commercially confidential. Sakhalin Energy is not privy to the ENL survey details and does not have the right to publish them. The scale of ENL's 4D survey in 2015 is substantially larger than Sakhalin Energy's and, crucially, includes acquiring lines in a significant portion of the whales' near shore feeding area. Subsequently, a series of negotiations took place between Sakhalin Energy and ENL, within the context of employing the environmentally responsible practices and acquiring the data, to avoid simultaneous seismic survey activity at Odoptu and Piltun-Astokh. A decision was made to treat the Odoptu and Piltun-Astokh survey areas as if they had been joined to form one survey management area.

A major objective was to conduct the survey in the most environmentally sensitive areas first and included the completion of all of the higher risk A-lines by August 1st. This allowed for much clearer and effective application of the responsible practices and deployment of respective survey vessels. To use the limited time even more effectively, the two surveys could operate at the same time but, for practical reasons to avoid noise interference, only in areas tens of kilometres apart. It hinged on the two independent, oil and gas companies agreeing to work together constructively, employing Best Practice to mitigate their risks of affecting the whales and not compromising each other's survey.

Mitigation of Risk to the Whales

It was important from the risk to whales' mitigation and commercial perspectives, that this plan was created. Leaving aside the fact that interference from each other's seismic acquisition activities would inter alia greatly reduce their effectiveness, this is a remarkable example of two independent companies uniting to this level in their approach, applying the Best Practice principles from Nowacek et al 2013 and mitigating their potential impact on marine mammals. It required leadership from Sakhalin Energy and a responsible attitude from both companies to achieve their independent aims most effectively. For example, the acquisition lines likely to place the whales most at risk would be those in or closest to the feeding areas. The companies carried out an assessment and revealed that ENL's lines are closest and therefore present the highest risk. Using the Best Practice and guidance from the WGWAP process, it was agreed that ENL should start their survey first and as soon as the area is ice free. That means that Sakhalin Energy must adjust their plans for acquisition of their most at risk lines, the A-lines, which are actually further from the feeding area and offer less risk to the whales than ENL's. By starting early, ENL should acquire their most at risk lines before the whales arrive or arrive in higher densities. Meanwhile, Sakhalin Energy will acquire low risk lines, for example, at Lunskoye. As soon as ENL acquisition is completed, Sakhalin Energy will sail to the relevant area to acquire its A-lines. Analysis of tidal tables for the estimated operation times has revealed that strong currents are likely in that period. Turbulence from those currents can affect the towed streamers and consequently is likely to increase the risk of poor data acquisition from the survey. This, in turn, could lead to repeated acquisition of the same lines with a concomitant increase in risk to the whales arriving in the area. Sakhalin Energy may decide to minimise this risk by acquiring the lines at the calmest stage of the tidal cycle which is at slack water, or alternatively, postpone the lines till later in July when slack water occurs during the day. Early July '15, slack water occurs during the night. If acquiring at night, a team of experienced Marine Mammal Observers (MMO), trained in the use of night vision and radar, will scan the area around the towing vessel on the lookout for whales. A pre-dusk scan as per 2010 procedures would also be carried out if night time acquisition is deemed necessary. As part of the risk management strategy, the detection of Gray Whales within 2km of the vessel will lead to operations shut down until deemed safe to re-start by the MMO.

If the shared survey approach described above was not taken then, in all likelihood, the risk of disturbing the whales on the feeding ground would be increased and would continue to increase with the daily arrival of more foraging whales. With two or possibly three companies acquiring and probably re-acquiring lines in the vicinity over a prolonged period, the whales would be put at higher risk of disturbance and injury from activity and noise. The line acquisition would be constantly interrupted by shut downs triggered by the presence of whales, leading to an extended survey. The likely outcome of that disturbance would be slower recovery in individuals from the exertions of the migration or even no recovery at all. That would lead inevitably to a higher risk of mortality in the return migration due to a lack of condition for the demands of the journey.

Survey Dynamics

The joint 4D surveys will proceed as follows: The Sakhalin Energy vessel will commence the 2015 4D seismic survey tens of kilometres away at the distant and lower risk area of Lunskoye. ENL will commence the survey of their Odoptu field from around 10-June (estimated because it depends on the sea being free of ice) to 11-July; Sakhalin Energy Piltun-Astokh will commence its seismic survey from (estimated) 12 July, finishing the A-lines before 1-Aug and acquiring the remaining B-lines by 10-Aug. While Sakhalin Energy is recording Piltun-Astokh, ENL will be recording at Arkutun-Dagi offshore, maintaining a 40km separation. When Sakhalin Energy finishes at Piltun-Astokh, ENL carries on working at Arkutun-Dagi.

In the above plan, the seismic survey in the environmentally most sensitive area, Odoptu, (it is estimated that around 85% of the ENL survey lines for that area run into the northern end of the onshore feeding grounds) is surveyed first and earliest, in accordance with the principle of the responsible practices. Importantly, avoiding simultaneous seismic survey activity at Odoptu and Piltun-Astokh is likely to maintain less ensonified areas in the whales' feeding ground.

The Piltun-Astokh area has a buffer of several kilometres from the feeding grounds (with approximately one third high priority lines) and is prioritised second to allow for ENL to make an early start to its survey in the feeding ground area with the expectation of an early finish. Sakhalin Energy will start its Piltun-Astokh 4D survey after ENL, at a time when the weather is expected to be better and the number of whales is predicted to be higher than early June. Historic meteorological data show that Sakhalin Energy is less likely to have downtime in that period. However, records show that there are likely to be more whales present in the feeding grounds, so the Company can expect to have more source suspensions (downtime). The net effect of these two opposite assumptions on the total survey duration is expected to be small. On balance, the Company expects to be able to complete the full survey in 30 days, as before. The timing estimates above are conservative in terms of start date (linked to the sea being free of ice) and duration (accounting for downtime).

Impact Assessment

Scoping of the International ESHIA is a process where the scope and terms of reference of the impact assessment are defined. It outlines those issues that are to be addressed during the impact assessment, and identifies valued ecosystem components (VECs); VECs are those elements of a project or activity's surroundings that are of importance, for example, a protected species (Gray Whales) or a resource (local fisheries) central to a government agency and other stakeholders. The purpose of identifying VECs is to help rationalise the scope of the assessment and to guide the impact evaluation process to apply only to the most important environmental receptors. Specifically, the source-pathway-receptor concept was considered in determining the reasonable likelihood of significant interaction ('pathways') of ecosystem components ('receptors') with survey activities ('sources').

Following a recommendation from the WGWAP to Sakhalin Energy, the 4D Seismic Survey in 2015 is to use the standards set in the 2010 EIA as a baseline.

The key environmental issues for this assessment have been identified as:

- Disturbance and injury to marine mammals
- Disturbance to marine and migratory fish and fisheries
- Effluent discharge, emissions, and waste disposal
- Accidental spills, leaks and dropped objects
- Interaction with other users of the area

Based on these issues, source-pathway-receptor relationships were identified.

The primary mitigation was to conduct the seismic survey as early in the GWs' feeding season as reasonably practical when feeding whale numbers were lowest and fewest GWs would be exposed to seismic survey sound.

Impact Significance Criteria

Impacts may be direct or indirect, permanent, long-term, short-term or temporary. Quantitative predictions of environmental impacts are generally acknowledged as problematic and there are a number of different methods used to define impact and significance levels. To determine the significance of potential impacts, assessment criteria in relation to the status (i.e. vulnerability, sensitivity, and value) of the environmental receptor are taken into consideration; four levels of impact significance are applied (Sakhalin Energy 2003):

- Major Impact: affects an entire population or species in sufficient magnitude to cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations of the species being affected;

- Moderate Impact: affects a portion of a population and may bring about a change in abundance and/or distribution over one or more generation(s) of the species affected, but does not threaten the integrity of that population or any population dependent on it. Moderate Impact to the same resource multiplied over a wide area would be regarded as a Major Impact;

- Minor Impact: affects a specific group of localised individuals within a population over a short time period (one generation of the species affected or less), but does not affect other trophic levels or the population itself;

- Negligible or No Impact: where no significant impact is predicted to occur; the impact is of such small magnitude that it does not require further consideration in the assessment.

In the tables below, impact predictions have been made using available data, but where uncertainty remains, this is acknowledged and an indication of its scale is provided. Where the sensitivity of a receptor to a particular activity is unknown and the level of impact cannot be predicted, the EIA team has used professional judgement as to whether a significant impact is likely to occur.

Issue	Impact	Unmitigated Impact	Mitigated Impact
Disturbance and Injury to Marine Mammals			
The effects of noise and physical presence of survey vessels	TTS, PTS and non-auditory physiological effects on all cetaceans and pinnipeds	Moderate	Minor
	Disturbance and short-range avoidance movements in non-endangered baleen whales	Moderate	Minor
	Disturbance and short-range avoidance movements in odontocetes and pinnipeds	Moderate	Minor
	Disturbance and short-range avoidance movements in North Pacific right whales	Moderate	Minor
	Disturbance, short-range avoidance movements and reduced feeding opportunities, possible loss of breeding potential, reduced growth, reduced survival in Gray Whales	Moderate	Minor
	Injury or fatality to marine mammals from collisions with vessels and deployed equipment	Minor	Negligible
Disturbance and Injury to Fishes			
The effects of noise and physical presence of survey	Injury and fatality from underwater airgun noise	Minor	Minor
	Spawning disturbance or damage to eggs	Minor	Minor
	Behavioural disturbance e.g., dispersal of fish shoals	Minor	Minor
Effluent Discharge, Emissions, and Waste Disposal			
Effluent discharge	Impacts on water quality and marine biota from cooling water and deck-surface runoff (e.g., sea spray and rain water)	Negligible	Negligible
	Impacts on water quality and marine biota from non-accidental release of drainage and sanitary waste water discharges	Minor	Minor
Emissions from combustion & incinerators	Reduction in local air quality	Minor	Minor
	Contribution to regional and global atmospheric pollution	Minor	Minor
Solid and hazardous waste	Impacts on water quality and marine biota (toxicological effects)	Negligible	Negligible

Issue	Impact	Unmitigated Impact	Residual Impact
Accidental Spills, Leaks and Dropped Objects			
Spills and leaks	Small release of harmful substances (e.g., wastes, oil, lubricants, cable fluid) resulting in a decrease in water quality and impact on marine organisms	Minor	Minor
	Large release of harmful substances (e.g., wastes, oil, fuel) resulting in a decrease in water quality and impact on marine organisms	Moderate	Minor
Dropped objects	Loss of small objects/equipment	Negligible	Negligible
	Loss of large objects and cargo causing pollution, impact on marine organisms, and obstruction to other vessels	Moderate	Minor
Interaction with Other Users of the Area			
Vessel and equipment interference; use of local resources	Potential for collision or other accident with other vessels, equipment and concomitant injury, loss of human life, vessel damage, loss of property	Moderate	Minor
	Temporary interference with commercial fishing/damage to fishing equipment	Minor	Minor
	Interference with military use of the area	Negligible	Negligible
	Damage to marine archaeology and cultural heritage	Negligible	Negligible
	Hunting of marine mammals	Negligible	Negligible
	Effects on the local social environment and economy	Negligible	Negligible
	Disturbance or damage to cables and other submarine infrastructure	Negligible	Negligible

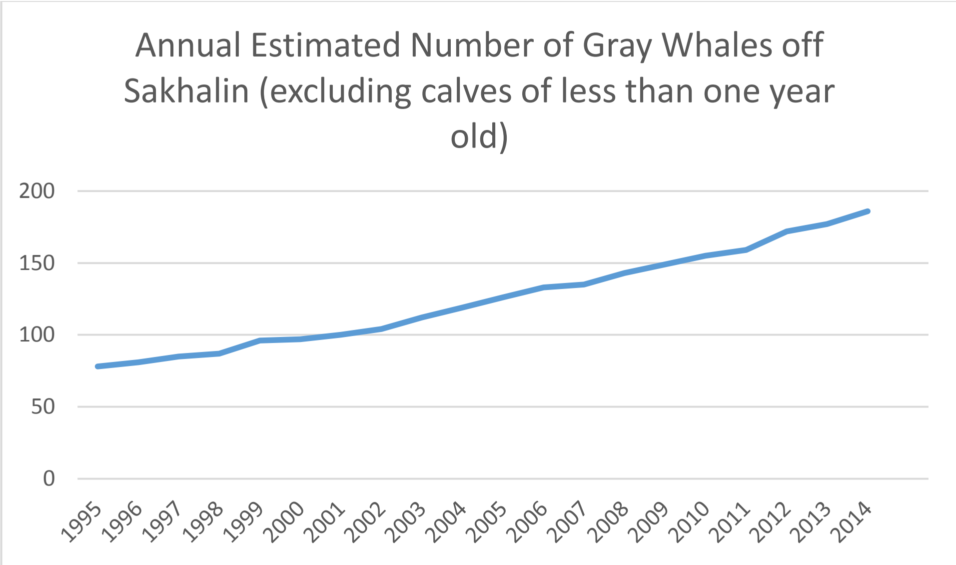
Alternatives to Proposed Activities

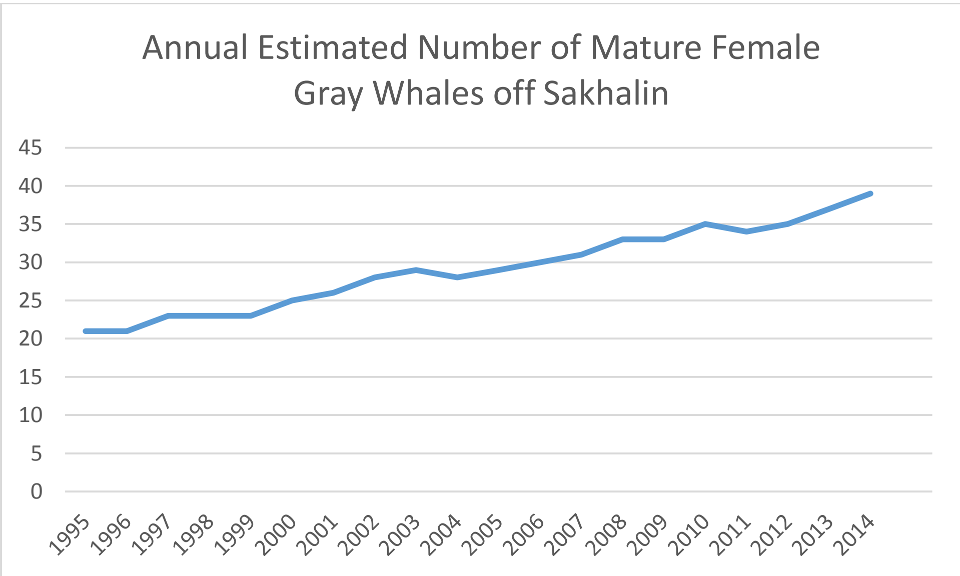
Alternatives to the proposed activities were considered by the Company and discussed with the Noise Task Force (a sub-group of specialists from the WGWAP process with responsibility for advising the WGWAP on Noise Issues) and the wider WGWAP. They concluded that there are no like-for-like alternatives to the proposed seismic survey and that the monitored, managed and mitigated survey was justifiable for a number of reasons. Cancellation of the survey would bring genuine commercial risks to Sakhalin Energy, its staff and assets. When compared to a seismic survey, no other methods or techniques could produce the quality and quantity of data at that scale in the time available that could inform the safe and efficient management of the hydrocarbons in the fields. In-well monitoring, for example, would produce only very restricted information up to 20 metres from the well. Ocean Bottom Nodes would be ideal for deployment to the discrete areas in and around platforms of tens or hundreds of metres but are not appropriate for an area the size of the planned survey, which could be measured in hundreds of square kilometres. They also offer no advantage from a vessel disturbance point of view since a vessel is still required to tow the acoustic source.

Annual estimated numbers of gray whales off of Sakhalin

Numbers of gray whales at Sakhalin are presented as estimates below and based on data collected by three independent teams. One from Russia Institutes, another counting at Kamchatka and a third from a Russian Marine Biology Institute (these counts include immature animals seen off Kamchatka in recent years that were seen previously as calves off Sakhalin and which may or may not return to Sakhalin as adults). Annual counts tend to be lower than estimates because not all of the whales are recorded every year. The latest assessment results are presented in Fig. 8 of the WGWAP 14 report: (http://cmsdata.iucn.org/downloads/wgwap_14report_final_en.pdf). No attempt is made to estimate the total number of calves born each year because an unknown fraction does not survive the journey to the Sakhalin feeding grounds (Charts below).

Photo identification studies and satellite tagging have revealed several examples of repeat, annual visits by individual whales. No negative effect or impact has been observed or measured in the numbers of gray whales recorded off of Sakhalin.


Annual Estimated Number of Gray Whales off Sakhalin (excluding calves of less than one year old)
200
150
100
50
0
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014


Annual Estimated Number of Mature Female Gray Whales off Sakhalin
45
40
35
30
25
20
15
10
5
0
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014

Net Gains

Net Gains are additional conservation outcomes secured for the gray whales off of Sakhalin. Normally, they are achieved through the development of a biodiversity offset. However, this is likely to be inappropriate or impractical for a large, oceanic mammal such as a gray whale. Nevertheless, Performance Standard 6 recognises that situation and allows for the achievement of Net Gains by meeting the requirements of paragraph 17 of PS6 without a biodiversity offset (also see Cumulative Impacts below).

This could be through the implementation of programmes that could be applied on-the-ground to enhance habitat, protect and conserve the gray whales. In that respect, Sakhalin Energy Investment Company, has been remarkably effective. Through its approach and commitment to environmental management and assurance practices and its willingness to work with experts, Sakhalin Energy has built up enormous experience in carrying out its activities in Critical Habitats. It now has genuine influence and a good reputation, regionally and internationally in the oil and gas sector, particularly for operating in sensitive areas.

Examples of its commitment, transparency and development of 'tools' for the wider industry include:

- The Monitoring and Mitigation Plan for seismic surveys
- The joint research programme with ENL including satellite tagging and photo identification
- The development, promotion and publication of best practice, culminating in the publication of Nowacek *et al.* 2013: a scientific paper describing responsible practices for minimising and monitoring environmental impacts of marine surveys with an emphasis on marine mammals the publication of a book on the Gray Whales of Sakhalin

The Company's record on corporate responsibility in this context is robust:

- In March 2015, due largely to previous engagement by Sakhalin Energy, the Oblast Biodiversity Group viewed and discussed presentations from Sakhalin Energy and ENL. IUCN and representatives of environmental NGOs were included in the meeting
- Their sensitive and effective handling of the issue, when two industrial salmon nets were set amongst the whales in 2013 was appreciated by the local authorities and Indigenous People

- Their decision, at great additional costs and delay, to divert the Piltun-Astokh pipeline route to minimise any potential impact on the whales or the offshore feeding grounds
- Their resourcing of research and analyses of the distribution, behaviour and abundance of the whales has increased greatly the overall knowledge gray whales in the north eastern Pacific, leading to a much better and informed basis for conservation management
- For over ten years they have resourced singlehandedly the 17 person Western Gray Whales Advisory Panel, it's meetings, reports and research
- To aid transparency, they insisted on the International Union for Conservation of Nature as the secretariat
- In early 2013, they committed to the 2012 IFC Performance Standards

Sakhalin Energy managing their own activities is not a Net Gain. Rather it is the dissemination and take up of Best Practice to and by other operators that has the potential to be so. It is only a Net Gain if the reduction in impact of others is greater than the impact of Sakhalin Energy's own activities. This may be extremely difficult to quantify convincingly so qualitative arguments and examples are required. There is also the issue of companies working together to manage cumulative impacts, which is a good approach but not necessarily a Net Gain.

As an example, the agreement made with ENL, described above, to approach the two surveys as if they were one combined survey in order to avoid, minimise and mitigate any combined or cumulative effects of the surveys (and to refrain from interfering with each other's data acquisition) on the foraging whales sets new industry standards for responsible and pragmatic activities. It is common in the industry to come to a private agreement on time-sharing when seismic acquisition has to be achieved in the same time frame and in close proximity. Where this agreement sets new standards is in bringing two rival companies together, albeit encouraged by all concerned, in the context of recognising the risks to the whales created by two independent surveys and then taking steps to apply Best Practice in a way that provides a model for the industry and authorities. Sequential scheduling of the surveys was selected by the Companies, as opposed to concurrent 24 hour time sharing, to ensure less ensonified areas would be accessible to the whales throughout June and July. This has the Net Gain of take up by another operator but also the Cumulative Impact of their combined approach.

This transparent, responsible and progressive approach has led to influence on local government and, importantly, influence on the behaviour of rival operators. This independent initiative is very likely to have contributed to the increased awareness, respect and lowering of risk to the gray whales and other sea mammals in the Sea of Okhotsk.

Cumulative Impacts

Cumulative impacts can occur in a range of ways and across different spatial and temporal scales. For example, Sakhalin Energy mitigates its cumulative impact on the whales in the Sea of Okhotsk from its day to day operations via a range of practices. These include, as examples, direct, practical actions such as minimizing survey areas, managing the number and routing of vessel movements, maintaining 5 knot speed limits in low visibility or within 1km of a whale, speed limits of 10 knots in Piltun area and 11 knots in Offshore Feeding Area and monitoring noise and emissions from platforms and other activities.

Equally, but more strategically, the company has promoted the management of cumulative impacts in less tangible ways (providing further **Net Gains** along the way). These can impact at national and range-wide level. Examples of both include:

- Providing support and resources for the WGWAP process including IUCN
- Promoting the Memorandum of Communications (IWC) concerning measures for the conservation of Gray Whales among range states
- Promoting the findings of projects at industry conferences and events
- Encouraging other operators to adopt Best Practice
- Adopting and Deploying Best Practice from Sakhalin at Sakhalin Energy's component partners' (Shell and Gazprom) operations throughout the world
- Contributing to the major UNDP/GEF project "Mainstreaming biodiversity conservation into Russia's energy sector policies and operations"
- Supporting the Russia-US Gray Whale Research Program
- Engagement with the Ministry of Natural Resources' Interdepartmental Working Group for the conservation of Gray Whales

- Hosting a visit from the Russian President to promote the effective and safe development of oil and gas in territorial waters
- Promotion of the Business and Biodiversity Platform
- Promotion of links to local Government (Oblast) through engagement with the Expert Working Group on Biodiversity
- Promotion of Industry-wide standards for Marine Mammal Observers

1 INTRODUCTION

1.1 Background

Sakhalin Energy Investment Company Ltd (Sakhalin Energy) is a consortium comprising currently: Gazprom Sakhalin Holdings B.V., Shell Sakhalin Holdings B.V., Mitsui Sakhalin Holdings B.V. and Mitsubishi. It formed in 1991 to develop the Sakhalin II oil and gas project off the north-eastern coast of Sakhalin Island, Russia, in the north-western Pacific Ocean. In 1994, the company signed a Partnership Sharing Agreement with the Russian Federation and the Sakhalin Oblast (Government) to operate at the Piltun-Astokhskoye (generally shortened to Piltun-Astokh or P-A) and the Lunskoye oil and gas fields. Sakhalin Energy has been producing and exporting oil since 1999 and liquefied natural gas since 2009.

In May 2013, Sakhalin Energy announced formally to the Western Gray Whale Advisory Panel's (WGWAP) Noise Task Force in Tokyo that it planned to carry out a 4D (time-lapse) geophysical seismic survey in the Piltun-Astokh area (350 km^2 area) in the summer of 2015 (*Figure 1. 'Location of Piltun-Astokh and Lunskoye oil and gas fields'*). This is in the vicinity of a crucial, early season feeding area of the gray whale *Eschrichtius robustus.*

The planned seismic survey in 2015 of the, separate and more distant, Lunskoye oil and gas field (290 km^2 area) to the south was announced shortly afterwards and, largely because of its remoteness in relation to gray whale feeding and transit areas, may appear initially to have limited relevance in the context of this document. However, it will be carried out as part of the same overall activity and the same standards of environmental and social risk management will apply.

Exxon Neftegas Ltd (ENL) and Rosneft will be carrying out seismic surveys in the vicinity and at around the same time. The areas to be surveyed are not publically available but it is known that the Rosneft data will be acquired via the ENL survey and that Sakhalin Energy plan to mitigate the risk to the whales by working closely with ENL to acquire lines (see below).

1.2 Objectives of the Seismic Survey

Reservoir monitoring seismic surveys are required to contribute to efficient and effective production of hydrocarbons from the fields that the Company operates. Two of the main objectives are to undertake seismic monitoring of hydrocarbon production and water injection in the Piltun, Astokh and Lunskoye fields and to generate state of the art 3D images of the reserves, for comparison with the results from previous surveys, as part of the management and planning process for future production wells, managed from existing facilities.

1.3 Gray Whales off of Sakhalin Island

These gray whales time their arrival for early summer, just as the sea ice dissipates, to seek out particular feeding areas after a prolonged migration; recent evidence strongly suggests that the majority, at least, travel from the Eastern Pacific, possibly from Baja California in Mexico (In Press; Mate et al. 2015 Biol. Lett.). In this earlier part of the season, they feed on arthropods and amphipods from grounds to the north of the survey area, literally just offshore in relatively shallow water of 5m to 15m. This is referred to as the near shore or Piltun feeding area. Later in the season, they move to an area referred to as the offshore feeding ground, tens of kilometres distant and in deeper water, where the dietary items are different from those of the near shore grounds (Figure 2).

These Sakhalin gray whales are deemed by the International Union for Conservation of Nature's Red List of Threatened Species™ to be Critically Endangered Western Gray Whales. Consequently, they are accorded higher levels of protection from risk by national regulations and international standards. Industrial activities, usually oil and gas, are perceived by several organisations as being a threat to gray whales in the north eastern Pacific Ocean. This is based on the potential risks arising from collision with vessels and/or harm from underwater, anthropogenic sound. To date, there has been no measured effect or record of harm to any whale off Sakhalin from Sakhalin Energy's activities. The numbers of whales returning each year continue to rise, as do repeat visits by individuals. Of course, Sakhalin Energy has little influence over the numbers of whales returning each year. They are operating in a relatively minute part of the gray whales' range albeit at a vital time in their migrations and development. If an individual whale was to collide with a ship off of Vancouver, Canada or a mother and calf are separated by a reckless tourist boat skipper at Baja California, Mexico then no one in Sakhalin is likely to know of that incident, but they may record its impact. Nevertheless, monitoring and mitigation of the Company's activities must continue and management of risk continually developed.

Figure 1. Locations of Piltun Astokh and Lunskoye Oil and Gas Fields

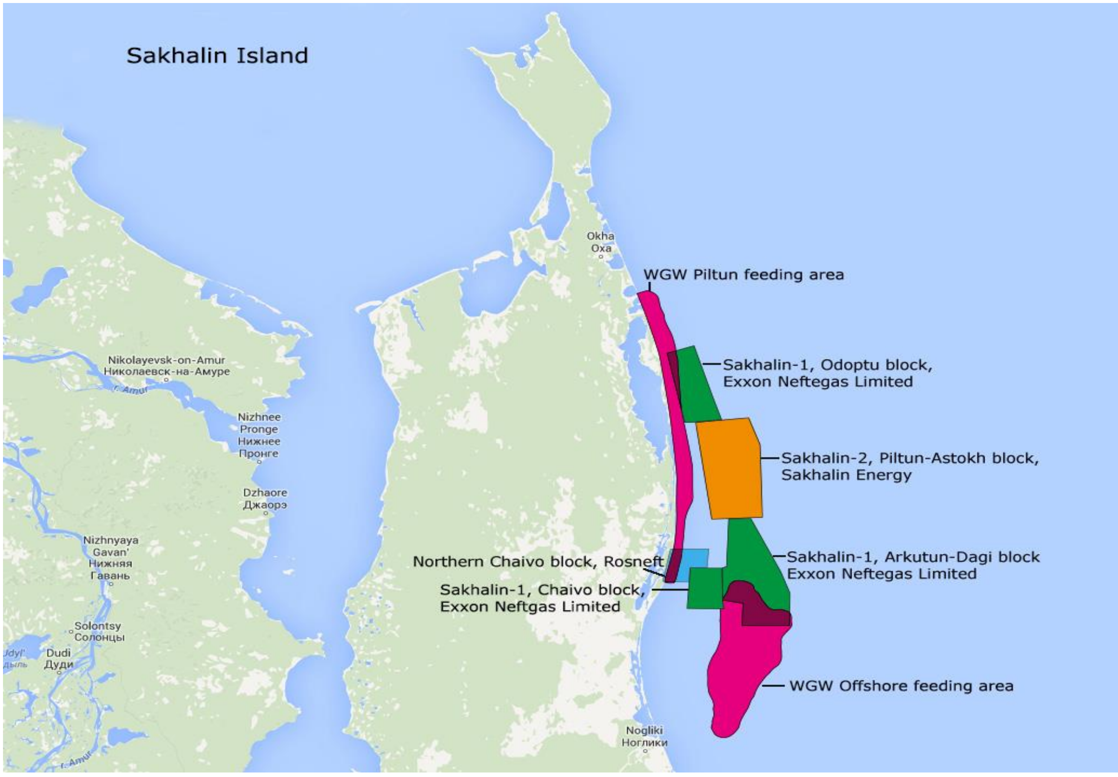


Figure 2: Schematic showing the approximate development blocks where seismic surveys are planned for 2015 on and near the gray whale feeding areas off north-eastern Sakhalin.

1.4 Contemporaneous Surveys

The Sakhalin Energy 4D seismic survey is a vital component of the ongoing, hydrocarbon reservoir monitoring effort. It brings the essential, fourth dimension of time to the information produced by previous seismic surveys in 1997 (Lunskoye 3D survey) and 2010 (Astokh 4D survey). Consequently, it will allow for the detection of production effects which may have occurred in the interim and thus enable the Company to respond in a timely fashion to the information generated.

Marine seismic surveying involves projecting large amounts of sound energy through the water column to penetrate the seabed. This low-frequency, loud noise can disturb and harm marine creatures, particularly mammals. Therefore, it is critical that avoidance or mitigation of the risk of impacts on any sea mammals, such as the gray whale, are planned for, managed closely and monitored during the seismic survey activities. It is equally important that these activities and processes are evaluated afterwards.

In recent years, more exploration and exploitation licences in the Sea of Okhotsk have been granted by the Russian authorities to other operators. Consequently, Sakhalin Energy could be viewed now as one of many, as opposed to one of few, carrying out oil and gas operations off Sakhalin. In addition, Sakhalin Energy can be considered now as being in steady operation while several other companies are still developing and in a much more 'active' state.

Several of those companies, having received licences and expanded their operations into the area to exploit the hydrocarbon reserves, operate at a much greater scale than Sakhalin Energy's footprint and at a lower level of scrutiny in regard to the potential impact on the gray whales. It became apparent that some of these operators (none of whom is officially engaged in the IFC/IUCN/WGWAP process) had plans for similar surveys in summer of 2015 and that their activities were collectively and individually, in all likelihood, presenting a higher risk to the whales than Sakhalin Energy's planned activities (at least one operator was planning to survey directly in the onshore feeding ground). This situation created a challenge to the WGWAP, IUCN and the local regulators. In response, the Company examined its role in helping to find a solution to this potential increase in risk to the whales. Consequently, it has agreed to work jointly with Exxon Neftegas Ltd to achieve the data for their surveys (see below).

2 PROJECT DESCRIPTION

2.1 Background

Several seismic surveys are planned by operators in the Sea of Okhotsk off Sakhalin in the 2015 season. These surveys will be subject to permission from the Russian authorities and conducted under Russian law and regulation. Gray whales are included in the Red Data Book of the Russian Federation. The GWs visiting Sakhalin are classified as a Category 1 population (threatened with extinction) and are protected strictly under Russian Law.

Nevertheless, the risk of disturbance or harm to the whales can be increased from the cumulative effects of multiple surveys by one or more operators. For example, whales can be disturbed and displaced from feeding areas by acoustic energy and boat activities, especially if from multiple directions. This can have very serious impacts on the development and recovery of individuals and groups of whales. In the case of these particular gray whales, there is a high likelihood that the adult hasn't fed for several months and a calf is being weaned on to solid food. Consequently, prolonged, undisturbed access to the feeding resource is essential for their well-being and survival.

2.2 Risks from Competing Surveys

Contemporaneous marine seismic surveys in adjacent areas are avoided by operators throughout the world for a number of reasons. Simultaneous airgun shooting from two (or more) vessels not only increases the amount of instantaneous noise emitted into the environment, but also leads inevitably to re-shoots because of cross-interference from each source. This, in turn, leads to longer duration surveys. The results are: a higher risk of harm to marine creatures, non-compliance with environmental legislation and increased costs. It is in the companies' interests to come to a working agreement.

ENL is intending to carry out extensive seismic work in 2015 to the north and to the south of the Sakhalin Energy Piltun-Astokh survey area. Sakhalin Energy viewed as essential an agreement between both companies to share the time resource if the risk of harm to gray whales is to be avoided, minimized and managed while ensuring both companies can acquire their respective data. Please see **Timing of Survey** below for details.

The number and timing of the surveys lead to a Statement being released by the WGWAP which elicited a public response from Sakhalin Energy (Appendix II and Appendix III respectively)

2.3 Area to be surveyed

The contracted scope of work consists of the Piltun-Astokh area 4D and the Lunskoye area 4D surveys, measuring 350 km^2 and 290 km^2 respectively. The areas are not contiguous, Lunskoye is tens of kilometres to the south of Piltun-Astokh. *Figure 4 'Sakhalin Energy and ENL seismic survey areas 2015'*

2.4 Seismic Survey Vessel

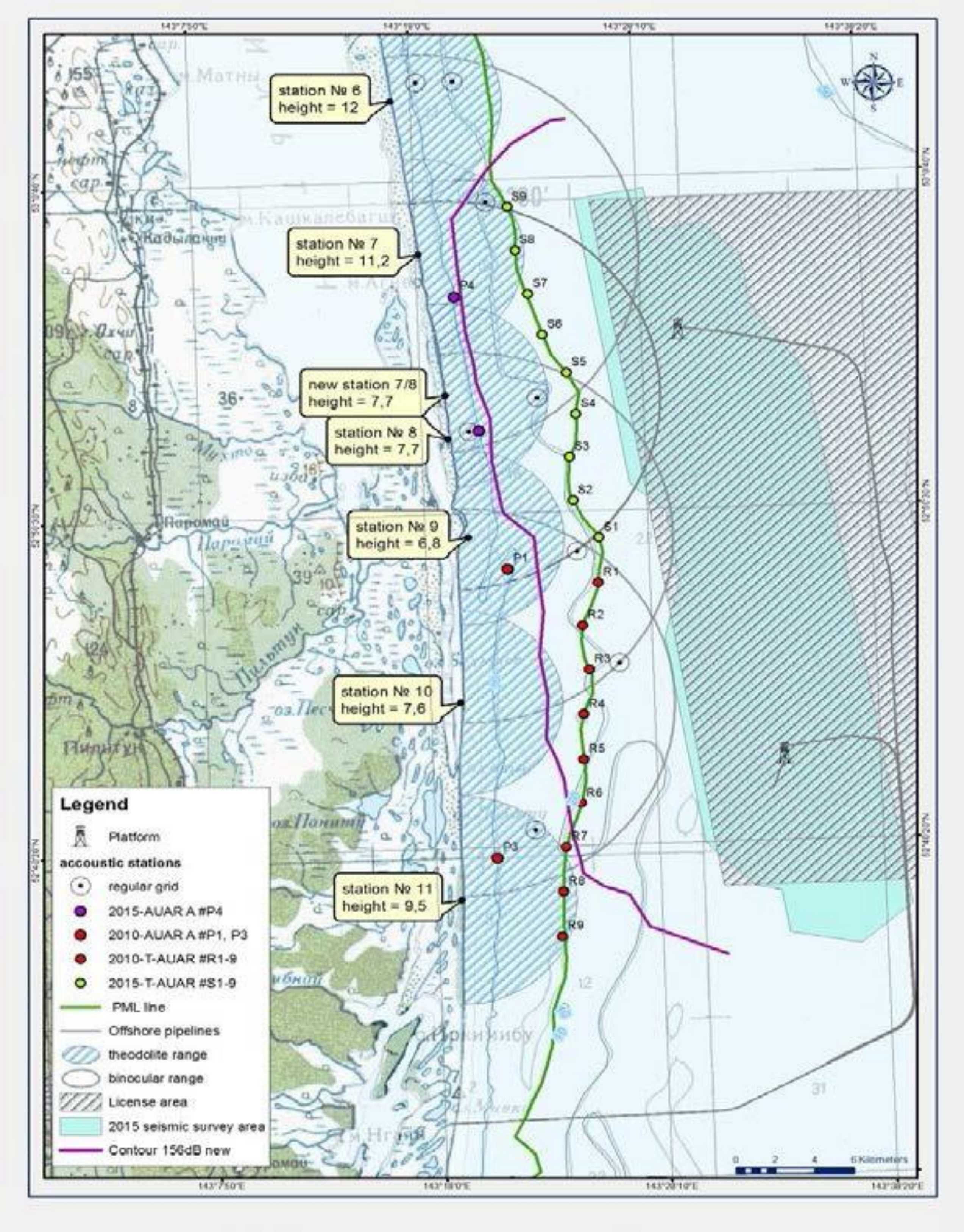
A vessel in 8-streamer configuration will be deployed for the survey. Streamer separation will be 100m, resulting in a 700m wide tow, which is deployed to a 6 x 100 m (500m wide) pre-plot already established from the 1997 and 2010 surveys (reducing the need for infill shooting later in the survey). Cable length will be 4,500m. A support vessel will be present and operating to the same mitigation principles.

2.5 Acoustic Source

The source will be an airgun array operating with two sub-arrays spaced 9m apart. The output of this airgun array was modelled by the '*Nucleus*' software package, which is the industry standard. This modelled 'signature' will also be used in seismic data processing for 'de-signature' – which is the step that reduces the imprint from the source wavelet in a deterministic fashion. The source array will be towed at a depth of 6m (± 1m), which is an important parameter for the eventual output 'signature'. The lines to be acquired are described by two risk classes: A lines and B lines and defined by their exceedance of an accepted sound energy exposure level (SEL) in decibels. Those lines deemed by sound model interpretation to present a higher risk of encountering a marine mammal with a commensurate increased risk of disturbing or harming a marine mammal are called A lines. Those lines deemed to have a low risk of encountering and therefore disturbing or harming a marine mammal are called B lines. As a general example, the lines closest to the near shore whale feeding area would carry a higher risk of ensonifying marine mammals to a level where they could be disturbed or harmed than a line several kilometres distant. In that case, the near shore lines would be called A lines and the distant lines would be called B lines.

Source volume will be 2888 in^3. Modelling has shown this set up to have a shoreward front of 156 dB per-pulse SEL that is just outside the nearshore feeding area boundary, in other words, the first full B Line/lower risk line is just outside the boundary of the feeding area (Appendix IV Jasco Modelling). This lower risk line is now the 20th from the western edge of the survey or five lines closer to shore than was the case for the prior source design proposed originally for this survey. From an operational point of view, this works in favour of a timely completion of the survey. This source has a markedly smaller safety radius than the originally proposed design, indeed comparable to or smaller than the 2620 cu in source used in 2010. In terms of the distance that the damaging sound might propagate, modelling showed that 1.6 km or 1.4km could be used as the safety buffers depending on the level of risk of exposure is selected, 100% or 95% respectively. Generally, the latter is taken as more realistic because it excludes small outlier pockets of sound at the fringes of the main lobes. In this instance, considering the criticality of the risk and the fact that no cautionary offsetting of the results is used (often a +3dB safety buffer is introduced), the Rmax value of 1.6 km would have been be applied originally as the safety radius going into the operation. However, the Russian Authorities, in the SEER, have stated that an exclusion zone of 2000m, in effect providing an even lower risk of harm or disturbance to marine mammals, is to be maintained around the source. Therefore, a 2km exclusion zone will be maintained throughout the operations.

Figure 3: Automatic Underwater Acoustic Receiver Array



2.6 Responsible Seismic Survey Practices

Sakhalin Energy has spent over a decade collaborating with the WGWAP developing Best Practice for carrying out seismic surveys in the proximity of marine mammals (Monitoring and Mitigation Plan Appendix VI and Behavioural Monitoring Protocol VII). As a result, the Company was acutely aware of the issues that could arise if an agreement on survey time sharing was not made with ENL.

In autumn 2014, the Sakhalin Energy took the initiative and contacted ENL to open up dialogue. A series of meetings followed, aimed at developing an accord to acquire successfully the geophysical data both companies required, while applying the responsible practices developed over many years with the WGWAP for minimising and monitoring the impacts of the surveys on marine mammals, the gray whales in particular.

The responsible practices include:

- Optimisation of the area to be surveyed
- Deployment of Real Time listening devices along the border of the Feeding/Aggregation Area to monitor actual sound levels (Figure 3)
- Creating an Exclusion Zone around seismic source
- Early Start: commencing activities before the whales return in increasing numbers (in practice, this means as soon as the sea ice has dissipated);
- Short Duration: starting early in the season can help achieve an early finish (again, before all of the whales have arrived);
- employment of 'shut down' criteria (these can be triggered when a whale is spotted and deemed to be at risk of harm, for example, within 1 kilometre of the source. Typical responses are shutting down the source and/or stopping the vessel)
- Deployment of a gradual ramp-up rate of the source following shut downs or inactivity
- first acquiring the lines modelled to be at most risk to the whales (for example, likely to be particularly loud and/or to encounter whales, say close to feeding grounds or transit areas; referred to as 'A lines'; 'B lines' have a modelled lower risk to marine mammals but are far more numerous)
- acquiring the lines in parallel to the coast to limit direct ensonification of the shore, where the whales would be congregating
- imposing even stricter shut down rules when the risk involves mothers and calves

- Real time acoustic monitoring of Sakhalin Energy's activities
- Real time behavioural monitoring of Sakhalin Energy's activities
- Real time distribution monitoring of Sakhalin Energy's activities

2.7 Strategy for Achieving a Safe and Effective Survey in 2015

Details of ENL's survey are commercially confidential. Sakhalin Energy is not privy to the ENL survey details and does not have the right to publish them. The scale of ENL's 4D survey in 2015 is substantially larger than Sakhalin Energy's and, crucially, includes acquiring lines in a significant portion of the whales' near shore feeding area (Fig 4 Sakhalin Energy Piltun-Astokh and *ENL 2015 4D Seismic Survey Area*). Subsequently, a series of negotiations took place between Sakhalin Energy and ENL, within the context of employing the environmentally responsible practices and acquiring the data, to avoid simultaneous seismic survey activity at Odoptu and Piltun-Astokh. A decision was made to treat the Odoptu and Piltun-Astokh survey areas as if they had been joined to form one survey management area.

A major objective was to conduct the survey in the most environmentally sensitive areas first and included the completion of all of the higher risk A-lines by August 1st. This allowed for much clearer and effective application of the responsible practices and deployment of respective survey vessels. To use the limited time even more effectively, the two surveys could operate at the same time but, for practical reasons, only in areas tens of kilometres apart. It hinged on the two independent, rivals agreeing to work together constructively, employing Best Practice to mitigate their risks of affecting the whales and not compromising each other's survey.

It was important from the risk to whales' mitigation and commercial perspectives, that this plan was created. Leaving aside the fact that interference from each other's seismic acquisition activities would *inter alia* greatly reduce their effectiveness, this is a remarkable example of two independent companies uniting in their approach, ENL agreeing to apply the Best Practice principles from *Nowacek et al* 2013 in the zone closest to the nearshore feeding area (it is not known what standard is applied in the lower risk area) and mitigating their possible impact on marine mammals. It required leadership from Sakhalin Energy and a responsible attitude from both companies to achieve their independent aims most effectively. For example, the acquisition lines likely to place the whales most at risk would be those in or closest to the feeding areas. The companies carried out an assessment and revealed that ENL's lines are closest and therefore present the highest risk. Using the Best Practice and guidance from the WGWAP process, it was agreed that ENL should start their survey first and as soon as the area is ice free. That means that Sakhalin Energy must adjust their plans for acquisition of their most at risk lines, the A-lines, which are actually further from the feeding area and offer less risk to the whales than ENL's. By starting early, ENL should acquire their most at risk lines before the whales arrive or arrive in higher densities. Meanwhile, Sakhalin Energy will acquire low risk lines, for example, at Lunskoye. As soon as ENL has completed acquisition, Sakhalin Energy will sail to the relevant area to acquire its A-lines. Analysis of tidal tables for the estimated operation times has revealed that strong currents are likely in that period. Turbulence from those currents can affect the towed streamers and consequently is likely to increase the risk of poor data acquisition from the survey. This, in turn, could lead to repeated acquisition of the same lines with a concomitant increase in risk to the whales arriving in the area. Sakhalin Energy may decide to minimise this risk by acquiring the lines at the calmest stage of the tidal cycle which is at slack water, or alternatively, postpone the lines till later in July when slack water occurs during the day. Early July '15, slack water occurs during the night. If acquiring at night, a team of experienced Marine Mammal Observers (MMO), trained in the use of night vision and radar, will scan the area around the towing vessel on the lookout for whales. A pre-dusk scan as per 2010 procedures would also be carried out if night time acquisition is deemed necessary. As part of the State Environmental Expertise Review (SEER), the detection of gray whales within 2km of the vessel will lead to operations shut down until deemed safe to re-start by the MMO. Further, Sakhalin Energy is committed to acquiring no more A-lines after the 31st July. An Independent Observer has been appointed by the WGWAP to oversee the seismic survey. A communications strategy for disseminating and recording observations and comment has been agreed (Appendix V)

If this approach was not taken then, in all likelihood, the risk of disturbing the whales on the feeding ground would be higher and would continue to increase with the daily arrival of more foraging whales. With two or possibly three companies acquiring and probably re-acquiring lines in the vicinity at the same time, the whales would get little respite from activity and noise. The line acquisition would be constantly interrupted by shut downs triggered by the presence of whales, leading to an extended survey. The disturbance would increase the risk of slower recovery in individuals from the exertions of the migration or even no recovery at all. That would lead inevitably to a higher risk of mortality in the return migration due to a lack of condition for the demands of the journey.

The updated, modelled assessment from the WGWAP (Cooke) shows similar impacts, within the known limitations of the method (Appendix I).

Cumulative modelling was performed by the Panel member Cooke in 2014, including consideration of a conservative, late start date case. The sound source and particularly the configuration of the air gun array have been modified since the Panel's meeting at the end of 2014 (WGWAP-15) with the aim of reducing the acoustic energy expected to enter the feeding area.

The Panel welcomed this new information and the cumulative model was updated by the Panel member Dr Justin Cooke: http://www.iucn.org/wgwap/wgwap/meetings/wgwap_wm/, refer to technical Supplements.

The modelling results show that night time acquisition is beneficial to cumulative distribution of maximum exposure and cumulative exposure; this is due to the reduced overall survey duration when relaxing night time recording. The results also show that the behavior shutdown rule has little effect on both maximum and cumulative exposure. This conclusion is in accord with the spreadsheet modelling developed by the Company and the Task Force.

If accepting that ENL is also surveying then Cooke concludes that the old and new schedules (referring to the order of ENL & Sakhalin Energy surveys) make little difference to cumulative exposure levels. This is a questionable result, and possibly an artefact from the assumptions made; see the discussion below.

The source model (page 3) is simplified. To our knowledge, ENL has not provided details of its source; without it, not enough of the detail of ENL's surveys is known to realistically model the cumulative exposure.

The modelling assumes that whales are spread across the area with a static distribution irrespective of seismic survey activity. This is not clearly stated, but it is a key assumption, which is probably flawed. During private communication with experts and during NTF-7 and NTF-8, several Panel members shared their empirical observation that whales seek out quiet areas in response to noise exposure. The scientists therefore expressed a desire that during the combined ENL-Sakhalin Energy surveys, Companies should leave parts of the feeding grounds not ensonified. The proposed combined ENL-Sakhalin Energy schedule responds to that concern. However, the modelling does not include the empirically observed shift of whale distribution in response to exposure, but continues to assume the original static distribution. Doing so, cumulative exposure seems to increase (see Cooke's figs 3 and 4). The static distribution is inconsistent with empirical observation that shows that whales shift their distribution in response to noise exposure. This observation should be captured in future modelling work. Sakhalin Energy anticipates that this would show that the chosen survey schedule has a beneficial effect compared to the original continuous time sharing arrangement on a 24-hour basis between ENL-Sakhalin Energy, as discussed at NTF-7/8.

2.8 Survey Dynamics

The joint 4D surveys will proceed as follows: The Sakhalin Energy vessel will commence the 2015 4D seismic survey tens of kilometres away at the distant and lower risk area of Lunskoye. ENL will commence the survey of their Odoptu field from around 10-June (estimated because it depends on the sea being free of ice) to 11-July; Sakhalin Energy Piltun-Astokh will commence its seismic survey from (estimated) 12 July, finishing the A-lines before 1-Aug and acquiring the remaining B-lines by 10-Aug. While Sakhalin Energy is recording Piltun-Astokh, ENL will be recording at Arkutun-Dagi offshore, maintaining a 40km separation. When Sakhalin Energy finishes at Piltun-Astokh, ENL carries on working at Arkutun-Dagi.

In the above plan, the seismic survey in the environmentally most sensitive area, Odoptu (it is estimated that around 85% of the ENL survey lines are A Lines impacting the northern end of the onshore feeding grounds), is surveyed first and earliest, in accordance with the principle of the responsible practices. Importantly, avoiding simultaneous seismic survey activity at Odoptu and Piltun-Astokh is likely to maintain less ensonified areas in the whales' feeding ground.

The Piltun-Astokh area has a buffer of several kilometres from the feeding grounds (approximately one third of the survey lines are A lines) and is prioritised second to allow for ENL to make an early start to its survey in the feeding ground area with the expectation of an early finish. Sakhalin

Energy will start its Piltun-Astokh 4D survey after ENL, at a time when the weather is expected to be better and the number of whales is predicted to be higher than early June. Historic meteorological data show that Sakhalin Energy is less likely to have downtime in that period. However, records show that there are likely to be more whales present in the feeding grounds, so the Company can expect to have more source suspensions (downtime). The net effect of these two opposite assumptions on the total survey duration is expected to be small. On balance, the Company expects to be able to complete the full survey in 30 days, as before. The timing estimates above are conservative in terms of start date (linked to the sea being free of ice) and duration (accounting for downtime).

3 REGULATORY CONTEXT AND APPLICABLE STANDARDS

3.1 National and International Compliance

Under an agreement with the investment banks (which comprise the Lenders to the Sakhalin II project), the Company is contracted to manage its activities, *inter alia*, to avoid, mitigate and minimise any risk to the environment and respective human populations' social welfare, safety and health as per national legislation and international requirements as described in HSESAP (see below) . Under national legislation, Sakhalin Energy complies with the Russian Federation Environmental Impact Assessment process and submitted its documentation for State Environmental Expert Review (SEER) in February 2015. In practice, Russian Federation legislation is complementary to, or reinforces, IFC Performance Standards.

As part of the compliance process, typically the Project develops an Environmental Social and Health Impact Assessment (ESHIA), an Environmental and Social Management System (ESMS) and an Action Plan (AP). In Sakhalin Energy the AP is referred to as the Health, Safety, Environment and Social Action Plan (HSESAP). Importantly, the HSESAP is a component of the ESMS and is covenanted within the loan documentation. Therefore, it can't be changed without the Lenders' agreement. The Lenders and their independent environmental consultant (LIEC) agree the contents of the HSESAP with the Company to ensure compliance with the Performance Standards. The LIEC then monitors the project to ensure compliance with the HSESAP. This document is a key component of that process and procedure.

3.2 International Finance Corporation's 2012 Performance Standards

Sakhalin Energy committed voluntarily to the International Finance Corporation's 2012 Performance Standards. Previous activities had been covered by predecessors of these standards but the 4D Seismic Survey is to conform to the 2012 Performance Standards. Some additional requirements in the 2012 PSs are particularly relevant to this document and project. Those additions include: Ecosystem services, Offsetting and Protection of Critical Habitats. This means, for example, that in areas with Critically Endangered species present, the operator must have examined all alternatives to those activities and then, if there is no alternative, must show how it is mitigating any risk to the species and describe any Net Gains from its activities; importantly, any Cumulative Impacts of activities must be described and mitigated.

3.3 Oversight, Coordination and Scientific Review of Sakhalin Energy's Plans and Activities

IUCN and the Western Gray Whales Advisory Panel

In 2004, as part of the Lenders' compliance process, Sakhalin Energy contracted IUCN to establish an Independent Scientific Review Panel. In 2006, IUCN created a longer term panel of independent scientists, the WGWAP, to provide scientific advice and recommendations on the company's operational plans and mitigation measures. It comprises scientists from a range of disciplines and manages some subjects through specialist Task Forces. In addition, to aid transparency and to engage with stakeholders, observers are invited to the WGWAP. Generally, the Chair allows Observers the opportunity at each meeting to comment on presentations and public documents. They regularly include representatives from Sakhalin Oblast (local government), Russian and Japanese branches of the International Fund for Animal Welfare (IFAW), WWF Russia, Pacific Environment and Lenders' representatives including the LIEC and advisors.

According to the IUCN: 'The WGWAP's stated objectives are:

1. To provide independent scientific and technical advice to decision makers in industry, government and civil society with respect to the potential effects of human activities, particularly oil and gas development activities, on the Western Gray Whale population

2. Co-ordinate research to: achieve synergies between various field programmes; minimise disturbance to Western Gray Whales (e.g. by avoiding overlap and redundancy of field research programmes); identify and mitigate potential risks associated with scientific research activities; and maximise the contributions of research to understanding the status and conservation needs of the Western Gray Whale population.'

‘The WGWAP has been established to provide an independent review process and advice regarding the management of risks to the Western Gray Whales. Its main roles and responsibilities are:

1. To focus on the **conservation** of western gray whales and related biodiversity
2. To **assess** the status of the western gray whale population
3. To provide **advice and recommendations** regarding research for the conservation of the whales
4. To **independently review** Sakhalin Energy’s plans and assessments, and the effectiveness of the mitigation measures implemented
5. To provide independent **scientific and technical advice** to decision makers, governments and civil society concerning whales and related biodiversity conservation
6. To **coordinate research efforts** on western gray whales and their habitat
7. To increase **global knowledge** and understanding of western gray whale population and their habitat’

As mentioned above, part of the process of compliance with the 2012 Performance Standards is achieved through the HSESAP. It is through the HSESAP that Sakhalin Energy has contracted with the Lenders to support the WGWAP:-

HSESAP, Rev. 3; paragraph 2 of Marine Mammals Specification, 2010

‘Western Gray Whale Advisory Panel (WGWAP)

A. Sakhalin Energy has implemented the WGWAP in line with the outcome of the Vancouver Report, and shall support the WGWAP until such time as review by the Company and Lenders results in agreement that this is no longer appropriate.

Sakhalin Energy shall provide funding for the WGWAP to undertake its activities in line with its agreed terms of reference and shall make best efforts to ensure that the WGWAP operates in line with the terms of reference in conjunction with a suitable independent convener.

Should the WGWAP cease to operate due to circumstances beyond the control of Sakhalin Energy, Sakhalin Energy shall make reasonable endeavours to instigate an equivalent advisory body. The *new body would be convened and operated to the satisfaction of the entities that make up the new body. The Company shall consult with the Lenders throughout this process.*

B. Sakhalin Energy shall keep the WGWAP informed of its offshore activities (including any future seismic surveys) on a regular basis in order that all future priority issues can be identified and reviewed in a timely fashion. (Supported by WGWAP recommendations)

c. All proposed changes to the MMPP shall be provided to the WGWAP for review.

d. The Company shall implement all reasonable recommendations from the WGWAP, provided that they comply with Russian law, and to seek support for these recommendations from shareholders, Russian Party and joint industry partners as appropriate. '

3.4 Sakhalin Energy as a developer of Best Practice

As the only industry participant and sole funder of the Western Gray Whales Advisory Panel, Sakhalin Energy has worked intimately with IUCN, the Panel and its Task Forces, over many years, to develop and produce effective, pragmatic, mitigation measures, monitoring plans and scientific data on gray whales, their environment and the Company's activities. This relationship allowed for a much more informed and responsible approach for avoiding and minimising risk to the whales from industrial activities. Combined with an industry initiative, a major outcome has been a large increase in information regarding the gray whales which visit Sakhalin, particularly on their abundance, distribution, behaviour, ontogeny and reproductive dynamics. The outputs from this approach, relationship and Company activities were presented formally, by several Panel members and associates, as industry Best Practice for seismic surveying, as a scientific paper in the journal, Aquatic Mammals, in 2013 (ref Nowacek *et al.* 2013).

3.5 The ENL/Sakhalin Energy Joint Programme

Another operator in the region, Exxon Neftegas Limited (ENL), contributes to an industry gray whale joint research and monitoring programme run in partnership with Sakhalin Energy. The programme has run for several years and has revealed significant, new, scientific knowledge on gray whales:

- the number of gray whales estimated to be visiting Sakhalin is increasing each year

- Photographic identification, satellite tagging and genetic sampling each give a very strong indication that GWs visiting Sakhalin comprise a feeding aggregate and are unlikely to be genetically separate from the Pacific Eastern gray whale population
- Mitigations, developed with expert advice, have been implemented to manage potential risk to the whales from activities.
- This approach has been successful and resulted in no observed or measureable impacts to GWs or their habitat off Sakhalin.

In the context of all marine creatures likely to be at risk in the area but with an obvious focus on marine mammals and gray whales in particular, this ESHIA describes the activities, examines the potential risk of effects and impacts of those activities, describes the avoidance and management of risk and presents the monitoring and mitigation plans developed with experts. It explains how the Company endeavours to operate commercially while complying with the 2012 IFC Performance Standards on Environmental and Social Stability and developing Best Practice to generate the information required to safely and efficiently manage the hydrocarbon reserves in the seabed off Sakhalin Island.

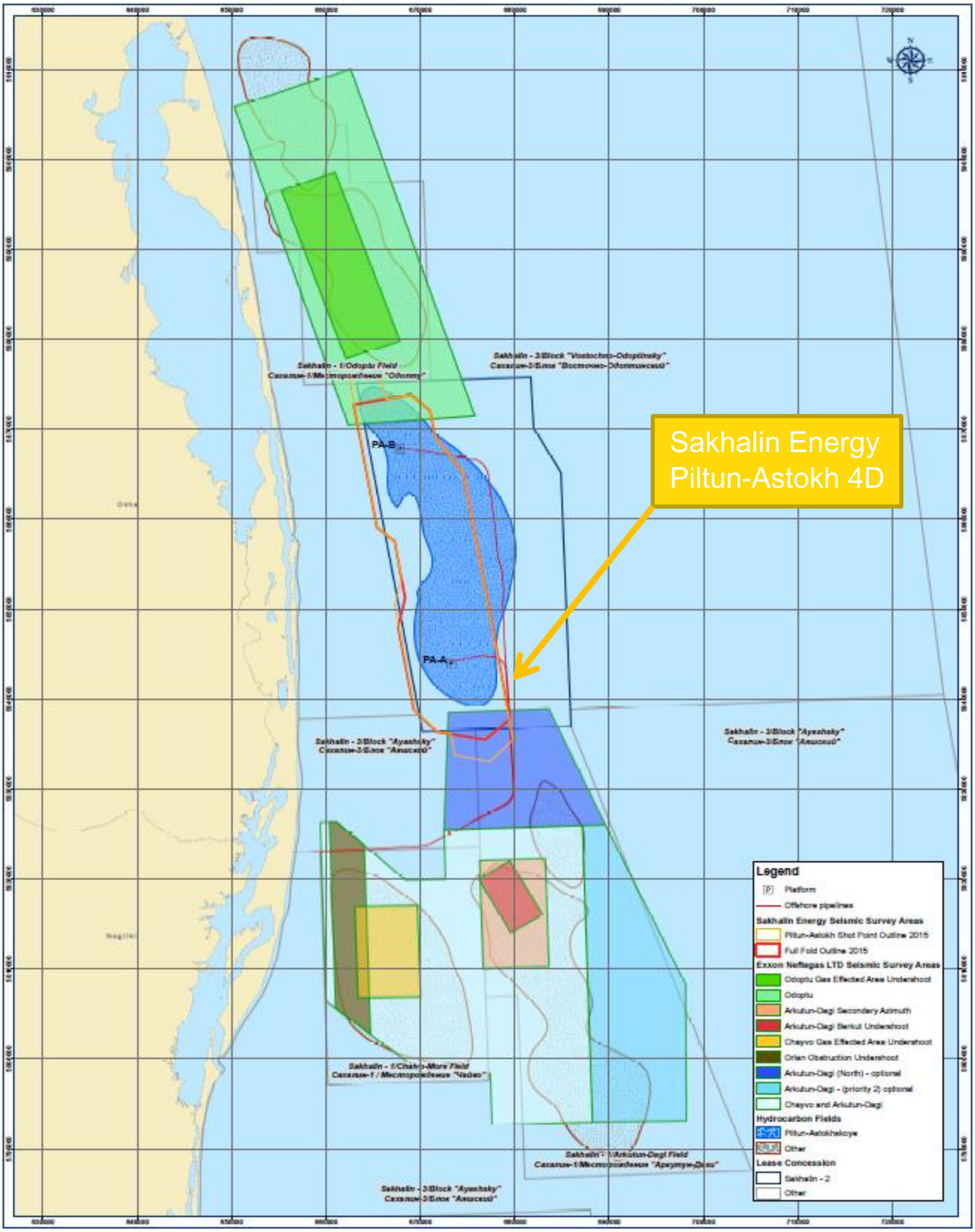


Figure 4 Sakhalin Energy Piltun-Astokh seismic survey area 2015

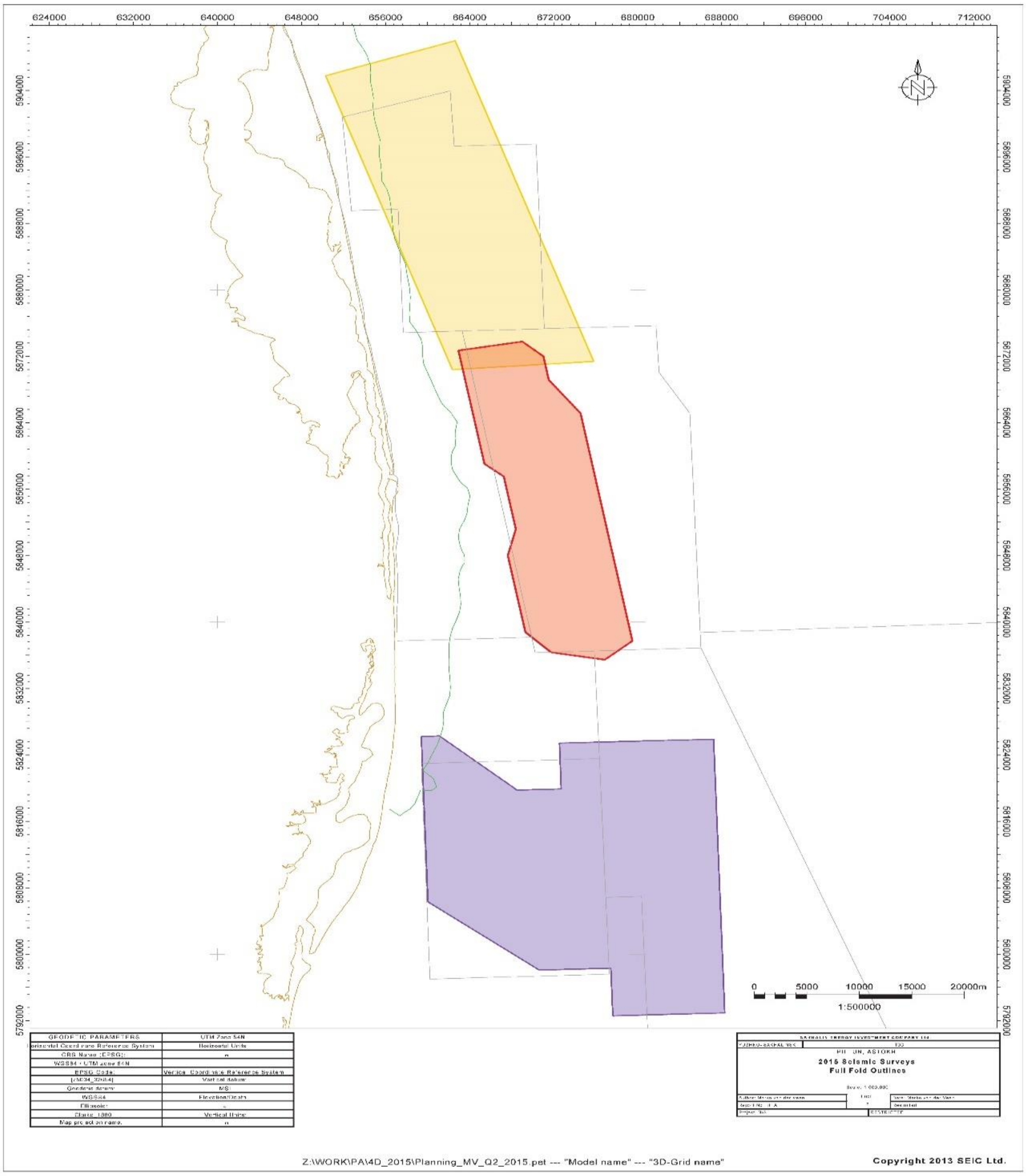


Figure 5 Sakhalin Energy Piltun-Astokh (red) and ENL (Odoptu-yellow; Chaivo &Arkutun-Dagi-violet) seismic survey areas 2015

4 METHODOLOGICAL APPROACH

4.1 Background

Scoping of the International ESHIA is a process where the scope and terms of reference of the impact assessment are defined. It outlines those issues that are to be addressed during the impact assessment, and identifies valued ecosystem components (VECs); VECs are those elements of a project or activity's surroundings that are of importance, for example, a protected species (Gray Whales) or a resource (local fisheries) central to a government agency and other stakeholders. The purpose of identifying VECs is to help rationalise the scope of the assessment and to guide the impact evaluation process to apply only to the most important environmental receptors. Specifically, the source-pathway-receptor concept was considered in determining the reasonable likelihood of significant interaction ('pathways') of ecosystem components ('receptors') with survey activities ('sources').

In scoping this assessment, previous environmental assessments for Sakhalin Island and elsewhere were reviewed (e.g., Clarke *et al.* 2001; Sakhalin Energy 2003, 2005; U.S. Navy 2005; L-DEO and NSF 2006; MMS 2006a and 2006b; MMS 2007) together with reports that focus on the gray whales. The key environmental issues for this assessment have been identified as:

- Disturbance and injury to marine mammals;
- Disturbance to marine invertebrates, fish and birds;
- Effluent discharge, emissions, and waste disposal;
- Accidental spills, leaks and dropped objects; and
- Interaction with other users of the area.

Based on these issues, source-pathway-receptor relationships were identified and are presented in Table 1. Also shown are references within this chapter where these issues are discussed.

The impacts which could arise or have been recorded in marine organisms have been comprehensively presented previously in the 2010 Piltun-Astokh 3D Seismic Programme EIA prepared for Sakhalin Energy by LGL Ltd, Royal Haskoning and JASCO Research Ltd (*Relevant section* *x presented in Appendices*). The primary mitigation was to conduct the seismic survey as early in the GWs' feeding season as reasonably practical when feeding whale numbers were lowest and fewest GWs would be exposed to survey sound.

4.2 Habitat Determination

Sakhalin Energy's 2015 4D survey activities impinge on vital habitat of the gray whale, *Eschrichtius robustus*. A group of these sea mammals migrates to the Sea of Okhotsk for the summer and is deemed Critically Endangered by IUCN methods and standards. Examination of the quantitative thresholds for Tiers 1 and Tiers 2 of Critical Habitat 1 through to 3 reveals overlaps but the habitat is best fitted by Criterion 1 *Critically Endangered:* Tier 2 d) (as an aggregation rather than at species level) plus e) containing regionally important concentrations of a *Critically Endangered* species. Subsequently, the habitat is determined as Critical Habitat.

Attributing a boundary to that habitat involves defining an area within which the management issues have more in common with each other than they do in adjacent areas. Put simply and in the context of oceanic, marine mammals, the Critical Habitat of the whales extends beyond the geographical area of the seismic survey. Under Guidance Note 65 for PS 6, the Discrete Management Unit should be considered as the zone where the A and B lines are acquired but, since there is still a potential risk of harm to whales, from mitigated and unmitigated activities, outwith the seismic survey spatial footprint, Critical Habitat actually continues outside of it and must be considered in the monitoring and mitigation process.

4.3 Scoping Assessment

Following a recommendation from the WGWAP to Sakhalin Energy, the 4D Seismic Survey in 2015 is to use the standards set in the 2010 Piltun-Astokh Seismic Survey EIA as a baseline. The baseline characterisation of the receptors was described in the Sakhalin Energy 2010 EIA for the Piltun-Astokh Seismic Survey and is presented in Appendix VIII with permission. (The gray whale section is understandably dated but the distribution and location information is still pertinent in this context.)

Table 1

Acquisition activities (sources) and potential means of interaction (pathways) with ecosystem components (receptors)

SOURCE	**Active Airgun Array**	**Vessel Operations**			
PATHWAY	Ensonification of marine environment	Streamer Entanglement	Collision	Emissions to atmosphere, effluent discharge, waste disposal	Accidental spills, leaks, dropped objects
RECEPTOR					
Baleen whales (mysticetes)	SAA1	SE	SS	EM	AS
Toothed whales odontocetes)	SAA2	SE	SS	EM	AS
Seals (pinnipeds)	SAA3	SE	SS	EM	AS
Stakeholders and fisheries	SAV	SAV	SAV	SAV	SAV

Noise Contour Prediction: Acoustic footprint modelling of planned 2015 Piltun-Astokh 4D seismic survey Jasco Ltd, Appendix IV

After studying the conclusion of the State Environmental Expertise Review (SEER) for the 2015 4D seismic, Sakhalin Energy decided to cancel the Sound Source verification test planned at the beginning of the Piltun-Astokh survey. The reasons for cancellation were as follows:

'JASCO modelling has previously indicated that the 180dB RMS per pulse sound level would be at a radius of 1400-1600m around the source. Company set the exclusion zone at 1600m based on this modelling. However, the SEER conclusion has prescribed a 2000m exclusion radius around the source. This is significantly larger than what we anticipated based on the modelling, but it is a directive from the applicable Regulator, overriding any modelling/field calibration work. Therefore the sound source verification test adds no practical value at this point in time. Conducting the test does however require significant effort from the Contractor and Company's Marine Logistics department and requires coordination with the seismic vessel. Moreover, the operation of deployment and retrieval of equipment is not without risks. On balance Company saw no reasons to continue with the SSV test.'

4.4 Impact Significance Criteria

Impacts may be direct or indirect, permanent, long-term, short-term or temporary. Quantitative predictions of environmental impacts are generally acknowledged as problematic and there are a number of different methods used to define impact and significance levels. To determine the significance of potential impacts, assessment criteria in relation to the status (i.e. vulnerability, sensitivity, and value) of the environmental receptor are taken into consideration; four levels of impact significance are applied:

- Major Impact: affects an entire population or species in sufficient magnitude to cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations of the species being affected;

- Moderate Impact: affects a portion of a population and may bring about a change in abundance and/or distribution over one or more generation(s) of the species affected, but does not threaten the integrity of that population or any population dependent on it. Moderate Impact to the same resource multiplied over a wide area would be regarded as a Major Impact;

- Minor Impact: affects a specific group of localised individuals within a population over a short time period (one generation of the species affected or less), but does not affect other trophic levels or the population itself;

- Negligible or No Impact: where no significant impact is predicted to occur; the impact is of such small magnitude that it does not require further consideration in the assessment.

Impact predictions have been made using available data, but where uncertainty remains, this is acknowledged and an indication of its scale is provided. Where the sensitivity of a receptor to a particular activity is unknown and the level of impact cannot be predicted, the EIA team has used professional judgement as to whether a significant impact is likely to occur.

The impact assessments use the impact criteria described above for both unmitigated and residual (mitigated) impacts. The mitigated assessments are made in the context of the Marine Mammal

Plan, Behavioural Monitoring Protocol, advice from the WGWAP, model outputs, scientific reports and the SEER instructions.

5 IMPACT ASSESSMENTS

5.1 SAA1

Known and Potential Acoustic Effects on Mysticetes (Baleen whales)

This section provides a synopsis of available information on the potential acoustic effects of seismic surveys on mysticetes, including masking, disturbance, temporary and permanent hearing impairment and other physiological effects. Sections below provide similar information for odontocetes and pinnipeds.

It is plausible that an animal sufficiently close to a high-energy sound source for sufficient duration could be harmed by that sound's energy, even if the frequencies of the sound are outside the hearing range of the animal. Of concern, however, are seismic survey-generated sounds that overlap the hearing range of mysticetes in general and of gray whales in particular. Since mysticete hearing sensitivity is poorly understood (hearing sensitivity has only been measured for a captive gray whale), this impact assessment assumes that mysticetes whose sound production characteristics overlap those of seismic survey-related sounds, can detect those sounds.

Sounds produced by mysticetes range in frequency approximately 7 Hz to 22 kHz (Richardson *et al.* 1995; Miller *et al.* 2005a). Mysticetes are therefore considered most sensitive to low-frequency sounds.

Airguns used in seismic surveys typically have dominant frequency components <200 Hz and zero-to- peak nominal source outputs ranging from 240-265 dB re 1 uPa-1 ·m (rms). This frequency range overlaps the lower range of sound produced by most mysticetes; the mysticetes expected to be most sensitive to sound produced by airguns are those that rely primarily on these frequencies, including the blue and fin whale. Airguns also produce a small proportion of mid- and high-frequency sounds, although at lower energy levels and the nominal source

outputs of airguns are well within the detection thresholds of mysticetes. Pulsed sounds associated with airguns also have higher peak levels than most other anthropogenic sounds to which marine animals are routinely exposed.
Echosounders typically operate at frequencies of approximately 11-12 kHz with a maximum source level near 240 dB re 1 µPa-m (rms). This frequency range overlaps the frequency range of sounds produced by three species of mysticete that can occur in the Sea of Okhotsk: the gray whale, the humpback and minke whale.

The frequencies and amplitudes of sounds emitted by ship engines and by vessel hulls (reviewed in Richardson *et al.* 1995 and NRC 2003) also overlap the frequencies and thresholds of mysticete hearing, although the intensity of vessel sounds would be considerably less than sounds emitted by airguns and sonar (Richardson *et al.* 1995). Limited studies indicate that vessel sounds may cause behavioural responses in mysticetes, depending mainly on species, location, behaviour, novelty, vessel activities, and habitat (reviewed in Richardson *et al.* 1995). However, vessel sound intensities would not be expected to cause anything more than localized behavioural changes, considering that large vessel traffic is prevalent worldwide and is considered a usual source of ambient sound (McDonald *et al.* 2006). Based on the above, potential effects of vessel noise on mysticetes are likely to be short-term in nature and are not further discussed in detail in this document.

Thus, airgun and echosounder noise may cause physiological and behavioural effects in mysticetes. The likelihood of these effects occurring depends on the sound intensity received by the individual, as well as the sensitivity of the individual to sound and disturbance (e.g., prior habituation, activity, behaviour, age, sex, etc.). The magnitude and type of effect would generally depend on proximity to the source, but may also be influenced by other factors (e.g., water depth, water temperature, airgun array size and volume etc.). Physiological effects might occur in those individuals sufficiently close to an active source operating at high levels for sufficient duration of time. While short-term behavioural effects are more likely to occur, adverse effects on the viability of mysticete populations would not be expected in most cases.
Although energy of seismic airgun sound is generally greatest at frequencies from 10 to 200 Hz (Goold and Fish 1998; Sodal 1999), significant energy above 500 Hz has also been

recorded (DeRuiter *et al.* 2005; Potter *et al.* 2006; Tyack *et al.* 2006; Goold and Coates 2006). DeRuiter *et al.* (2005) and Tyack *et al.* (2006) also noted that on-axis source levels and spherical spreading assumptions alone are inadequate to describe airgun pulse propagation and that source and environmental characteristics also influence the level and frequency output of seismic airguns. Goold and Coates (2006) concluded that the output of airguns covers the entire known frequency range used by marine mammals, and that this output includes substantial energy levels clearly audible to most, if not all, cetacean species.

Assessment: Unmitigated Impact is deemed to be Moderate;

Mitigated Impact is deemed to be Minor

5.2 SAA2

Known and Potential Acoustic Effects on Odontocetes

(Toothed whales)

A number of direct measurement studies have been conducted on the hearing capabilities of odontocetes. The small- to moderate-sized odontocetes that have been the subject of audiology have relatively poor hearing sensitivity at frequencies below 1 kHz, but extremely good sensitivity at and above several kHz (Richardson *et al.* 1995; Miller *et al.* 2005b). Sensitivity to the low frequencies most prominent in the broadband sounds produced by seismic operations and vessels is considered rather poor for most odontocete species. However, they presumably can hear the less prominent mid-to-high frequencies produced during these activities. Of the odontocetes, sperm whales are probably more sensitive to low frequencies based on what is known about their sound production. Some odontocetes exhibit avoidance behaviour to seismic operations; this is discussed below.

With respect to noise from seismic surveys, odontocetes are presumably more sensitive to the mid- to high frequencies produced by the echosounder than the generally low frequencies produced by the airguns and vessel. The emitted beam of the echosounder is usually narrow (approx. 2°) in the fore-aft extent and wide (approx. 130º) in the cross-track extent. Therefore, an animal at depth near the track line would be in the main beam for only a fraction of a second and are unlikely to be subjected to repeated pulses. Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when such a sonar system emits a pulse is small; the animal would have to pass the transducer at close range and be swimming at a similar speed and direction to that of the vessel in order to be subjected to sound levels that could potentially result in significant impacts. Thus, it is unlikely that echosounders produce pulse levels strong enough to cause hearing impairment or other physical injuries even in an animal that is (briefly) in a position near the source (UTA and NSF 2006). There is also potential for airgun noise to cause adverse physiological and behavioural effects in odontocetes, although such effects have not been clearly demonstrated. The likelihood of these effects would depend on the sound level received by the individual as well as any variability in sensitivity of the individual (i.e., prior habituation, activity, behaviour, age, sex, etc.). The level and type of effect would generally be related to proximity to the source, but may be influenced by other factors as well (e.g., water depth, water temperature, airgun array size, etc.).

Possible effects of vessel noise on odontocetes and results are variable. Studies indicate that vessel sound may cause behavioural disturbance or avoidance in some individuals and species, particularly beaked whales; among other species, there is no apparent response, while habituation, or even attraction and bowriding have been recorded in others (Richardson *et al.* 1995; Würsig *et al.* 1998). Apparent variability is related to species, location, behaviour, novelty of the sound, vessel activity and habitat (Richardson *et al.* 1995). Based on the above, potential effects of vessel sound on odontocetes are considered to be short- term behavioural in nature and are not further discussed in detail in this document.

Assessment: Unmitigated Impact is deemed to be Moderate;

Mitigated Impact is deemed to be Minor

5.3 SAA3

5.3.1 Known and Potential Acoustic Effects on Pinnipeds (Seals and Sea Lions)

This section discusses acoustic effects (masking, disturbance, temporary and permanent hearing impairment), and other physiological effects of noise and disturbance on pinnipeds. Few studies on the reactions of pinnipeds to airguns and sonar have been published, and the biological significance of any effects and potential effects at the population scale are largely unknown.

As with odontocetes, pinnipeds typically hear and produce sounds at higher frequencies than those produced by airguns and are therefore expected to be less affected by airgun operations than mysticetes. Echosounder frequencies occur in hearing range of pinnipeds; however, the pulses are short and the beams narrow, and therefore pinnipeds at depth near the track line would only be subjected to brief exposure of this noise. Effects of these sonars on pinnipeds have not been reported.

Although the frequencies of sounds emitted by ship engines and hull overlap with the frequencies associated with pinniped hearing (reviewed in Richardson et al. 1995 and NRC 2003), the possible effects of vessel noise on pinnipeds are variable. Studies indicate that vessel noise may cause behavioural changes in some individuals and species, while in others there was no apparent response or habituation and even attraction occurred (see review in Richardson *et al.* 1995).

While various pinnipeds have been shown to react behaviourally to airgun pulses under some conditions, at other times they have shown no overt reactions (see review in Richardson *et al.* 1995). In general, pinnipeds seem to be more tolerant of exposure to airgun pulses than mysticetes.

Assessment: Unmitigated Impact is deemed to be Moderate;

Mitigated Impact is deemed to be Minor

5.4 SAV

5.4.1 Effects of Seismic Survey Sound on Marine Fish

One reason for the adoption of airguns as the standard energy source for marine seismic surveys is that, unlike explosives, they have not been associated with large-scale fish kills. However, existing information on the impacts of seismic surveys on marine fish populations is still limited. There are three types of potential effects on fish from exposure to underwater seismic and other anthropogenic sounds: pathological, physiological and behavioural. The specific received sound levels at which permanent adverse effects on fish could potentially occur are little studied and largely unknown. Furthermore, available information on the potential impacts of seismic surveys on marine fish involves studies of individuals or portions of a population and not at the population scale.

5.4.2 Pathological Effects

The potential for pathological damage to hearing structures in fish depends on the energy level of the received sound and the physiology and hearing capability of the particular species. For a given sound to result in hearing loss, the sound must exceed, by some specific amount, the hearing threshold of the fish for that sound (Popper 2005). The consequences of temporary or permanent hearing loss in individual fish or a fish population are unknown.

Little is known about the mechanisms and characteristics of potential injury to fish from exposure to seismic survey sounds. McCauley *et al.* (2003) found that exposure to airgun sounds caused observable anatomical damage to the auditory structures of caged pink snapper. This damage had not been repaired in fish examined almost two months post exposure. However, the fish were exposed to high cumulative levels of seismic survey sound that may not be analogous to that experienced by free-ranging fish. Popper *et al.* (2005) documented TTS in two of three fishes in the Mackenzie River Delta but also found that broad whitefish that received an SEL of 177 dB re 1 $\mu Pa^2 \cdot s$ showed no hearing loss. In both cases, the sound exposure was greater than would have occurred in a typical seismic survey. TTS was also observed in studies involving goldfish and catfish (Amoser and Ladich 2003). In those experiments, fish were exposed to white noise (158 dB re 1µPa) for periods of 12-24 hours and were then tested for post- exposure hearing sensitivity. Both species showed a loss of hearing sensitivity, with sensitivity returning to normal in 3 days for the goldfish and 14 days for the catfish. Smith *et al.* (2004b) reported threshold shift in goldfish after just 10 minutes of exposure to white noise (160-170 dB re 1µPa), with recovery in 14 days.

Wardle *et al.* (2001) suggest that in water, acute injury and death of organisms exposed to seismic energy depends on two features of the sound source: the received peak pressure and the time required for the pressure to rise and decay. Generally, as received pressure increases the period for the pressure to rise and decay decreases and the chance of acute pathological effects increases. However, numerous studies provide examples of no fish mortality upon exposure to seismic sources (Falk and Lawrence 1973; Holliday *et al.* 1987; La Bella *et al.* 1996; Santulli *et al.* 1999; McCauley *et al.* 2000a, b; Thomsen 2002; Hassel *et al.* 2003; McCauley *et al.* 2003; Popper *et al.* 2005).

Some studies have reported, some equivocally, that mortality of fish, fish eggs, or larvae can occur close to seismic sources (Kostyvchenko 1973; Dalen and Knutsen 1986; Booman *et al.* 1996; Dalen *et al.* 1996), although in some cases, the treatment examined was very different from any real-world scenario. Saetre and Ona (1996) applied a 'worst-case scenario' mathematical model to investigate the effects of seismic energy on fish eggs and larvae. They concluded that mortality rates caused by exposure to seismic surveys are so low, as compared to natural mortality rates, that the impact of seismic surveying on recruitment to a fish stock must be regarded as negligible.

Fish Mortality Assessment: Unmitigated Impact is deemed to be Minor;

Mitigated Impact is deemed to be Minor

Fish Larvae and Eggs Assessment: Unmitigated Impact is deemed to be Minor;

Mitigated Impact is deemed to be Minor

5.4.3 Commercial Fish Resources

As discussed above, the proposed survey has the potential to affect marine fish. It is apparent from the available studies that fish responses to seismic sources are species specific and may differ according to the species' life stage. Immediate mortality and physiological damage to eggs, larvae, fry and adult and juvenile marine fishes is unlikely to occur, unless the fish are present within 5 m of the sound source (although mortality is far more likely to occur within 1 m). Behavioural changes resulting from increased noise levels may include disoriented swimming behaviour; displacement to areas outside of the noise disturbance; interruption of important biological behaviours (e.g., feeding, mating); shifts in vertical distribution and occurrence of alarm and startle responses. Some fish may be displaced from suitable habitat for hours to weeks, depending on the intensity and duration of the seismic survey work.

The potential zone of ensonification that could potentially elicit a response from fish (i.e. displacement as a result of behavioural change) is likely to be localised and focused around the airgun array during firing. Thus, a large area of coastal/offshore waters would remain unaffected (with regard to enhanced noise levels) or noise disturbance would be at levels below which a response from fish would be unlikely to occur. Significant areas of coastal waters would therefore not be disturbed during seismic firing to the extent that the migratory behaviour of salmonid fish would be disrupted. Potential migratory routes for salmon to coastal lagoons and river mouths would remain open and the available resource would not be diminished as a result of the survey.

Available science and management literature demonstrates that, at present, there are no empirical data to demonstrate potential impacts to fish that reach a population-level effect and the information that does exist indicates that seismic surveys would be highly unlikely to result in significant impacts to marine fish or related issues (e.g. impacts to migration/spawning, rare species, fishing). Therefore, it is considered that although the seismic survey may have very localised and adverse impacts on fish in the immediate vicinity of the airgun array, the effect on the resource available to commercial fisheries would be negligible and any effect would be of a short-term nature. This conclusion is particularly relevant to the potential displacement of fish during migration through or adjacent to the survey area and their continued availability with regard to fisheries.

In addition to the effects of increased noise levels, other potential impacts on fish may be caused by anchor or cable deployment and the accidental spillage of fuel/oil from vessels.
A coarse filtration system will be fitted to the seismic survey vessel, which will prevent the entrainment of fish into the seawater intakes. As a result of this measure, although there may still be some entrainment of small, pelagic fish via the seawater uptake, the effects of this on available resources will be negligible.

5.4.4 Fishing Practices

As described below, the proposed survey area lies within offshore waters that, according to the Fishery Agency, do not support occasional commercial fishing activity. The majority of fisheries conducted in the Piltun-Astokh area are of a subsistence nature and are conducted close to shore.

The seismic survey has the potential to interfere with fishing activities and damage fishing equipment (e.g. nets, lines, fixed gear) in the area. Damage to fishing equipment is a concern from both a safety perspective (i.e. potential risk to personnel on the fishing vessel and the survey vessels) and in terms of adverse reactions/complaints and subsequent compensation claims from fishermen whose equipment has been damaged (i.e. loss of equipment and temporary loss of earnings/livelihood). Damage to the streamers from fishing gear, the loss of streamer fluid (if used) and resulting impact on marine biota is also a concern (see below on accidental spills and leaks). Given the absence of commercial fishing in the areas, it is considered that the likelihood of significant interaction with fisherman is minor and the unmitigated risk is considered negligible.

To avoid any potential conflicts, notifications will be issued prior to the start of the survey to alert any fishermen who may be planning to operate in the vicinity to avoid the survey area during the period of operations. The duration of the survey (approximately three to four weeks) and the limited area coverage indicate that the potential effect on any fishing activity will be short term and also limited to a relatively small part of the total near shore fishing area available to local fisherman.
During the survey, the scout vessel will be used to warn fishing vessels in the area of the ongoing activity and to remove any fixed fishing gear that may potentially become damaged or cause damage to the survey equipment. It is expected that compensation claims and conflicts with fishing activities will be resolved by the survey contractor in line with requirements of the Sakhalin Oblast Administration.

Provided these measures are implemented, the likely impact on both the ability of fishermen to realise potential quotas (i.e. maintain fishing effort) and the integrity of their fishing equipment (if present in the survey area) is considered to be of minor significance.

Short note on potential risk from fishing operations:
An incident occurred involving the appearance of two fishing nets in July 2013 close to Piltun. The nets each stretched out from the coast for approximately 1.5km. During observational visits to the nets, several gray whales were seen within 100m of the nets, including mother and calf pairs.

5.4.5 Fishes

The most important subsistence fishery is for salmon, with the majority of the fishing in north-east Sakhalin being undertaken to coincide with the migration of pink and chum salmon during the summer-autumn months.

In the north-east of Sakhalin the peak migratory period for pink salmon and therefore the peak of fishing effort in the north-east generally occurs from the end of July to end-August and ends at the middle of September, although some fish may start arriving in offshore waters at the beginning of July (SakhNiro 1998). For chum salmon, there are two migratory movements of fish during the year (summer and autumn). The summer run, which takes place in July, is the minor of the two runs in the north-east with fish being much more abundant during the autumn run. Peak migration activity during the autumn occurs from mid-September to early October, with the beginning of the run occurring in mid-August in the majority of years (SakhNiro 1998
The seismic survey work is proposed to take place during late June into July, over a three or four week period. It thus would occur outside of the main migratory period for pink salmon and would avoid the main autumn, chum salmon run. Potentially, there could be some overlap with the summer chum salmon run and the early part of the pink salmon run. However, it is considered that from a resource perspective that the timing of the survey would, if any disturbance were to occur, leave the majority of the resource and potential fishing effort (i.e. undertaken during the main runs) unaffected. It is also important to note that disturbance to migratory populations of salmon would be highly unlikely to occur during the seismic survey. On this basis, it is considered that given the location and timing of the seismic survey work, that the potential for disruption to migratory salmon populations and the resource available to local people in the north-east of the island is negligible. If the survey were to be delayed until later in the summer, the potential exists for an increased risk of disturbance to migratory fish populations, although as stated previously it is considered that any such effect is unlikely. In this situation, while the level of risk of disturbance may be slightly raised, it would be highly unlikely to be of such extent that local fisherman were not able to realise their subsistence quotas.

Assessment: Unmitigated Impact is deemed to be Minor;

Mitigated Impact is deemed to be Negligible

5.4.6 The Local Social Environment and Economy

The seismic survey vessel is expected to depart from its home-port in May 2015 and will travel to the Astokh Field fully supplied to conduct the survey. Contact with local communities is therefore very unlikely, except in the event of an accident or emergency when the vessel may be forced to visit port (likely to be in the south of the island) or personnel are airlifted to suitable facilities on the island for treatment.

The seismic-survey activities are mostly vessel based, therefore stresses to local community infrastructure, health care, and emergency response systems are expected to be negligible; consequently, social systems in these communities would experience no direct disturbance from the staging of people and equipment for the proposed survey. As discussed above, it is also anticipated that there would be a negligible impact on natural resources (i.e. regularly hunted animal species) that local people may target.

5.4.7 Statutory Public Hearings and Community Consultations

From 21st to 23rd January 2015, Sakhalin Energy held consultations regarding the seismic survey in the nearest settlements and distributed questionnaires. The consultations covered 4 communities, with public meetings in Val, Nogliki and Nekrasovka with involvement of the community in general and Indigenous Peoples specially. The questionnaires were collected in Okha. The responses from the communities were typical: what is the likely impact on the salmon and what is the possibility of employment of the Indigenous People's representatives as observers? The company responded that the potential impact on fish was calculated and submitted as part of the project documentation to the Fishing Agency (Rosrybolovstvo). The Fishing Agency had pointed out in December 2014 that Lunskoye and Piltun-Astokh licenced plots do not include fishing areas. As for the opportunities for employment, the Company's response was that it is a very short-term project, the observers are trained specialists and that the vessels will arrive fully crewed. The observers will be stationed on each vessel and others will be positioned along the coast.

There are no records of any diving or recreational activities in the vicinity of the Piltun-Astokh area. As a precautionary measure, warnings of the proposed activities will be issued to relevant parties (Notice to Mariners) and a vigilant watch will be maintained throughout survey activities in case such activities are occurring in the area.

No impacts (either adverse or beneficial) on local communities, amenities, the local economy, recreational activities and tourism are therefore predicted.

5.4.8 Marine Traffic

Due to the meteorological conditions in the region, the majority of ports are located towards the south of Sakhalin Island where they remain free of sea ice for most of the year. For this reason, there are no merchant shipping routes in the vicinity of the Piltun-Astokh area. Levels of marine traffic in these areas are therefore expected be very low, consisting mainly of local fishing boats and some oil field related traffic. Potential impacts from interactions between the seismic survey vessels and equipment and other marine traffic include:

- Damage to vessels and potential harm to crew
- Pollution from fuel, streamer oil or cargo spillage

All vessels involved in the survey work will adopt standard warning and navigation equipment and procedures in order to reduce the risk of collisions with any other vessels that may be present in the area. These will include the use of radar, foghorns, and issuing a Notice to Mariners to warn that the survey is taking place and conveying the limited manoeuvrability of the survey vessel. The scout and guard vessels will also be available to warn marine traffic to keep clear of the seismic survey vessel and associated equipment. Collision risks with other vessels during transit to and from the survey also exist. Although these risks will be controlled by the adoption of standard navigation procedures the unmitigated risk of collisions is considered moderate and the Residual Impact considered Minor.

5.4.9 Potential Threat from other mitigated and non-mitigated industrial activities

An additional potential risk has been described recently. In the summer of 2014, a large tourist ship (91m long) anchored one kilometre off the Sakhalin coast near the entrance to Piltun Lagoon. Subsequently, it launched eight or nine inflatable boats to allow clients to have close encounters with the gray whales. These motored amongst the foraging whales for some time before returning to the cruise ship. No standard protocols appeared to have been applied to prevent or minimise disturbance to the whales from close approaches. The Russian Authorities, IUCN and the WGWAP were informed.

As part of a terrestrial project nearby and to facilitate the movement of very heavy loads, ENL plan to create a pier facility at the entrance to Piltun lagoon in 2016. Activities associated with the construction are likely to commence in spring of 2016 and will involve pile driving and sand banking to create the facility.

5.5 SE1

5.5.1 Entanglement

Entanglements occur when marine mammals become caught in cables, lines, nets, or other objects suspended in the water column. During seismic operations, numerous cables, lines, and other objects primarily associated with the airgun array and hydrophone streamers will be towed behind the survey ship near the water's surface. Incidents of entanglement by mysticetes in fishing gear are well known. Heyning and Lewis (1990) noted that gray whales were the most frequently entangled species (94% of records) in Southern California. Most of the entangled gray whales were 3 years of age or younger (<10 m in length), and many of the live entanglements were released alive. However, it is unknown whether entanglement has any long-term effects on live-released whales (Moore and Clarke 2002).

Unfortunately, actual harm and death of gray whales has occurred in recent years in the north eastern Pacific from industrial activity. Two adult gray whales and one gray whale calf have been found entangled in fishing gear in Japan and China. In 2013, observations, recorded by Sakhalin Energy personnel, at salmon nets off Piltun have revealed just how risky it can be for mothers and calves, in particular, to forage amongst fishing gear (For details, see 5.4.4 Fishing Practices Special Note, above). Recent information supplied to the WGWAP suggests that there could be seven nets installed at this location in the summer of 2015.

Visual observations during the proposed survey will monitor the towed array and other equipment. Cetaceans would be expected to avoid the seismic vessel, further lessening the likelihood of any impacts related to entanglement. Onshore observers can monitor for the installation of salmon nets, alerting the authorities if these activities take place.

Incidents involving entanglement of pinnipeds in fishing gear and other marine debris are also well known (Arnould and Croxall 1995; Hanni and Pyle 2002; Page *et al.* 2004). Northern fur seals have been particularly susceptible to entanglement. In some years over 50,000 fur seals in Alaskan waters were dying from entanglement in fishing nets and strapping bands (NRC 1995). So great was the mortality of northern fur seals, that their population was deemed directly threatened by entanglement. Visual observation of the area surrounding the seismic vessel during the survey will ensure that any close approaches to the equipment by pinnipeds are monitored and the appropriate action taken to ensure that entanglements do not occur.
The Unmitigated Impact is deemed minor and the Residual Impact is deemed Negligible.

5.6 SS1

5.6.1 Ship Strikes

Studies indicate that vessel traffic may have negative impacts on marine mammals, particularly baleen whales, through collisions (e.g., Moore and Clarke 2002; Jensen and Silber 2003). Efforts are usually made by vessel operators to avoid marine mammals; in addition to injury or death of the animal, such collisions can result in damage to the vessel. Many species of baleen whales tend to show avoidance in response to vessels (reviewed in Richardson *et al.* 1995; Macleod *et al.* 2006). However, avoidance does not always prevent collisions, injury, and mortality of whales, especially for the slower-swimming species such as right whales (reviewed in Richardson *et al.* 1995; Jensen and Silber 2003).

Collisions between ships and marine mammals occur in many parts of the world and has been summarized by Laist *et al.* (2001) and Jensen and Silber (2003). These datasets indicate that migrating gray whales appear more susceptible to collisions compared to other whale species (Laist *et al.* 2001). In the North Atlantic, endangered right whales are also known to be highly susceptible to vessel collisions, experiencing significant mortality and damage from collisions (Richardson *et al.* 1995; Laist *et al.* 2001; Jensen and Silber 2003). Shipping has been restricted in some areas of the Northwest Atlantic, such as the Bay of Fundy, during times when right whales congregate there. Off the east coast of the U.S., NMFS has recommended vessel routes and vessel speed reductions to reduce the number of collisions. Collisions have also been reported for other species of mysticetes, including humpback, fin, and minke whales (Barlow *et al.* 1994; Richardson *et al.* 1995; Laist *et al*. 2001; Jensen and Silber 2003). Although most whales try to avoid ships, collisions often occur when a whale attempts to flee ahead of the vessel (Richardson *et al.* 1995). Whales to the side or beneath the vessel can also be dragged into the vessel's propeller by the low pressure wave around the vessel (Knowlton *et al*. 1998). The likelihood of collisions increases during darkness and poor weather conditions, particularly fog, thunderstorms, and high seas. Particular care is needed to minimize the chance of collisions during poor visibility. It is unknown whether whales are always killed by such impacts. It also appears likely that most impacts are not reported. For example, large vessels may be unaware that an impact has occurred. Often, impacts are only realized after-the-fact if the whale remains caught on the front of the ship when the vessel enters port. Pinnipeds can probably move quickly enough to avoid collisions with ships. However, when feeding, pinnipeds may be inattentive to vessels. Fur seals are attracted to fishing vessels to feed and some are killed by the propellers (Richardson *et al.* 1995). Sea lions and seals have been seen with wounds and disfigurements caused by the propellers of powerboats. Between 1996 and 2000, two northern elephant seals were struck and killed due to ship strikes off California (Monterey Bay National Marine Sanctuary 2006).

Evidence suggests that a greater rate of mortality and serious injury correlates with a greater vessel speed at the time of a ship strike (Laist *et al.* 2001; Vanderlaan and Taggart 2007). Most lethal and severe injuries to large whales resulting from documented ship strikes have occurred when vessels were travelling at 14 knots or greater (Laist *et al.* 2001). Vanderlaan and Taggart (2007), using a logistic regression modelling approach based upon vessel strike records, found that for vessel speeds greater than 15 knots, the probability that a collision will result in a lethal injury (mortality or severely injured) approaches 1. The probability that a collision will result in lethal injury declined to approximately 20 % at speeds of 8.6 knots and to less than 5 % at of 4 knots (Vanderlaan and Taggart 2007). Considering the reduced speed at which seismic survey vessels travel during periods of active seismic surveying (typically

4.5 to 5 knots) plus the extra noise that they emit relative to routine vessel traffic, the risk of lethal injury from a vessel strike, would be limited.

A modelling exercise undertaken to assess the monthly risk of collisions along typical Sakhalin Energy vessel routes (e.g. Korsakov to PA-A, Kaigon to PA-A, PA-A to PA-B) suggested a low number of expected monthly ship/whale encounters with Sakhalin Energy vessels in Sakhalin Island waters per route, with a range of 0.00 to 0.10 expected encounters during the June-July time period and a range of 0.00 to 0.20 expected encounters during the August-September time period (Muir *et al.* 2006). To translate expected encounters into expected ship strikes, it is necessary to adjust for evasive action taken by whales and/or vessels prior to a possible encounter. While the model allowed the avoidance and observer variables to be adjusted, these could only be tested as a sensitivity analysis because data were not available to estimate these parameters. There have been no ship strikes associated with industrial activity in north-east Sakhalin Island. Mitigation measures implemented by Sakhalin Energy (Sakhalin Energy 2007) and detailed in Sakhalin Energy's Marine Mammal Protection Plan appear to have been effective at minimizing the risk. The model does suggest that the risk of ship strikes could increase during periods of low visibility or high sea state and thus additional, enhanced, mitigation measures may be warranted during certain conditions (see Marine Mammal Plan, Appendix VI, for more information on mitigation measures for the proposed survey).

The risk of collision with marine mammals exists but is extremely unlikely due to the slow operating speed of the seismic vessel. The presence of on-board observers substantially minimizes the risk of ship strikes. The Unmitigated Impact is considered Minor and the Mitigated Impact is considered Negligible.

5.7 EM1

5.7.1 Effluent Discharge, Emissions and Waste Disposal

Effluent discharges, emissions and disposal of wastes from vessels engaged in survey activities have a range of potential environmental consequences. Potential discharges and impacts include:

- Oil contaminated drainage and sanitary effluent discharges may effect water quality resulting in direct and/or indirect adverse effects on marine organisms;
- Chlorine in discharges from sewage treatment or water generator systems may cause harm to marine organisms;
- Toxic effects on marine organisms in the event of an accidental release of solid or scheduled wastes into the marine environment;
- Physical damage to marine organisms and impacts on water quality and the coastal environment as a result of inappropriate waste management and disposal methods; and
- Short-term localised increases in downwind pollutant concentrations and reductions in local air quality.

5.7.2 Drainage System Discharges

Drainage effluents such as rainwater and sea spray runoff from uncontaminated deck areas will have no effect on the water quality and ecology of the receiving waters. Drainage from cable handling areas, machinery spaces, bilges etc. may be contaminated with oil (e.g. diesel, cable oil, lubrication oil). These drainage fluids will be processed through an oil/water separator prior to discharge in compliance with MARPOL Annex I requirements (maximum discharge concentration of 15 parts per million (ppm)). After processing, the residual hydrocarbons in the effluent discharge will be diluted and disperse rapidly in the receiving waters so that any reduction in water quality will be localised and temporary. The potential effects of discharge of drainage system waters on marine biota are therefore considered to be negligible.

5.7.3 Sanitary Effluent

Sewage generated onboard the survey vessels is expected to be treated using aerobic methods, settlement, and the neutralisation of pathogens, prior to discharge. Discharged sanitary effluent is predicted to exert a negligible biological oxygen demand on the receiving waters. Because of natural dispersion by wave action, current flow and the assimilative capacity of the water column, these localised and temporary increases in organic material are expected to have a minor impact, providing that all the material discharged is biodegradable. All solid wastes will be transported to shore for waste disposal and no solid waste will be permitted to be disposed overboard by any vessels. There will therefore be no impact on marine water quality from these sources.

5.7.4 Chlorinated Water Discharges

Discharges from vessel service water systems and sewage treatments may contain residual concentrations of chlorine. Typical concentrations are estimated to be approximately 1.0 ppm. Chlorine is harmful to aquatic life even at low concentrations, with toxic thresholds for fish species being in the range of 0.1 to 0.4 ppm (International Hydrological Programme 1979). Following discharge to marine waters, a combination of dilution and dispersion effects will rapidly reduce chlorine concentrations to below potentially harmful levels. Impacts on marine organisms as a result of residual chlorine in effluent discharges are therefore considered to be localised, short term (i.e. will only occur for the duration of the survey works) and of negligible significance with respect to marine ecology.

5.7.5 Cooling Water Discharge

Heated engine cooling water from the survey vessels will be discharged to the marine environment, usually after a once-through pass, forming a plume of water with a temperature significantly greater than the ambient water temperature. This heated water will rapidly lose thermal energy to the surrounding water column, reducing the plume temperature, and ensuring that a significant thermal plume cannot form. No impacts are predicted to occur as a result of this discharge.

The intake of seawater for cooling purposes and service water use (e.g. potable water production and deck wash down) has the potential to damage and entrain marine biota in the uplift stream. Weakly swimming or free floating planktonic populations are likely to be affected by the intake, experiencing mortality and injury as a result of mechanical and thermal effects. It is considered that the level of mortality likely to occur would not constitute a significant effect with regard to populations of planktonic and nektonic organisms within the water column. This is largely due to the generally ubiquitous nature and abundance of planktonic organisms in offshore waters, the high level of natural mortality in planktonic populations and the highly localised nature of any impact (i.e. confined to the volume of water in the immediate vicinity of the intake). The overall impact of this effect during the survey is therefore considered to be negligible.

5.7.6 Solid and Scheduled Wastes

Scheduled wastes such as lubrication oil and oily slops generated on the survey vessels will be returned onshore and disposed of at an appropriate facility when the vessels return to port. The handling, management and disposal of these wastes will be conducted in accordance with appropriate legislative requirements and Sakhalin Energy procedures where relevant. Hazardous materials (e.g. lithium batteries) will be stored onboard and returned to the supplier.

There have been numerous reports of marine life ingesting disposed wastes. It is believed that floating debris is mistaken for food or accidentally ingested as the animals feed on their prey. Pinnipeds, toothed whales, and baleen whales are all known to have ingested plastic products. Foreign objects can obstruct the gastrointestinal tract and cause gastric inflammation, nausea and loss of appetite, which may result in starvation and death. Gray whales found dead in California have been found with plastic bags and plastic sheeting in their stomachs (California Coastal Commission 2002). Walker and Coe (1990) have commented that bottom-feeding cetaceans are at risk from ingesting non-buoyant debris. Uncontrolled disposal of solid and schedules wastes could damage sea mammals and other marine organisms and potential impacts, in this respect could be moderate unless suitable actions are taken to prevent such disposal to marine waters occurring.

The seismic survey vessel is likely to have onboard facilities for the compaction and incineration of solid wastes (including food wastes). Non-combustible wastes and incineration residues will be stored onboard and returned to port for disposal. The waste management procedures in place onboard the survey vessels will be designed to ensure that there will be no fouling or contamination of the marine environment as a result of solid and scheduled wastes generated during survey operations. As long as these procedures are fully implemented there should be no impact from the generation of on board waste.

5.7.7 Air Quality

The principal emission sources from the survey operations will be exhaust gases from vessel propulsion systems and incinerators, power generation equipment, and from the incineration of solid wastes. The primary emissions from these sources will include carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_X), hydrocarbons, sulphur dioxide (SO_2) and particulates. Ozone depleting substances are not expected to be used onboard the vessels, but may be used as refrigerants in older vessels where closed recovery systems are in place. No release of ozone depleting substances is therefore anticipated during survey operations.

Emissions from the vessel propulsion and power generation systems together with intermittent releases from the onboard solid waste incinerator will result in slight increases in downwind pollutant concentrations. Exceedance of ambient air quality criteria is not expected to occur, and given the transient nature of the survey operations, the volatility of the air emissions and the generally high winds, emissions would be expected to undergo rapid dispersion resulting in only localised, very short term and therefore minor impacts upon air quality.

Under Sakhalin Energy's Marine Operating Procedures, it is expected that Masters of the survey vessels will report the fuel consumption of their vessels and the sulphur content of the fuel used.

5.8 AS1

Accidental Spills, Leaks and Dropped Objects

5.8.1 Release of Harmful Substances

During seismic survey work there are a number of routes via which potentially polluting releases of hydrocarbons, contaminants or other substances to the marine environment could occur. These uncontrolled events or incidents effectively represent acute hazards that may affect marine water quality and biota in a number of ways. Typically though, such incidents involve the accidental discharge of materials (e.g. oily wastes) that locally may adversely affect environmental conditions, generally over short periods of time. The level of significance depends to a great degree on the scale of the release and also the nature of the substance that is released. Accidental spills and leaks may arise for a variety of reasons including vessel collision (with other vessels, equipment or natural features), poor management of equipment or processes, and natural events. The vast majority of potential accidents, and therefore environmental impacts, can be prevented through the adoption and implementation of appropriate HSE procedures and measures onboard survey vessels during survey operation. The following sections provide an assessment of the potential impacts associated with the most likely sources of spills and leakages.

5.8.2 Streamer Fluid Release

Damage to one or more of the streamers deployed during the seismic survey may release streamer fluid (this is typically a kerosene-like fluid which predominantly consists of C12-C15 isoparaffinic hydrocarbons) into the marine environment. The risk of damage to streamers depends on the hazards in the area (e.g. fishing equipment, submerged wrecks), the weather conditions and the operational procedures. Previous seismic survey work indicates that on average damage to one segment of each streamer occurs every three to six months (Sakhalin Energy 2003). Older streamer cables may contain 100-200 litres of streamer fluid to provide buoyancy, with individual sections containing approximately 20 litres of fluid. Breaks in cables are rare and typically only occur when currents whip cables around a structure such as an oil platform. Damage may result in the rupture of individual sections of the streamer, leading to the release of small amounts of fluid (20 litres or more depending on the number of sections damaged). In practice, the full volume of fluid within a segment is rarely lost. For the Astokh survey the survey vessel will deploy streamers for a period of three to four weeks and, therefore based on experience from other surveys, it can be expected that damage to at least one streamer section may occur.

In the event of damage to or loss of a streamer, potential environmental effects will be limited to:

- Localised reduction in water quality due to fluid release as a result of rupture. On release of the fluid into the marine environment it would be expected to have a short residence time owing to its light and volatile nature and biodegrade relatively rapidly. Although the liquid may evaporate within a few hours under moderately warm conditions, residence times would be greater in the colder conditions experienced in the Sea of Okhotsk.
- Physical impacts on benthic communities arising from the cable and associated equipment sinking to the seafloor. Streamers have automatic flotation devices that

activate at a depth of approximately 50 m, it is therefore unlikely that any physical impacts would occur.

- Potential chemical/biological impacts on demersal and pelagic communities arising from slow leakage of streamer fluid, as individual sections of the cable are punctured. Ecotoxicological studies on fish (freshwater) indicate that kerosene-like fluids have an observable adverse effect at concentrations >5 mg/l, although low-level mortality does not tend to occur until concentrations exceed 10 mg/l (American Petroleum Institute 2003). Such concentrations are highly unlikely to be exceeded as a result of damage, except in the immediate vicinity of the streamer section, as any fluid would be rapidly diluted upon immediate release. Pelagic, free swimming organisms would also be able to actively avoid any contaminated waters and/or pass through such areas rapidly, without the potential for suffering any acute effects.

Because of the nature of the streamer fluid, expected weather and sea-state conditions, and the relatively small volumes likely to be released, spillages of streamer fluid are likely to disperse and weather rapidly. As a result, it is considered that there will be minimal opportunity for any adverse effects on water quality or biota in the survey area. Significant smothering, spreading and fouling effects would not be predicted to occur from the release of streamer fluid due to its volatility. The risk associated with small releases of harmful substances is therefore considered minor.

5.8.3 Bunker fuel, Diesel, Lube Oil and Oily Sludge Release

It is estimated that approximately 1.25 million tonnes of oil enter the sea each year, due to sea-based activities. There are many sources of oil in the sea, the most visible being large slicks from damaged tankers. Operational discharges from ships make up 45% of the input of 457,000 tonnes/yr., followed by shipping accidents at 36% of the input. Fuel oil sludge from vessels is the major routine operational input (~186,000 tonnes/yr.), or 68% of ship operational inputs. Oil tankers, which are often identified as being major routine polluters, account for 4.2% (~4%) of ship inputs as oil in ballast waters, an operational input. However, tanker and barge accidents are a major input (158,000 tonnes/yr.), even with the decline in large spills from tankers in recent years.

Discharge of oily wastes into the marine environment due to minor accidents (e.g. failure of spill containment systems, separation of fuel hoses during bunkering operations) or discharge of bilge water prior to treatment have an impact on water quality and marine ecology. The impact depends on the type of oil released, the volume of oil, the location of the spill and the prevailing weather and tidal conditions. Larger releases of bunker fuel, diesel or kerosene as a result of vessel grounding, collision or other major accident may have the potential for significant impact, particularly on marine life and, depending on the prevailing weather and coastal conditions, have the potential for affecting nearby coastal areas.

As soon as oil is spilled, it starts to spread out over the sea surface, initially as a single slick. The speed at which this takes place depends to a great extent upon the viscosity of the oil. Fluid, low viscosity oils spread more quickly than those with a high viscosity, although generally slicks quickly spread to cover extensive areas of the sea surface. Spreading is rarely uniform and large variations in the thickness of the oil are typical. Slicks tend to break up quite rapidly as a result of wind and wave action and water turbulence and the rate of spreading is also determined by the prevailing conditions such as temperature, water currents, tidal streams and wind speeds. The more severe the conditions, the more rapid the spreading and breaking up of the oil. Lighter components of the oil evaporate to the atmosphere. The amount of evaporation and the speed at which it occurs depend upon the volatility of the oil. Evaporation can increase as the oil spreads, due to the increased surface area of the slick. Rougher seas, high wind speeds and high temperatures also tend to increase the rate of evaporation and the proportion of oil lost by this process. Waves and turbulence at the sea surface can cause all or part of a slick to break up into fragments and droplets of varying sizes. These become mixed into the upper levels of the water column. Some of the smaller droplets remain suspended in the sea water while the larger ones tend to rise back to the surface, where they may either coalesce with other droplets to reform a slick or spread out to form a very thin film. Oil that remains suspended in the water has a greater surface area than before dispersion occurred. This encourages other natural processes such as dissolution, biodegradation and sedimentation to occur.

Light refined products, such as diesel, No. 2 fuel oil, and kerosene, are narrow-cut fractions that have low viscosity and spread rapidly into thin sheens when in contact with water. They do not tend to form emulsions except under very cold conditions. Evaporation may be relatively rapid and up to 70-100% of volume may be lost within a few days. As low-viscosity, moderately persistent oils, light distillates tend to disperse readily into the water column by even gentle wave action. Thus, they have the highest potential if any oil type for vertical mixing. There is also a greater potential for dissolution to occur, from both surface sheens and droplets dispersed in the water column. The water- soluble fractions are dominated by two- and three-ringed polycyclic aromatic hydrocarbons (PAHs) that are moderately volatile and may, in higher concentrations, affect aquatic biology. Thus, spills of fuel oil and diesel have the greatest risk of impacting water-column resources. These products are not very adhesive; therefore, they do not adhere strongly to sediments or shoreline habitats. Loading levels on the shoreline are relatively low because of the thinness of sheens on the water surface and the low adhesion of stranded oil. The constituents of these oils are light to intermediate in molecular weight and can be readily degraded by aerobic microbial oxidation. Long-term persistence in sediments is greatest under heavy loading and reducing conditions where biodegradation rates for anaerobic bacteria are low.

Heavier oil types that could be accidentally released, such as No. 6 fuel oil, bunker oil, and heavy sludge oils (heavy fuel oils typically contain between 1 percent and 5 percent sludge or waste oil, which cannot be burned as fuel) lose only up to 10% of their volume via evaporation. Some of these products are so viscous that they cannot form emulsions, but many emulsify shortly after release. They show low natural dispersion because the oil is too viscous to break into droplets. These oils have the lowest water-soluble fraction; thus, loadings to the water column are generally low under slicks. Spills of heavy distillate quickly break up into thick streamers and then fields of tarballs that are highly persistent. The weathered products of these oil spills can be transported hundreds of miles, eventually stranding on shorelines, where, depending on volume and extent, may pose significant impacts to birds and other marine animals. Because of their high density, these releases are more likely to sink after picking up sediment, either by mixing with sand in the surf zone or after stranding on sandy shorelines.

5.8.4 Potential Effects of Oil Spills

The effects of petroleum hydrocarbons in the marine environment can be either acute or chronic. Acute toxicity is defined as the immediate short-term effect of a single exposure to a toxicant. Chronic toxicity is defined as either the effects of long-term and continuous exposure to a toxicant or the long-term sublethal effects of acute exposure. Oil spills in marine waters can lead to direct mortality of marine organisms, reduce their fitness through sublethal effects, and disrupt the structure and function of marine communities and ecosystems. Such effects have been well established in laboratory studies, but determining the subtler long-term effects on populations, communities and ecosystems at low doses and in the presence of other contaminants is difficult and poses a significant scientific challenge.

The most toxic components in oil tend to be those lost rapidly through evaporation when oil is spilt. Because of this, lethal concentrations of toxic components leading to large-scale mortalities of marine life are relatively rare, localised and short-lived. Sub-lethal effects that impair the ability of individual marine organisms to reproduce, grow, feed or perform other functions can be caused by prolonged exposure to a concentration of oil or oil components far lower than will cause death. Sedentary animals in shallow waters such as oysters, mussels and clams that routinely filter large volumes of seawater to extract food are especially likely to accumulate oil components. It should be noted that there is no clear relationship between the amount of oil in the marine environment and the likely impact on wildlife. A smaller spill at a particularly sensitive time/season and in a vulnerable environment may prove much more harmful than a larger spill at another time of the year in another or even the same environment.

In relation to the identified marine ecological interests in the near shore Piltun area, it is apparent that the main groups of organisms that are of interest in relation to potential oil spills are fish, marine birds and marine mammals. The following text provides a brief summary of the effects of oil spills and contamination of marine waters on these groups. Throughout, the description of potential effects is biased towards the assumption that any spills are likely to be small, the oil involved is likely to be relatively volatile and the effects will be short term.

In open waters, fish have the ability to move away from an area of pollution, and are therefore either unaffected by oil or affected only briefly. There is no definitive evidence to suggest that fish are affected by oil in the open sea (White and Baker 1998). However, fish can be substantially affected in some circumstances, especially when oil spills into shallow or confined waters. As the oil begins to weather it enters the water column and fish become directly exposed. Fish kills may occur as a result of high exposure to emulsified oil in shallow waters and gross oil pollution may clog fish gills causing asphyxiation.

Species at particular risk include bottom-dwelling fish such as flounders that are exposed to sediments that quickly become contaminated with sunken oil. Fish can accumulate hydrocarbons in tissues or body fluids through exposure from contaminated sediment, water or food. The bioavailability of hydrocarbons from sediments and food is less than that from solution in water. If there is widespread dispersal of oil in the water column it may be taken up through their gills or eaten resulting in an accumulation in the stomach, gall bladder and liver. In commercial species this may lead to the flesh having a tainted flavour making it inedible (Clark 1997). Although some hydrocarbons may persist in the body for some time, most are rapidly lost when the fish are no longer exposed to the pollution.

Oil poses a much greater threat to fish eggs and larvae that cannot actively avoid or escape a pollution event. As fish eggs and larvae are mostly planktonic they can be affected by all early stages of a spill and many clean-up techniques (IPIECA 2000). These life stages are extremely vulnerable to the toxicity of both oil and chemical dispersants and heavy mortalities often result. Even low concentrations of hydrocarbons can have marked effects on the proportions of eggs that hatch and on the growth rates and development of larvae. Lethal effects on the population as a whole are rare but long term, sub-lethal effects are possible, particularly if a major spawning area is affected.

An oil spill can have varying effects on fish populations partly depending on the nature and state of the oil. Light oils such can lead to extensive fish kills in enclosed waters. This is because they are rapidly dispersed into the water column and the fish become exposed to the toxins contained in these oils. Heavy oils are less toxic, and their dispersion into the water column is more gradual causing less dramatic effects. In the open ocean, the concentration of oil below the slick is low, ranging from a few parts per million (ppm) to less than 0.1 ppm (IPIECA 2000).

Marine birds and mammals can be affected by oil in the sea through several pathways. As air-breathing organisms that obtain much or all of their food from beneath the surface of the sea, marine birds and mammals must frequently pass through the water's surface. Fouling by oil may affect the insulating characteristics of feathers and fur and lead to death from hypothermia.

Most marine mammals are not very susceptible to the effects of oil and hydrocarbon-based fuels. Whales exposed to oil are generally not at risk because they rely on a layer of blubber for insulation, and oiling of the external surface does not appear to have any adverse thermoregulatory effects (Geraci 1990; St. Aubin 1990). Preliminary laboratory tests show that eastern gray whale baleen, and possibly skin, may be somewhat resistant to damage from short-term exposure to oil (Geraci and St. Aubin 1985; Geraci 1990). However, Hansen (1985) points out that oil or clean up dispersants could have indirect negative effects on gray whales by killing or contaminating their benthic food supply.

Whales could ingest oil with contaminated water or food, or it could be absorbed through the respiratory tract. If oil is ingested, it can be voided in vomit or faeces, but some is absorbed and could cause toxic effects (Geraci 1990). However, whales exposed to an oil spill are unlikely to ingest enough oil to cause serious internal damage. Crude oil could coat the baleen and reduce filtration efficiency; however, effects may be reversible within a few days (see Geraci 1990 for a review). Effects of oiling of the baleen on feeding efficiency appear to be only minor (Geraci 1990).

Seabirds and pinnipeds may be poisoned when they ingest oil during the course of trying to remove it from their feathers or pelage, or when it adheres to food items. Likewise, marine mammals (and possibly seabirds) may inhale toxic doses of petroleum vapor when at the surface in the vicinity of an oil spill (Geraci 1990; Geraci and Williams 1990), although there appear to be few data indicating that this is an important source of mortality. In some cases, these upper trophic level predators may become exposed to oil by ingesting prey that have oil or its metabolites in their tissues. Seabirds can transfer oil from their feathers to the surface of their eggs during incubation. Depending on the type of oil on the feathers and the presence of toxic components, embryos in the affected eggs may fail to develop. Oil can also indirectly affect the survival or reproductive success of marine birds and mammals by affecting the distribution, abundance or availability of prey (NRC 2003).

In seabirds, ingestion of oil or oil-contaminated prey may lead to immuno-suppression haemolytic anaemia which compromises the ability of the blood to carry oxygen. This effect persists long after the birds appear to have recovered from exposure (Fry and Addiego 1987). Large spills that occur over the deeper ocean in open water that has little bird life will have a lesser effect on seabirds than a small spill in a critical habitat where high numbers of birds are aggregated on the water. The season in which a spill occurs is also critical (Hunt 1987). If the spill occurs when birds are aggregated during breeding or migration, the impact will be much greater than if they are widely dispersed at sea.

In addition to the significant evidence for the impact of massive contamination associated with an oil spill, there is increasing evidence that chronic, low-level exposures to hydrocarbons can have a significant effect on the survival and reproductive performance of seabirds and some marine mammals. Sublethal effects of oil on seabirds include reduced reproductive success, and physiological impairment, including increased vulnerability to stress (reviewed in Fry and Addiego 1987; Briggs *et al.* 1996). In contrast, in marine mammals, sublethal exposure to petroleum hydrocarbons has been shown to cause minimal damage to pinnipeds and cetaceans (e.g., Geraci 1990; St. Aubin 1990), although sea otters appear to be more sensitive (Geraci and Williams 1990). Because both marine birds and marine mammals have the enzymes necessary for the detoxification and elimination of petroleum hydrocarbons, parent compounds of petroleum hydrocarbons are not accumulated and sequestered in tissues as chlorinated hydrocarbons. Toxic metabolites produced by metabolism of PAHs, however, may accumulate and induce toxic effects.

5.8.5 Predicted Impacts from Release of Harmful Substances

As stated above, marine water quality could be affected by accidentally spilled lubricating oil or diesel fuel from vessels and equipment associated with seismic survey operations. Vessel collisions with ice are not likely to occur, because seismic surveys will be conducted in relatively ice-free conditions. Vessels colliding with each other or equipment-entanglement problems also are unlikely to occur because vessels are required to maintain a minimum separation of at least 15 nautical miles. It is assumed that there would be no unauthorized discharges, such as engine oil, etc., from the seismic vessel or support vessels. Therefore, any effects would be due to accidental discharges, such as a spill of fuel oil during a fuel transfer from a support vessel to a seismic vessel or through accidental release. Such incidents are considered unlikely to occur, but if they do the volume of material released would be small.

Small spills of diesel and light fuel oil are likely to undergo rapid evaporation and dilute and disperse rapidly and as such are unlikely to lead to fouling of seabirds or cause internal damage to marine mammals. Some mortality of planktonic fish eggs and larvae would be expected in the immediate vicinity of the spill, but no longer-term chronic effects to fish would be likely to occur. Adult fish would be able to avoid the area of any spill. Due to the effects of evaporation and dispersion it is not predicted that a spill of diesel or fuel oil would cause any effects to shoreline or coastal habitats and species. Although dependent on the extent and location of any release, a small hydrocarbon spill would generally be predicted to have a minor impact with respect to marine water quality and biota.

While large spills of diesel or fuel oil could cause significant mortality to young lifecycle stages of fish, it is unlikely that such a spill would lead to population level effects or longer-term chronic effects. As with smaller spills, it is unlikely that marine mammals and seabirds would be significantly impacted. However, as noted above the effects of the inhalation by marine mammals of oil vapour at the sea surface are largely unknown and in this respect if the spill covers an extensive area and prevents movement of animals away from the affected area the impact could be significant. With light oils the potential for fouling of plumage and the consequent loss of insulation is significantly less than for heavier oils and spillages of diesel and light fuel oil would be unlikely to lead to mortality at a level that would cause concern at the local population level. The timing of the seismic survey during the early summer months falls outside the main period of seabird assemblage in near shore waters. Thus, the potential for a significant impact on seabird populations would be avoided, although it would be expected that some minor impacts on seabirds in the immediate vicinity of the spill would occur.

Spills of heavier oils such as oily sludges, accidentally released during maintenance activities may have a greater residence time in the water column as these substances are less likely to evaporate. As these oils are less likely to be lost through evaporation and have a much greater potential to form emulsions than lighter oils their presence on the water surface may lead to the fouling of seabirds present in the area at the time of the spill or subsequently in areas to which any oil is transported by waves and currents. Because of their greater residence time in the water, these oil types also have a greater potential to impact upon coastlines, particularly where spills occur in near shore environments. The potential impacts associated with deposited oil are varied and depends on many factors such as the scale of the spill, nature of the weathered oil and the environmental sensitivity of the receiving coastline. However, it can be anticipated that the level of impact would range from minor in areas of dynamic open coast with relatively low ecological, environmental and social interests (e.g. coastal fisheries) to major in the event that oil found its way into sensitive lagoon habitats of north-east Sakhalin. Of particular concern in such areas would be the affect that any deposited oil had on salmonid fish (migratory behaviour and potentially spawning), wader and waterfowl populations using coastal habitats and pinniped haul out areas. It is apparent from numerous studies that while the impact of oil spills, even of a relatively small size, can be significant in the short term, full recovery in the medium-long term usually occurs and ecosystem functions are restored.

With heavier oils the potential for impact upon coastal and seabed sediments is increased in comparison with lighter oils. In north-east Sakhalin, any impact on areas of sediment that support benthic communities in known feeding areas for gray whales would be considered to be of major adverse impact. Amphipod communities are known to be significantly impacted by oil spills involving heavier oil types and significant mortality can occur. Typically, recovery of these infaunal and epifaunal communities is relatively rapid (1-2 years, as documented for the Sea Empress spill in 1996 [Edwards and White 1998]). However, recovery would be unlikely to occur during the period in which the whales would be present at the feeding grounds in north-east Sakhalin and, the temporary loss of part of this resource could have significant implications for the gray whales that feeds off north-east Sakhalin.

The overall unmitigated risk of a large release of a harmful substance, such as oil or fuel, is considered low.

5.8.6 Impact of Dropped Objects

Any survey equipment lost overboard may foul or create obstructions on the seabed and may act as a future source of pollution. Streamer sections are unlikely to be lost during the course of the survey operations due to automatic devices that inflate when the streamer falls below a certain depth. It is predicted that three plastic ‘birds’ (depth control units) of approximately 1 m in length will be lost over the thirty-day survey period. If solid-filled streamers are used, a small number of lead weight strips used to control buoyancy are predicted to be lost during the course of the survey. These objects are not considered to be a risk regarding the potential for obstruction or release of contaminants and losses of this nature are predicted to have a negligible impact. The loss of larger objects and cargo would be predicted to have a moderate impact on marine organisms or other vessels.

Issue	Impact	Unmitigated Impact	Mitigated Impact
Disturbance and Injury to Marine Mammals			
The effects of noise and physical presence of survey vessels	TTS, PTS and non-auditory physiological effects on all cetaceans and pinnipeds	Moderate	Minor
	Disturbance and short-range avoidance movements in non-endangered baleen whales	Moderate	Minor
	Disturbance and short-range avoidance movements in odontocetes and pinnipeds	Moderate	Minor
	Disturbance and short-range avoidance movements in North Pacific right whales	Moderate	Minor
	Disturbance, short-range avoidance movements and reduced feeding opportunities, possible loss of breeding potential, reduced growth, reduced survival in Gray Whales	Moderate	Minor
	Injury or fatality to marine mammals from collisions with vessels and deployed equipment	Minor	Negligible
Disturbance and Injury to Fishes			
The effects of noise and physical presence of survey	Injury and fatality from underwater airgun noise	Minor	Minor
	Spawning disturbance or damage to eggs	Minor	Minor
	Behavioural disturbance e.g., dispersal of fish shoals	Minor	Minor
Effluent Discharge, Emissions, and Waste Disposal			
Effluent discharge	Impacts on water quality and marine biota from cooling water and deck-surface runoff (e.g., sea spray and rain water)	Negligible	Negligible
	Impacts on water quality and marine biota from non-accidental release of drainage and sanitary waste water discharges	Minor	Minor
Emissions from combustion & incinerators	Reduction in local air quality	Minor	Minor
	Contribution to regional and global atmospheric pollution	Minor	Minor
Solid and hazardous waste	Impacts on water quality and marine biota (toxicological effects)	Negligible	Negligible

Table 2. Comparisons between unmitigated and mitigated impacts

Issue	Impact	Unmitigated Impact	Residual Impact
Accidental Spills, Leaks and Dropped Objects			
Spills and leaks	Small release of harmful substances (e.g., wastes, oil, lubricants, cable fluid) resulting in a decrease in water quality and impact on marine organisms	Minor	Minor
	Large release of harmful substances (e.g., wastes, oil, fuel) resulting in a decrease in water quality and impact on marine organisms	Moderate	Minor
Dropped objects	Loss of small objects/equipment	Negligible	Negligible
	Loss of large objects and cargo causing pollution, impact on marine organisms, and obstruction to other vessels	Moderate	Minor
Interaction with Other Users of the Area			
Vessel and equipment interference; use of local resources	Potential for collision or other accident with other vessels, equipment and concomitant injury, loss of human life, vessel damage, loss of property	Moderate	Minor
	Temporary interference with commercial fishing/damage to fishing equipment	Minor	Minor
	Interference with military use of the area	Negligible	Negligible
	Damage to marine archaeology and cultural heritage	Negligible	Negligible
	Hunting of marine mammals	Negligible	Negligible
	Effects on the local social environment and economy	Negligible	Negligible
	Disturbance or damage to cables and other submarine infrastructure	Negligible	Negligible

Table 3. Comparisons between unmitigated and mitigated impacts

6 Compliance with IFC Performance Standards 2012

IFC's Environmental and Social Performance Standards define IFC clients' responsibilities for managing their environmental and social risks.

There are eight IFC Performance Standards on Environmental and Social Sustainability:

1. Assessment and Management of Environmental and Social Risks and Impacts
2. Labour and Working Conditions
3. Resource Efficiency and Pollution Prevention
4. Community Health, Safety and Security
5. Land Acquisition and Involuntary Resettlement
6. Biodiversity Conservation and Sustainable Management of Living Natural Resources
7. Indigenous Peoples
8. Cultural Heritage

Performance Standard 1 establishes the importance of (i) integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client's management of environmental and social performance throughout the life of the project. Within Sakhalin Energy, compliance with PS 1 is achieved largely through the ESMS/HSESAP process.

Performance Standards 2 through 8 have more specific themes. They establish objectives and requirements to avoid, minimise and, where residual impacts remain, to compensate/offset for risks and impacts to workers, Affected Communities and the environment.

All relevant environmental and social risks and potential impacts should be considered as part of the assessment. However, these standards describe potential environmental and social risks and impacts requiring particular attention. Where environmental or social risks and impacts are identified, the client is required to manage them through its Environmental and Social Management System (ESMS) consistent with Performance Standard 1. In Sakhalin Energy's context that system is the HSESAP. Performance Standard 6 is the priority additional standard in the context of the gray whales, but others pertain.

Objectives of Performance Standard 6:

- Protection and conservation of biodiversity
- Maintenance of benefits from ecosystem services
- Promotion of sustainable management of living natural resources
- Integration of conservation needs and development priorities

The 2012 revision brought important but challenging additions to compliance with PS 6: Ecosystem services, Offsetting and the Protection of Critical Habitats. However, because these additions are relatively new, there is a lack of case studies, especially in the marine environment context. Consequently, interpretation and understanding of the additions are still developing.

In PS6, habitats are defined as:

Modified: for example the presence of non-native species or managed habitats

Natural: largely native species; the ecology essentially not modified by human activity

For activities in Natural Habitats, PS 6 requires that there is no net loss/preferably a net benefit. This aim can be achieved by measurable offsets. Any offsets must be demonstrated *in situ* and at an appropriate geographical scale.

The criteria for Critical Habitat assessment are defined as sustaining:

1. Critically Endangered and/or Endangered species
2. Endemic and/or restricted-range species
3. Migratory and/or congregatory species
4. Highly threatened and/or unique ecosystems
5. Key evolutionary processes

Further, paragraph 17 of the Performance Standard 6 states that if deemed Critical Habitat then the Project must:

- Demonstrate that there are no viable alternatives

- Not cause measurable adverse impacts
- Not lead to a net reduction in the population
- Have also a robust monitoring and evaluation programme.

Assuming that the objectives and criteria in PS6 are met, then there is a requirement for an appropriate mitigation strategy, within a Biodiversity Action Plan (BAP). The BAP should be designed to achieve **Net Gains** (see Net Gains and Cumulative Impacts sections below)

6.1 Alternatives to Proposed Activities

Alternatives to the proposed activities were considered by the Company and discussed with the Noise Task Force and the wider WGWAP. They concluded that there are no like-for-like alternatives to the proposed seismic survey and that the monitored, managed and mitigated survey was justifiable for a number of reasons. Cancellation of the survey would bring genuine safety and commercial risks to Sakhalin Energy, its staff and assets. When compared to a seismic survey, no other methods or techniques could produce the quality and quantity of data at that scale in the time available that could inform the safe and efficient management of the hydrocarbons in the fields. In-well monitoring, for example, would produce only very restricted information up to 20 metres from the well. Ocean Bottom Nodes would be ideal for deployment to the discrete areas in and around platforms of tens or hundreds of metres but are not appropriate for an area the size of the planned survey, which could be measured in hundreds of square kilometres.

6.2 Measureable Adverse Impacts to the Whales

No adverse impacts or effects have been observed or measured in the whales, individually or in the group as a whole, arising from the activities of Sakhalin Energy in over ten years of Company and independent monitoring. Two major studies focussed on the 2010 4D seismic survey and looked for effects or impacts on the whales. One was focussed on the distribution and abundance of gray whales during the survey and the other examined the behaviour of gray whales before, during and after the survey.

In the first of those, *Muir et al* reported on the distribution and abundance of gray whales during the 2010 4D seismic survey at Piltun-Astokh. According to her report, Gray whale distribution and abundance were monitored before, during and after the 4-D seismic survey activity to collect data for post survey analyses that assessed potential effects of sound exposure from the seismic survey activity on whales. Muir's study examined gray whale distribution and abundance data to answer the following questions:

1. Were there changes in patterns of whale distribution and abundance within the Piltun feeding area during the seismic survey activity?

2. Did cumulative sound exposure levels (cSEL) from the seismic survey activity over short (3 hour and 8 hour), moderate (3 days and 7 days) and total (since the start of the seismic survey) periods relate to any detected changes in gray whale distribution and abundance?

3. Did the characteristics of sound exposure (pattern of "on" sound when a seismic line was being acquired and "off" sound during a line turn and the magnitude of sound exposure level during each "on" period) relate to any detected changes in gray whale distribution and abundance?

To answer these questions, two multivariate analyses (MVAs) were conducted examining potential changes in mean sighting distance of gray whales from shore (Distance from Shore MVA) and mean gray whale densities in 1 km by 1 km grid cells (Densities MVA) from effects of both the magnitude of cumulative sound exposure and pattern of sound exposure by the 2010 4-D seismic survey activity. Three supporting analyses were also conducted which 1) assessed comparability in WGW sightings observed by two of the shore-based distribution teams, 2) investigated the trend in growth in WGW numbers over time in the Piltun feeding area and 3) developed a correction factor for errors in distance estimation by the reticule binoculars used during the gray whale surveys.

This study found limited effects of the seismic survey activity on gray whale distribution and abundance. Higher sound levels in the middle of a 3 day time window, i.e., during the preceding 24 to 48 hours, were significantly associated with decreased gray whale densities at grid cell locations. However, the evidence for this effect is weak because the upper bound for the Bayesian credibility interval bordered on zero. Analyses also suggested that there may have been some small and localized effects. There was a weak trend of gray whale sightings being slightly farther from shore during the seismic activity period of 18 June to 2 July 2010 compared to before and after the seismic survey. Gray whale presence, i.e., the probability that a 1 km by 1 km grid cell within the shore-based monitoring area would be occupied, also appeared to decrease slightly during the seismic survey activity in the area experiencing the highest sound levels from the seismic airguns. The analyses were limited by small sample size arising from the small number of gray whale sightings resulting from the primary mitigation of conducting the survey as early as possible in the feeding season when gray whale numbers were lowest. The need to address increasing numbers of migrating gray whales in the surveyed area throughout the monitoring period further complicated analyses. The ability to separate effects of seismic survey sound exposure from natural seasonal variation in gray whale distribution and abundance was also hampered by the limited survey effort after the completion of the seismic survey activity. Poor weather conditions allowed only a few scans to be conducted during this post-seismic period.

In the second study into the 2010 4D seismic, Gailey *et al. 2012*, reported on behavioural responses of gray whales. This study examined the effectiveness of the mitigation and monitoring efforts to minimize behavioural impacts relative to vessel proximities and sound level exposure generated during seismic exploration. Two shore-based behavioural observation teams monitored gray whale movements and respirations pre, during and post-seismic acquisition. Theodolite tracking and focal-animal follow methodologies were conducted to collect behavioural data. Mixed linear models were used to examine deviations from 'normal' patterns in 10 movement and 7 respiration response variables in relation to anthropogenic distances, orientations and 8 received sound metrics to examine if seismic and/or vessel activity influenced gray whale behaviour. Behavioural state and water depth were the largest natural predictors of western gray whale movement and respiration variables. After considering natural variation, none of the response variables was found to be significantly associated with seismic or vessel sounds. Distance from shore and relative orientation of gray whales to the closest vessel were found to be significantly influenced by vessel proximity, which suggested some non-sound related disturbance. Absence of movement and respiration responses to seismic pulses and vessel traffic could have been a result of an effective mitigation strategy. Alternatively, power analyses suggest this study had limited sample sizes to detect moderate to subtle changes in gray whale behaviour.

6.3 Annual estimated numbers of gray whales off of Sakhalin

Numbers of gray whales at Sakhalin are presented as estimates below and based on RUS + IBM + KAM data (these include immature animals seen off Kamchatka in recent years that were seen previously as calves off Sakhalin and which may or may not return to Sakhalin as adults). Annual counts tend to be lower than estimates because not all of the whales are recorded every year. The latest assessment results are presented in Fig. 8 of the WGWAP 14 report: (http://cmsdata.iucn.org/downloads/wgwap_14report_final_en.pdf). No attempt is made to estimate the total number of calves born each year because an unknown fraction does not survive the journey to the Sakhalin feeding grounds (Figures 6 and 7).

Photo identification studies and satellite tagging have revealed several examples of repeat, annual visits by individual whales. No negative effect or impact has been observed or measured in the numbers of gray whales recorded off of Sakhalin.

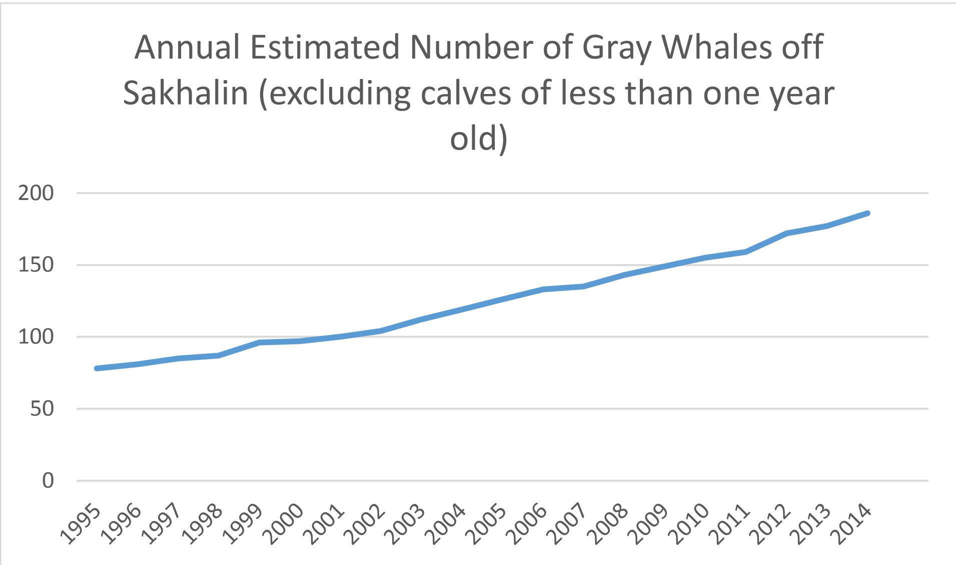


Figure 6

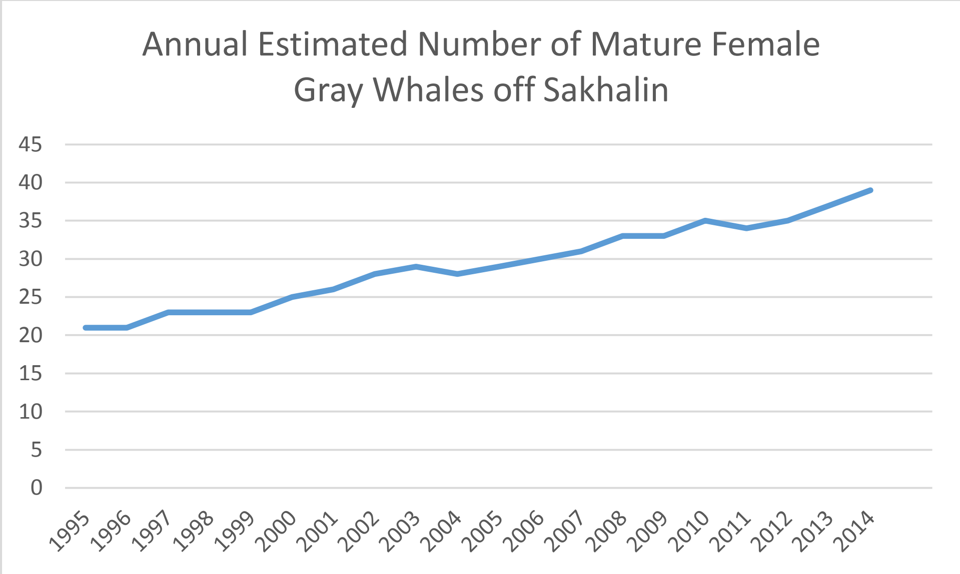


Figure 7

6.4 Net Gains

Net Gains are additional conservation outcomes secured for the gray whales off of Sakhalin. Normally, they are achieved through the development of a biodiversity offset. However, this is likely to be inappropriate or impractical for a large, oceanic mammal such as a gray whale. Nevertheless, Performance Standard 6 recognises that situation and allows for the achievement of Net Gains by meeting the requirements of paragraph 17 of PS6 without a biodiversity offset (also see Cumulative Impacts below).

This could be through the implementation of programmes that could be applied on-the-ground to enhance habitat, protect and conserve the gray whales. In that respect, Sakhalin Energy Investment Company, has been remarkably effective. Through its approach and commitment to environmental management and assurance practices and its willingness to work with experts, Sakhalin Energy has built up enormous experience in carrying out its activities in Critical Habitats. It now has genuine influence and a good reputation, regionally and internationally in the oil and gas sector, particularly for operating in sensitive areas.

Examples of its commitment, transparency and development of 'tools' for the wider industry include:

- The Monitoring and Mitigation Plan for seismic surveys
- The joint research programme with ENL including satellite tagging and photo identification
- The development, promotion and publication of best practice, culminating in the publication of Nowacek *et al.* 2013: a scientific paper describing responsible practices for minimising and monitoring environmental impacts of marine surveys with an emphasis on marine mammals the publication of a book on the Gray Whales of Sakhalin

The Company's record on corporate responsibility in this context is robust:

- In March 2015, due largely to previous engagement by Sakhalin Energy, the Oblast Biodiversity Group viewed and discussed presentations from Sakhalin Energy and ENL. IUCN and representatives of environmental NGOs were included in the meeting
- Their sensitive and effective handling of the issue, when two industrial salmon nets were set amongst the whales in 2013 was appreciated by the local authorities and Indigenous People
- Their decision, at great additional costs and delay, to divert the Piltun-Astokh pipeline route to minimise any potential impact on the whales or the offshore feeding grounds
- Their resourcing of research and analyses of the distribution, behaviour and abundance of the whales has increased greatly the overall knowledge gray whales in the north eastern Pacific, leading to a much better and informed basis for conservation management
- For over ten years they have resourced singlehandedly the 17 person Western Gray Whales Advisory Panel, it's meetings, reports and research
- To aid transparency, they insisted on the International Union for Conservation of Nature as the secretariat
- In early 2013, they committed to the 2012 IFC Performance Standards

Sakhalin Energy managing their own activities is not a Net Gain. Rather it is the dissemination and take up of Best Practice to and by other operators that has the potential to be so. It is only a Net Gain if the reduction in impact of others is greater than the impact of Sakhalin Energy's own activities. This may be extremely difficult to quantify convincingly so qualitative arguments and examples are required. There is also the issue of companies working together to manage cumulative impacts, which is a good approach but not necessarily a Net Gain.

As an example, the agreement made with ENL, described above, to approach the two surveys as if they were one combined survey in order to avoid, minimise and mitigate any combined or cumulative effects of the surveys (and to refrain from interfering with each other's data acquisition) on the foraging whales sets new industry standards for responsible and pragmatic activities. It is common in the industry to come to a private agreement on time-sharing when seismic acquisition has to be achieved in the same time frame and in close proximity. Where this agreement sets new standards is in bringing two rival companies together, albeit encouraged by all concerned, in the context of recognising the risks to the whales created by two independent surveys and then taking steps to apply Best Practice in a way that provides a model for the industry and authorities. Sequential scheduling of the surveys was selected by the Companies, as opposed to concurrent 24 hour time sharing, to ensure less ensonified areas would be accessible to the whales throughout June and July. This has the Net Gain of take up by another operator but also the Cumulative Impact of their combined approach.

This transparent, responsible and progressive approach has led to influence on local government and, importantly, influence on the behaviour of rival operators. This independent initiative is very likely to have contributed to the increased awareness, respect and lowering of risk to the gray whales and other sea mammals in the Sea of Okhotsk.

6.5 Cumulative Impacts

Cumulative impacts can occur in a range of ways and across different spatial scales. For example, Sakhalin Energy mitigates its cumulative impact on the whales in the Sea of Okhotsk from its day to day operations via a range of practices. These include, as examples, direct, practical actions such as minimizing survey areas, managing the number and routing of vessel movements, maintaining 5 knot speed limits in low visibility or within 1km of a whale, speed limits of 10 knots in Piltun area and 11 knots in Offshore Feeding Area and monitoring noise and emissions from platforms and other activities.

Equally, but more strategically, the company has promoted the management of cumulative impacts in less tangible ways (providing further **Net Gains** along the way). These can impact at national and range-wide level. Examples of both include:

- Providing support and resources for the WGWAP process including IUCN
- Promoting the Memorandum of Communications (IWC) concerning measures for the conservation of Gray Whales among range states
- Proselytizing the findings of projects at industry conferences and events
- Encouraging other operators to adopt Best Practice
- Adopting and Deploying Best Practice from Sakhalin at Sakhalin Energy's component partners' (Shell and Gazprom) operations throughout the world
- Contributing to the major UNDP/GEF project "Mainstreaming biodiversity conservation into Russia's energy sector policies and operations"
- Supporting the Russia-US Gray Whale Research Program
- Engagement with the Ministry of Natural Resources' Interdepartmental Working Group for the conservation of Gray Whales
- Hosting a visit from the Russian President to promote the effective and safe development of oil and gas in territorial waters
- Promotion of the Business and Biodiversity Platform
- Promotion of links to local Government (Oblast) through engagement with the Expert Working Group on Biodiversity
- Promotion of Industry-wide standards for Marine Mammal Observers

Simulating various whale arrival scenarios to compare broadly the implications of different mitigation strategies, rather than quantitative predictions on the outcome of a particular case, has been a key component of the Noise Task Force's recent work. The final results of what is termed the 'spreadsheet' approach were reviewed at Noise Task Force 8, Washington DC, November 2014 (see NTF-8 report, Item 3.2). Broad conclusions of this aspect of the simulation work are summarised below.

One important component of the discussions concerned the timing of the whales' arrival to the area, the speed at which their numbers increase and when their numbers reach a peak or plateau in the region. The NTF agreed that the base case scenario was that whales reached a plateau by 1 August (based upon consideration of all available data combined) but that a sensitivity test should be run assuming an 'early plateau' (15 June) as was suggested by a simple examination of the 2010 data. The analyses are confounded by difficulties related to varying start dates and effort correction issues and the NTF agreed that this reconfirms the importance of collecting good information on whale distribution and abundance early in the season, given that completing a seismic survey as early as possible when fewer whales are expected to be present is considered a key component of the mitigation strategy. If whale numbers did not ramp up from early June to mid or late July, then it could be argued that (a) starting the survey as early as possible is unnecessary and (b) the trade-off between allowing a few whales to be affected early in the season in exchange for ensuring that many whales are unaffected later in the season does not apply, thus putting the emphasis on the protection of individual whales.

6.6 The importance of an early start to surveying

Early starting of a seismic survey is of very high importance off Sakhalin. The whales tend to arrive after the ice has dissipated. This period is highly variable and whales do not arrive initially in large numbers. Instead, small groups start to arrive after the ice has melted. There is often a gap between the ice melting and the arrival of the whales. This combination of the sea being ice-free and none or extremely low numbers of whales means that it is the lowest risk time for acquiring seismic data. The early start also positions the operations for an earlier finish, possibly before the main contingent of whales arrives.

Sakhalin Energy has influenced the starting time for surveys of other operators in the area. Their leadership has resulted to most companies starting earlier and finishing earlier. This behaviour by the company has also created cooperation and coordination between and amongst other operators off Sakhalin. This will have led to a decrease in unmitigated risk and a commensurate decrease in risk to the whales.

Table 2. Summary of results (mean/SD assuming normal distribution)

S1: Only one survey which starts on 15 June (n=21 whales on that day). No false positives. 1 whale near Piltun receives >163dB hit each pass 1st 13, each 2nd pass next 14

S1E: Early start (in this table this is simply a different 50 run –iteration of S1 showing the results are essentially the same as one would expect); S1M – mid start; S1L – late start

S1P: This sensitivity run shows the case where all whales have arrived by 15 June and the survey starts on that day (in practice this scenario incorporates any start date that occurs in the peak season. S2: 50:50 time sharing. Otherwise as S1

S3: As S2 but with false positives due to Marine Mammal Observer (MMO) failings or night vision problems S4: As S2 but with late start (29 June)

S5: As S2 but with an early start S6: As S1P but for two companies

P27 means additional protection for all 27 A-lines; P13 means for only first 13 A-lines; IA means ignore all A-lines

	One Company														
	S1P27	**S1P13**	**S1IA**	**S1EP27**	**S1EP13**	**S1EIA**	**S1MP27**	**S1MP13**	**S1MIA**	**S1LP27**	**S1LP13**	**S1LIA**	**S1PP27**	**S1PP13**	**S1PIA**
Hits at Piltun 27 A	39/8	37/7	24/2	38/9	36/8	24/2	60/19	54/14	25/3	86/23	78/21	25/2	99/23	93/26	25/2
Hits at P-Bay 13	29/8	28/7	16/2	28/8	28/8	15/2	48/18	45/14	16/2	72/22	69/21	16/2	83/24	85/26	16/2
Hits at P-Bay next 14	10/1	9/1	9/1	10/2	9/1	8/1	12/2	9/1	9/1	15/4	9/1	9/1	16/4	9/1	9/1
Total Hits > 156dB	39/8	**40/7**	**35/4**	38/9	39/9	33/4	60/19	59/14	42/6	86/23	85/22	51/6	99/23	103/26	58/8
Total Hits > 156dB outside Piltun	0	3	**9**	0	18	9	0	5	17	0	7	26	0	10	33
Suspensions > 156dB in FA	19/9	19/10	0/0	19/10	19/10	0/0	59/31	51/23	0/0	117/44	105/42	0/0	146/43	140/50	0/0
Suspensions > 180dB	2/1	1/1	1/1	2/1	1/1	1/1	4/2	4/2	2/1	7/4	6/3	2/2	8/3	8/4	3/1
Days to complete survey	24/4	23/4	**16/1**	24/5	23/5	16/1	36/11	33/8	17/1	51/14	45/12	17/1	55/15	52/17	17/2
Lines Complete on day 30	40/2	40/1	40/0	39/2	40/1	40/0	34/5	35/5	40/0	28/4	29/4	40/0	25/4	26/4	40/0
	Two Companies 50:50 timeshare														
	S2P27	**S2P13**	**S2IA**	**S3P27**	**S3P13**	**S3IA**	**S4P27**	**S4P13**	**S4IA**	**S5P27**	**S5P13**	**S5IA**	S6P27	S6P13	S6IA
Hits at Piltun 27 A	38/8	36/8	23/2	41/9	38/8	23/2	65/18	62/16	22/2	26/3	26/3	23/1	96/20	87/20	23/2
Hits at P-Bay 13	28/8	28/8	15/2	31/8	30/8	15/2	53/17	54/16	14/1	18/3	18/3	15/1	81/21	79/20	15/1
Hits at P-Bay next 14	10/2	8/1	8/1	10/2	8/1	8/1	12/3	8/1	8/1	8/1	8/1	8/1	16/3	8/1	8/1

Total Hits > 156dB	38/8	**39/8**	**33/4**	**41/9**	**41/8**	**33/4**	65/18	**67/17**	**39/5**	**26/3**	**26/3**	**26/3**	96/20	96/19	54/5
Total Hits > 156dB outside Piltun	0	3	**10**	0	3	**10**	0	5	**17**	**0**	**0**	**3**	0	9	31
Suspensions > 156dB in FA	21/11	21/11	0/1	25/12	22/10	0/0	71/31	68/29	0/0	4/3	4/3	0/0	142/38	130/38	0/0
Suspensions > 180dB	2/2	2/1	1/1	5/3	4/3	3/2	5/3	5/3	2/2	0/1	0/1	0/1	9/3	8/3	3/2
Days to complete survey	30/5	30/5	**22/1**	32/5	31/4	**22/1**	45/10	45/9	**22/1**	23/1	23/1	**22/1**	61/15	55/15	22/1
Lines Complete on day 30	**38/4**	**38/3**	40/0	**36/4**	**37/3**	40/0	**30/4**	**29/4**	40/0	40/0	40/0	40/0	23/4	25/2	40/0

The simulation results (Table 2) led to the following assessments:

(1) the advice to start as early as possible is shown to be the most important mitigation measure (with the obvious exception of the scenario in which all animals have already arrived by 15 June, the earliest start date contemplated);

(2) for the predicted number of hits (whale exposures) at per-pulse levels above 156 dB re 1µPa2-s per-pulse sound exposure level (SEL), there is relatively little difference by mitigation strategy for early and mid-season starts;

(3) for the days to complete the Sakhalin Energy survey alone (i.e. no ENL survey) scenario, the case with no mitigation measures is always the shortest, taking some 16-17 days increasing to around 24 days for the mitigation options for the early start, around 35 for the medium start and 45-51 for the late start;

(4) for the time-sharing options and survey completion, the no mitigation option increases to around 22 days while the mitigation options take some 30 days for the early start and some 45 days for the medium start;

(5) for time sharing versus One Company scenario, the predicted number of hits at per-pulse levels above 156 dB SEL is similar.

The NTF agreed that these conclusions needed to be considered in the light of the maximum and cumulative sound exposure modelling, the objective of which was to provide more quantitative information on the trade-off between protecting individuals versus the broader population.

6.7 Maximum and cumulative sound exposure modelling

The analyses were conducted by the Panel, based on source level and propagation estimates provided by the Company, with a view to estimating the expected maximum and cumulative levels of sound exposure experienced by gray whales under various scenarios. Rough estimates of the 2010 Astokh survey were also obtained for comparative purposes and the surveys planned by ENL and Rosneft (to be carried out by Sakhalin geophysical company Dalmorneftegeophysica DMNG) for 2015, on the assumption of a similar noise source to that planned for the 2015 Sakhalin Energy survey.

The two technical mitigation measures considered in the analyses are: (1) shutdown whenever a gray whale is seen within 2 km of the source ('injury shutdown'); and (2) shutdown when whales (alternatively: just mother-calf pairs) are seen within the designated feeding area in a position subject to predicted ensonification exceeding 156 dB per-pulse SEL ('behavioural shutdown'). Strengthening or relaxation of these measures is examined in alternative scenarios.

6.8 Predictions of exposure for the proposed Sakhalin Energy survey

The results show that whales are likely to be exposed to higher levels of sound in the proposed 2015 Sakhalin Energy survey than in the 2010 Astokh survey, but if the sound source strength for 2015 could be reduced by 50% (3 dB), then sound exposures would be less than those estimated for the 2010 survey. Restricting the behavioral shutdown rule to mother-calf pairs is not predicted to increase the overall sound exposure of whales, but will increase the likelihood that all survey lines will be successfully acquired. The reason that relaxation of the shutdown rule does not increase overall exposures is that it enables the survey to be completed sooner, before the peak occurrence of whales.

Assuming the 13 inshore lines which potentially ensonify a substantial portion of the feeding ground to >156 Db SEL are surveyed by day, use of night-vision technology, even if it proves to be less effective for the detection of whales, is not predicted to have a significant effect on exposures. The reason is that few whales enter the 2 km shutdown radius anyway, typically only 2-3 per survey, such that the injury shutdown rule is rarely activated even with perfect detection. If whales arrive in the area earlier than expected, as suggested in the 2010 shore-based sighting results, then the predicted average sound exposures from the survey would be greater.

6.9 Provisional predictions of exposure for the DMNG (ENL and Rosneft) and combined surveys

DMNG is planning to conduct seismic surveys in the Odoptu-More, Chayvo and Arkutun-Dagi blocks for ENL and in the North Chayvo block for Rosneft. On the assumption that the entire area of these blocks would be surveyed with the same intensity and with a similar sound source as the Sakhalin Energy survey, the DMNG surveys are predicted to result in considerably higher acoustic exposures. If the DMNG surveys take place, exposure to those surveys is predicted to dominate the total exposure, such that the combined exposure from the DMNG (for ENL and Rosneft) and Sakhalin Energy surveys is not predicted to be noticeably more than from the DMNG surveys alone. However, the simultaneous conduct of the DMNG and Sakhalin Energy surveys could result in a greater risk to the whales, because of spatial effects (lack of a quieter part of the feeding ground to which to escape).

The predictions for the DMNG surveys assume the same injury shutdown radius of 2 km as used for the Sakhalin Energy survey. However, in the case of the ENL surveys, the injury shutdown rule alone results in non-completion of some near shore lines in the Odoptu-More block. If the behavioural shutdown rule is also implemented (shutdown when whales within the feeding ground are exposed to >156 dB per-pulse SEL) then more of the near shore lines fail to be successfully acquired. In the absence of a behavioral shutdown rule, exposures are predicted to become extremely high and to reach levels that, based on current knowledge, should be avoided.

6.10 Consideration of relaxing the rules with respect to behavioural threshold exposure

The results from that work show that, under the assumptions made (see recommendations below), the overall cumulative exposure is considerably lower if the shut-down requirement is relaxed and applies only to mother-calf pairs. This primarily relates to the fact that the survey is completed sooner. The results for the proportion of animals that receive a maximum exposure of 156 dB per-pulse SEL is also lower, but only slightly lower, if the shut-down requirement is relaxed.

The Panel was concerned that relaxation of the rule for 2015 may be seen as stepping back from its agreed protective principles developed for the 2010 survey. However, it noted that the primary mitigation measure agreed for that survey was completion as early and as quickly as possible to reduce the number of individuals potentially affected. In order to achieve that, different mitigation measures were adopted for A- and B-lines with respect to individuals, which was, in effect, a trade-off between individuals versus the population as a whole.

For the present survey, the NTF developed two simulation approaches (the spreadsheet and the 'Cooke' approaches) to address quantitatively the question of an appropriate trade-off. This represents a methodological advance on the approach used for the 2010 survey. The results of both approaches, under the assumptions made, confirmed that if the survey is to go ahead, then the numbers of whales that will be exposed to sound levels above the behavioural threshold will be lower if the shut-down rule is relaxed to apply only to mother-calf pairs. The difference is substantial with respect to cumulative exposure although only slight with respect to maximum single-pulse exposure. This general rule is applicable even if the acoustic modelling underestimates the actual footprints of the proposed survey. Because the mitigation benefits of relaxing the behavioural shutdown rule only apply to acquisitions prior to the period of peak whale abundance, the Panel considered that the relaxation should apply only to lines acquired prior to 15 July (the date by which whale abundance in the feeding area is predicted to have reached 75% of its peak level).

The Panel once again stressed that relaxation of the behavioural threshold protection for all animals in the proposed 2015 MMP should not be seen as a precedent and that it should be reviewed again in the light of results obtained in 2015 and any additional modelling work. They also noted that mother-calf pairs are less able than adults to change their distribution in response to disturbance.

In agreement with the NTF, the Panel also stressed that sightings of one or more mother-calf pairs within the zone of exposure to sound levels of 156 dB per-pulse SEL or higher must always trigger a shutdown. This mitigation measure must be adhered to strictly and consistently even if this means that seismic acquisition is incomplete as a result. The Company has accepted this condition.

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APPENDICES

Appendix I: Technical Supplement to WGWAP Statement of 8 May 2015

Updated predictions of cumulative sound exposure for Sakhalin gray whales from the proposed 4D seismic survey in 2015, with comparative predictions for other surveys

By Justin G. Cooke

(16 May 2015)

SUMMARY

The model used in the WGWAP-15 report to estimate the acoustic exposures resulting from seismic surveys planned for 2015 was revised to take into account changes to the plans announced subsequently. The results predict that the revised schedule for the proposed Piltun-Astokh 4D survey will increase the expected maximum and cumulative acoustic exposure of gray whales within their Sakhalin feeding ground compared to the original schedule, due mainly to the later start of the survey, which is only partly offset by improved airgun array design. When the planned surveys by Exxon Neftegas Limited in adjoining blocks are included, the predicted exposure is considerably higher than for the Piltun-Astokh survey alone, but is about the same under the old and new schedules. If Rosneft's North Chayvo block is also surveyed, the predicted maximum and cumulative exposure is substantially greater still, because this block contains an area of high average whale density in most years. Estimation of expected cumulative and maximum exposure should preferably become a standard part of the early planning stages for a survey to enable a science-based assessment of potential impact before irreversible operational decisions are made.

Introduction

An analysis appended to the WGWAP-15 report provided model-based predictions of the expected sound exposure of gray whales on and near their Sakhalin feeding ground from planned seismic surveys by Sakhalin Energy in the Piltun-Astokh area in the 2015 summer season (Cooke appendix in IUCN, 2014a). Comparative predictions were also made for the seismic surveys expected to be conducted in neighbouring blocks by other operators in 2015.

At and soon after the WGWAP Working Meeting (27-29 April 2015, Gland, Switzerland, see http://www.iucn.org/wgwap/wgwap/meetings/wgwap_wm/), Sakhalin Energy provided information to the Panel on plans that are meant to reduce interference between concurrent surveys by different operators. These include:

(i) Starting the Piltun survey later (early July), to allow time for Exxon Neftegas Limited (ENL) to survey the Odoptu-More block first;

(ii) Use of a modified sound source, which has the effect of emitting less sound in directions perpendicular to the survey line;

(iii) Contraction of the exclusion zone from 2km to 1,6km (source to be shut down when whale sighted within this range or on course to enter it);

(iv) Relaxation of the rule under which nearshore lines would not be surveyed at night. This change was argued to be a necessary consequence of starting the Piltun-Astokh survey later, because of spring tides that would exclude too many daytime hours.

The various survey blocks are shown in Figure 1. The Piltun-Astokh and Lunskoye blocks are proposed to be surveyed by Sakhalin Energy, while the Odoptu-More, Chayvo, and Arkutun-Dagi blocks are to be surveyed by Dalmorneftegeophysica (DMNG) for ENL, and the North Chayvo block may be surveyed for Rosneft.

Under the original plan reviewed by the Noise Task Force at its 8th meeting (IUCN, 2014b), it was envisaged that seismic surveys by Sakhalin Energy and those conducted by DMNG (for ENL and Rosneft) would operate over the same period, but with the acquisition of lines interleaved, such that actual shooting would not occur simultaneously. That is, while one operator is acquiring a line, the other operator would bring its vessel into position and get ready to acquire its next line.

Under the revised plan, the Odoptu-More (OM) block will be surveyed first, as soon as ice conditions permit, while Sakhalin Energy is surveying its Lunskoye block (south of the whales' offshore feeding area). The Piltun-Astokh block is to be surveyed when the OM block is finished.

This document provides an update of the WGWAP-15 analysis to estimate the effect of the proposed changes.

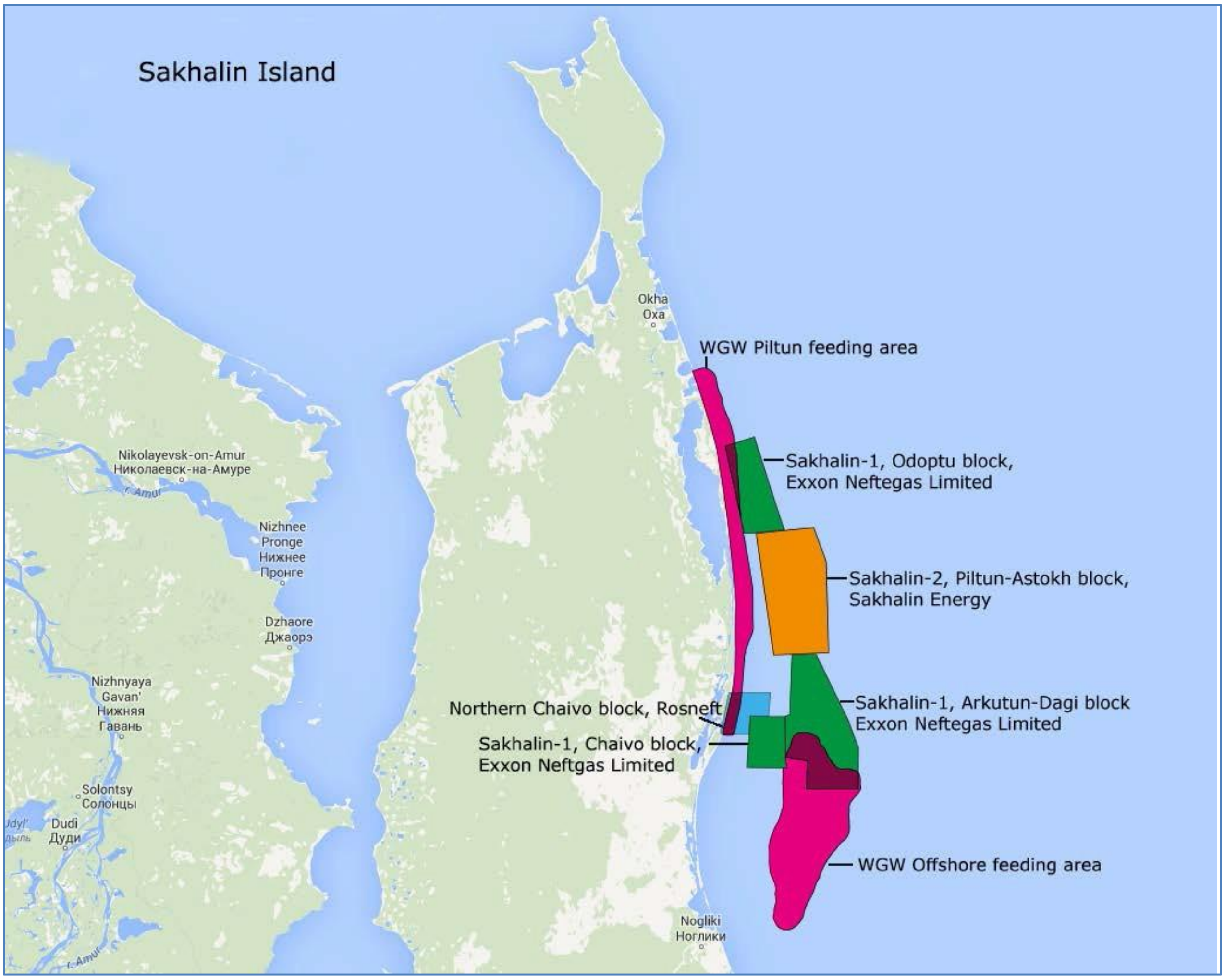


Fig. 1. Approximate location of survey blocks mentioned in the text. For illustrative purposes only, without prejudice to the actual legal status of any concessions or their boundaries.

Model specification

The model used for this analysis was described in Appendix 1 of the WGWAP-15 report, modified to account for changes in the survey plans. The model was constructed to simulate the seismic survey planned by Sakhalin Energy for 2015 near Piltun, in order to estimate the expected maximum and cumulative levels of sound to which gray whales would be exposed under various scenarios. Rough simulations were also conducted for comparative purposes of the 2010 Astokh survey by Sakhalin Energy, and of the surveys planned by DMNG for ENL and Rosneft in the Odoptu-More, North Chayvo, Chayvo and Arkutun-Dagi blocks in 2015. The survey of the Lunskoye block by Sakhalin Energy is not modelled explicitly, because it is too far away to impact whales on the near-shore (Piltun) feeding ground, but it is assumed that Sakhalin Energy can schedule the Lunskoye survey around the mitigation requirements for the Piltun-Astokh survey.

Source strength Sakhalin Energy has announced plans to use a new airgun array configuration with changed source characteristics. An example sound footprint for the revised source was provided by Racca (*in. litt*.). The footprints were found to be adequately described by the following models:

Old: $$dB_{\mathrm{SEL}} = 171.5 - 10\log_{10}(r) - 1.22r - \sum_{i=1}^{4} a_i \cos(i\theta)$$

New: $$dB_{\mathrm{SEL}} = 171.4 - 10\log_{10}(r) - 1.22r - \sum_{i=1}^{4} a_i \cos(i\theta)$$

The estimated angular coefficients a_i are:

I	a_i (old)	a_i (new)
1	-0,94	-0,76
2	-2,22	-0,19
3	0,05	-0,36
4	1,32	1,79

Table 1. Estimate angular coefficients

The corresponding angular distributions of relative source strength are displayed in Fig. 2:

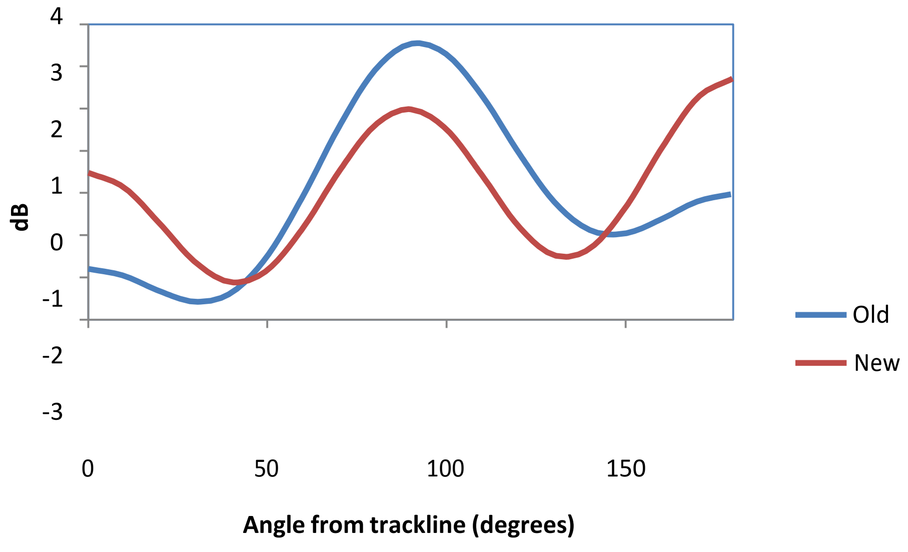


Fig. 2. Relative angular footprint of old and new source.

The model used in the WGWAP-15 analysis involved only a term in log *r* without a term in *r*. This model was found not to fit the new source footprint adequately. In order to enhance comparability, the new model was fitted to both footprints. The coefficients of the terms in *r* and log *r* were found not to differ significantly between the two footprints; therefore, common terms were fitted.

For the simulations of the ENL/Rosneft surveys, a source corresponding to the “old” footprint was assumed.

Line spacing and scheduling

The assumptions regarding line spacing, vessel speed, shot interval, ramp ups, and weather-related downtime are the same as in the WGWAP-15 analysis. Because no interleaving is involved in the new plans, the turn time between lines was reduced from 4.5 to 3 hr for the Sakhalin Energy’s survey. The turn time for the DMNG surveys was set to 1.5 hr because it is understood that two vessels will be used: this allows one vessel to get into position for the next line while the other vessel is still acquiring the previous line.

Assumptions concerning whale distribution are also unchanged from the previous model. The shore-based density data by 1km square from the years 2005-2009 were averaged to produce a relative density distribution. The total population in the area was assumed to increase linearly from zero on June 1 to a maximum of 100 (including 15 mother-calf pairs) whales by July 31.

The assumptions concerning detectability of whales were modified to better allow for night-time surveying. In daytime, the probability of seeing a surfacing at distance *r* from the vessel and angle θ from the trackline was taken to be: $p = 0.5\exp\left(-(r/2.5km)^2\right)\cos\theta$. With a surfacing rate of 40/hr, this implies a trackline detection probability of g(0) = 0.99 for whales. The relative efficiency of night-time detection using night vision technology was assumed to be 10% of the daytime efficiency on a per-surfacing basis. With these parameters, this implies a night-time trackline detection probability of g(0) = 0.61. In some mitigation scenarios, lines which expose part of the feeding ground to sound levels greater than 156 dB_{SEL} per pulse may not be surveyed at night or in poor visibility.

Mitigation

The main mitigation measure is to survey areas in or close to the gray whale feeding ground as early in the season as possible before many whales are present. It is assumed that the Piltun-Astokh block will be surveyed as soon as the OM block is finished, even if this means interrupting the Lunskoye survey, and completing it later, after the Piltun-Astokh survey is finished. *If this is not the intention, the acoustic exposures of gray whales are liable to be higher than as predicted by this analysis.*

The other mitigation measures included in the model are: (i) shutdown whenever a gray whale is seen within 1,6km of the source (“injury shutdown”); and (ii) shutdown when mother-calf pairs [or any whales after August 1] are seen *within the designated feeding area* in a position with a predicted sound level exceeding 156 dB_{SEL} ("behavioural shutdown"). When a shutdown takes place, the line is aborted and reshot later. Strengthening or relaxation of these measures is examined in alternative scenarios.

It is expected that the DMNG surveys will apply the injury shutdown rule, but maybe not the behavioural shutdown rule. Two scenarios were run where the DMNG surveys also applied the behavioural shutdown rule.

Scenarios and performance statistics

The scenarios tested are listed in Table 2. Scenario A models the exposure from the 2010 Astokh survey, while scenarios B, C and D model the Sakhalin Energy Piltun-Astokh survey planned for 2015. Scenarios E, F and G include the surveys to be conducted for ENL in 2015 in the OM, AD and Chayvo blocks. Scenario H includes Rosneft's North Chayvo block, too. Scenarios B and E are based on the original schedule and source characteristics for the Sakhalin Energy 2015 survey (as considered at the NTF-8 and WGWAP-15 meetings) while scenarios C, D, F and H are based on the proposed new schedule.

500 replicates of each scenario were simulated. For each whale, the maximum and cumulative sound exposure was recorded. The cumulative exposure was calculated by converting each shot exposure to a received energy value, summing up the received energies across shots, and converting back to dB_{SEL}. Cumulative distributions (across whales and replicates) of maximum and cumulative exposure were computed.

For each simulated line shoot, it was recorded whether the line was: (a) completed, (b) aborted due to behavioural shutdown or (c) aborted due to injury shutdown. The mean numbers in each category were computed for each scenario.

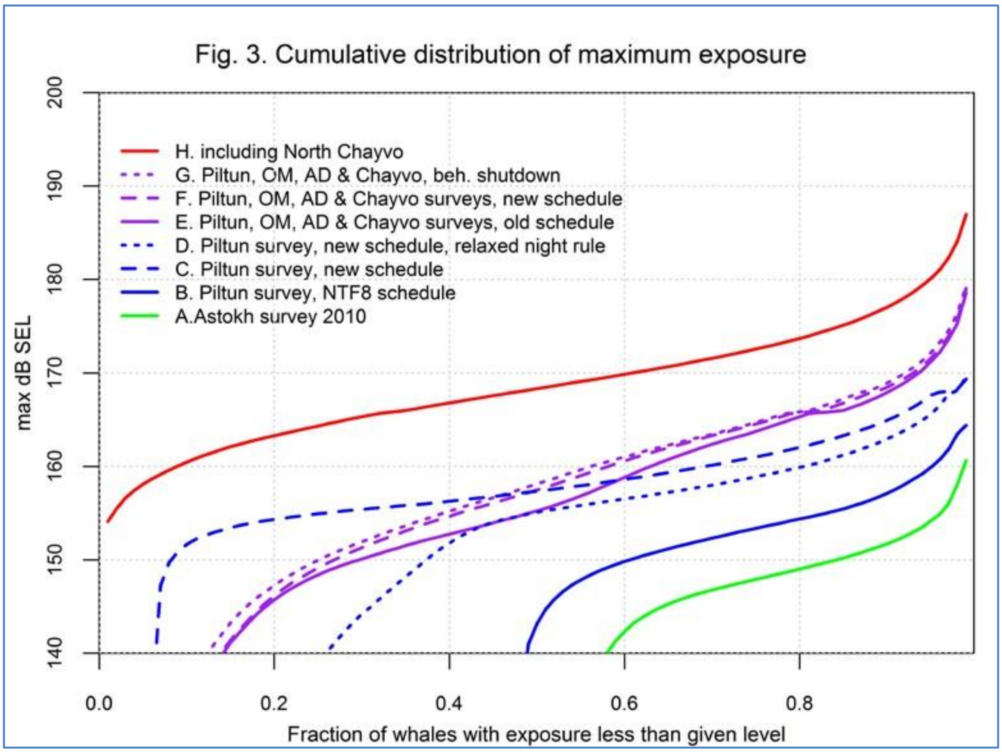
Table 2. List of scenarios simulated

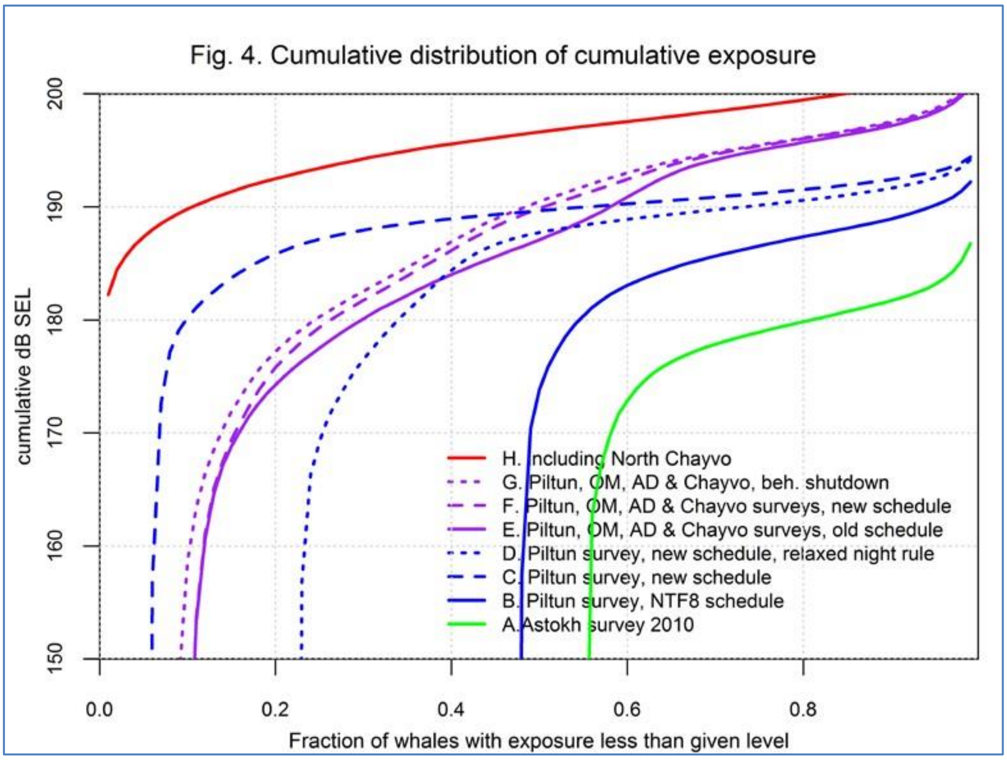
Case	Description	Source	Schedule	Night rule	Injury shutdown	Behavioral shutdown	All whales from*
A	Astokh 2010 4D survey for comparison	old	-	strict	2 km	yes	Jun 01
B	Piltun 2015 4D survey: old ("NTF") schedule	old	old	strict	2 km	yes	Jul 15
C	Piltun 2015 survey, new source & schedule	new	new	strict	1.6 km	yes	Jul 31
D	Piltun survey, new schedule, relaxed night rule	new	new	relaxed	1.6 km	yes	Jul 31
E	Piltun, OM, AD & Chayvo surveys, old schedule	old	old	strict	2 km	Piltun only	Jul 15
F	Piltun, OM, AD & Chayvo surveys, new schedule	new	new	relaxed	1.6 km	Piltun only	Jul 31
G	Piltun, OM, AD & Chayvo, with beh. shutdown	new	new	relaxed	1.6 km	yes	Jul 31
H	Including North Chayvo	new	new	relaxed	1.6 km	yes	Jul 31

*date after which shutdown rule applies to all whales seen within PML, not just mother-calf pairs

Results

Cumulative distributions of maximum and cumulative exposure (summed over whales and replicates) for scenarios are shown in Figures 3 and 4. These results show that the new schedule for the Sakhalin Energy survey implies a greater exposure of whales to sound than the WGWAP-15 prediction, due mainly to the later start of the survey, which is only partly offset by the reduction in lateral source strength. Relaxation of the restriction on night-time shooting reduces the cumulative exposures, because it allows the survey to be completed sooner.



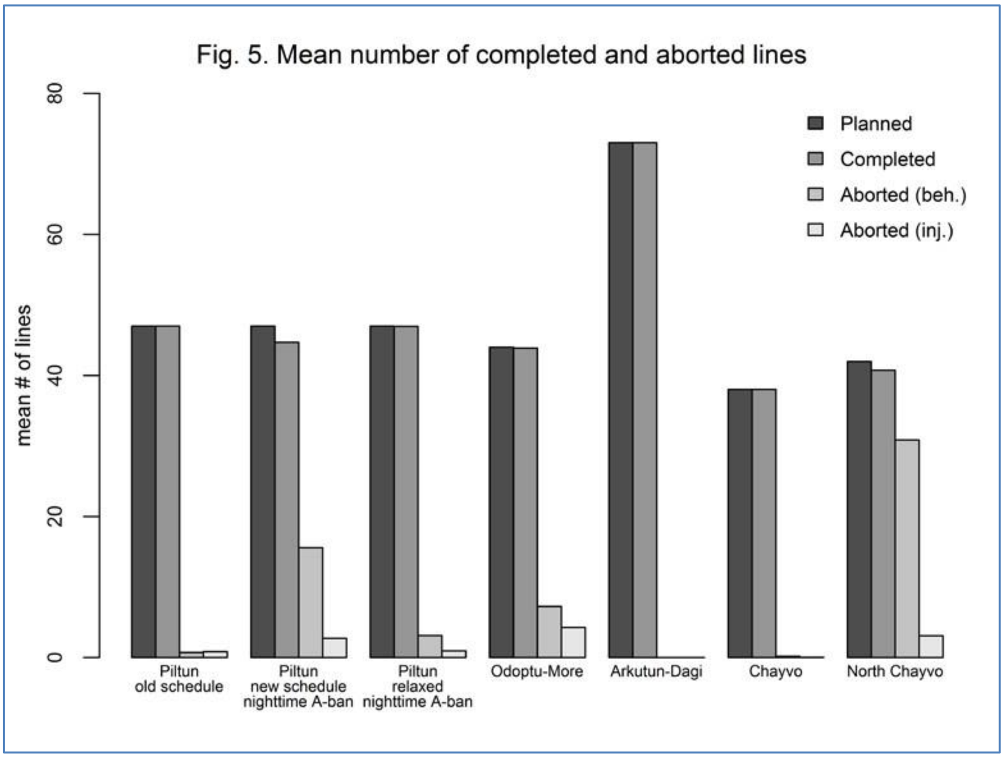


Under the original schedule (scenario B), nearly 50% of the whales were predicted to be not exposed at all, because they arrive after the survey is finished. Under the new schedule (scenarios C and D), only 10-30% are predicted to escape exposure, and 40-60% of whales are predicted to be exposed to levels exceeding the 156 dB behavioural threshold. The relaxation of the night survey rule (scenario D) is predicted to reduce exposure somewhat, probably because it allows the survey to be completed sooner.

When the ENL surveys of the OM, AD and Chayvo blocks are included (scenarios E and F), the predicted maximum and cumulative exposures are predicted to be greater than for the Sakhalin Energy survey alone (compare scenarios D and E), but do not differ much between the old and new proposed schedules for 2015 (compare scenarios E and F). Applying the behavioural shutdown rule in the DMNG surveys does not affect maximum or cumulative exposure much (compare scenarios F and G).

If Rosneft's North Chayvo block, which overlaps the feeding ground, is also surveyed, the predicted total exposure is much greater (compare scenarios G and H). It is unclear how much of the North Chayvo block is actually likely to be surveyed in 2015, as the westernmost part of it may be too shallow for a streamer survey.

Histograms of mean numbers of completed and aborted lines by scenario are shown in Figure 5, on the assumption of the behavioural shutdown rule being in place. Only for the North Chayvo block would the shutdown rule be predicted to extend the duration of the survey substantially.



Note: nighttime A-ban refers to ban on surveying A-lines (those predicted to ensonify part of the feeding ground with > 156 dB_{SEL}) at night or in poor visibility

Discussion

The results show that the revised schedule for the 2015 Piltun-Astokh survey would be expected to result in higher acoustic exposure of the whales on their feeding ground than the original schedule considered by the Noise Task Force at its 7th and 8th meetings (NTF-7 & NTF-8), which would in turn have been expected to result in considerably more exposure than the 2010 Astokh survey. The results also show that the combinations of Sakhalin Energy and ENL surveys are expected to result in a considerably greater exposure than the Sakhalin Energy survey alone, and that the new schedule is not predicted to reduce the total exposure for the combined surveys. If Rosneft's North Chayvo block is also surveyed, the total exposure is predicted to be greater still, by a substantial amount.

In view of the very high predicted exposures arising from the survey of the North Chayvo block, there is a case for postponing the survey of this block, to allow time for consideration of less invasive alternatives for all or part of the block, such as land-based surveys. Alternatively, the block should be surveyed early, before the arrival of significant numbers of whales.

The analyses in this document are necessarily crude, given the limited information, especially for the non-Sakhalin Energy surveys, and the limited time available. In order to improve the quality of such analyses, estimates of predicted exposures should form part of the normal planning process for seismic surveys at an early stage, so that decisions on scheduling and other mitigation options can be made on a scientific basis.

REFERENCES

IUCN. 2014a. Report of the Western Gray Whale Advisory Panel at its 15th Meeting (December 2014). http://www.iucn.org/wgwap/wgwap/meetings/.

IUCN. 2014b. Report of the Noise Task Force at its 8th meeting (Washington DC, November 2014). http://www.iucn.org/wgwap/wgwap/task_forces/noise_task_force/

Appendix II

WGWAP Statement of concern with respect to proposed seismic activity on the Sakhalin shelf in 2015

IUCN postponed WGWAP-16 because Sakhalin Energy had not delivered expected information and documents in a timely fashion or in some cases, at all. Instead, IUCN hosted an informal working group meeting at its headquarters in Gland from 27-29 April 2015[1] (comprising the Panel, IUCN, Sakhalin Energy staff and NGOs).

The Panel is very disappointed at this breakdown of communication since early 2015 and the absence of some essential information. This was particularly problematic with respect to the Panel's ability to provide final advice for monitoring and mitigation of Sakhalin Energy's planned 2015 seismic survey.

In the absence of complete information, a formal WGWAP-16 Panel meeting and hence a formal Panel report with recommendations, the Panel makes the following *Statement* based on the information that was available to it on 8 May 2015. As noted below, the basis for this includes some information provided by Sakhalin Energy during and shortly following the informal meeting. The Panel is also hoping to complete some additional modelling work that takes into account the new information but this is complex; if and when those results become available, this may necessitate an additional statement from the Panel.

Whilst the statement focusses on the 2015 seismic programme, the Panel notes that there are other activities that may disturb gray whales in the Sakhalin area, including possible entanglement in fishing gear and other non-seismic activities of the oil and gas companies. These should be included in any full assessment of cumulative impact but at present there is insufficient information to support such an assessment.

Background to the proposed 2015 seismic surveys

The Panel began working with Sakhalin Energy to develop a monitoring and mitigation plan (MMP) for the Company's proposed 2015 seismic survey in October 2013 (Noise Task Force meeting[2]) based upon the MMP that had been developed for a 2010 seismic survey and subsequently used as a case study to inform guidelines for responsible practices to minimise impacts of seismic surveys on marine mammals (Nowacek *et al.*, 2013). The total area of Sakhalin Energy's proposed 2015 survey is twice that of the Company's 2010 survey.

The primary mitigation measure advised by the Panel is for seismic surveys at Sakhalin is to ensure they are completed as early in the season as ice conditions allow and before peak numbers of whales have reached the Piltun feeding area. This was again the principal measure around which the MMP was developed for the 2015 survey, expected to begin around 10 June and last for about 30 days.

[1] http://www.iucn.org/wgwap/wgwap/meetings/wgwap_wm/
[2] Report available at https://www.iucn.org/wgwap/wgwap/task_forces/noise_task_force/

Some relaxation of provisions in the 2010 MMP was justified given this mitigation objective to complete the survey before most of the whales had arrived.

In October 2014, when development of the MMP for the planned 2015 Sakhalin Energy survey was approaching completion, the Panel learned that Exxon Neftegas Ltd (ENL) was also planning a major seismic programme (including some work on behalf of Rosneft), part of which is near the 2015 Sakhalin Energy survey off Sakhalin. However, as ENL does not seek the Panel's advice, detailed information on that company's plans was not available. It was nonetheless clear that the combined level of planned seismic activity adjacent to and inside the primary gray whale feeding area off Sakhalin was greater than had ever before occurred and therefore that the Panel needed to take the ENL surveys into account when providing advice regarding the 2015 season.

The Panel has long been aware of the problem that only one operator among several participates in the WGWAP process, and of the difficulties this brings for Sakhalin Energy. The Company's continuing engagement in the WGWAP process, especially given these circumstances, is appreciated by the Panel as well as IUCN and other groups that are active participants and contributors (e.g. some Russian authorities, lenders and NGOs).

Advice provided at the end of 2014

After a final NTF meeting (NTF-8[2)]) in November 2014, the Panel provided its advice in the WGWAP-15 report issued in December 2014[3]. In summary, the Panel concluded that from a precautionary perspective, it would not be appropriate for both companies' full proposed seismic programmes to take place in a single season given the predicted and prolonged ensonification beyond the threshold that has been shown to result in behavioural disturbance of almost the entire gray whale coastal feeding and especially nursery area. With the available information on the ENL surveys at that time, the Panel estimated that (1) the cumulative sound exposure of gray whales during the 2015 Sakhalin Energy survey would be greater than that during the 2010 survey (which could result in the whales moving away from their preferred feeding area) and (2) the cumulative exposure resulting from the 2015 ENL surveys would be considerably greater than that from the Sakhalin Energy survey. The Panel recommended that serious consideration be given to postponing either the Sakhalin Energy survey or the ENL surveys to 2016 (recommendations WGWAP-15/007 and 008). The Panel urged the companies to work together to develop a solution. The Panel also agreed on an MMP for the Sakhalin Energy survey *subject* to the provision of important information to show that the Company was prepared to implement the MMP successfully, and assuming that the seismic survey would start as soon as ice conditions permitted. It also recommended that other companies follow the same approach with appropriate modifications taking into account the details of their surveys.

The Panel's position on 7 May 2015

Through a meeting of the Biodiversity Group (BG) of the Environmental Council under Supervision of the Governor of Sakhalin Oblast on 4 March 2015, the Panel was first informed, in broad terms, of the arrangement that had been agreed by the two companies. To avoid simultaneous seismic shooting

[3] Report available at: https://www.iucn.org/wgwap/wgwap/meetings/

(which could (a) make results uninterpretable from the business perspective; (b) ensonify the whole gray whale feeding area; and (c) create a more complex sound exposure context that could complicate and exacerbate behavioral reactions of whales), they had agreed to stagger the Odoptu ENL survey and the Sakhalin Energy Piltun-Astokh survey, such that the Sakhalin Energy survey would begin only once that portion of the ENL survey closest to the feeding area (known as 'A' lines) has been completed. This means that the Sakhalin Energy survey would begin about one month later than had been anticipated when the 2010 MMP was modified in collaboration with the Panel at the end of 2014. Part of the companies' rationale for this approach was that it would avoid ensonification of the entire feeding area at a given time, and thereby allow the whales 'quiet' areas as potential refuge from high disturbance areas. To the Panel's knowledge, no exposure modelling has been conducted by either company or both to examine the implications of the new joint agreement with regard to the timing and nature of cumulative acoustic exposure of gray whales. This is in spite of the Panel's explicit reference in its WGWAP-15 report to the need for such modelling and its expressed willingness to assist in such modelling noted by IUCN/the Panel at the BG meeting in early March.

Sakhalin Energy 2015 survey

The Panel expected to receive detailed new information on Sakhalin Energy's plans for the 2015 survey well in advance of the planned WGWAP-16 meeting in late April 2015; as noted above, the information did not arrive and IUCN postponed the formal meeting. At the working meeting, Sakhalin Energy provided additional information on some aspects of the survey, as follows:

(1) The sound source and particularly the configuration of the airgun array have been modified since the Panel's meeting at the end of 2014 (WGWAP-15) with the aim of reducing the acoustic energy expected to enter the feeding area and the modelled estimates will be verified in the field. No information was available during the meeting on the effect this change would have on the cumulative modelling as performed by the Panel in 2014 (Cooke, 2014[4];). The Panel nevertheless welcomed this new information and will attempt to complete some additional cumulative modelling based on the new sound source as soon as possible.

(2) The Company may shoot some 'A' lines at night for operational reasons due to tides (this possible need arises out of the changed start date). This would not be consistent with the agreed December 2014 approaches to 2015 MMP and no modelling results to investigate the implications for gray whales were presented to the Panel at this meeting. (3) Some information was provided informally on preparations for practical implementation of the MMP at the meeting. These have also been included in Sakhalin Energy's recently updated response to the WGWAP-15 recommendations (ref). As noted above, the Panel had noted that its support for the 2015 MMP as of December 2014 was **conditional** upon timely receipt of certain information from the Company concerning implementation that satisfied its concerns (see NTF-8 and WGWAP-15 reports). This was stressed as being especially important given the much greater scale of the 2015 survey than the 2010 survey.

Given that the start of the Sakhalin Energy survey is only two months away, the Panel is extremely concerned by the limited information it has received thus far and also by the nature of some of that

[4] Appendix 1 in http://cmsdata.iucn.org/downloads/report_wgwap_15___15_dec_2014_final.pdf

information. The company's proposed MMP was not received by the Panel until 5 May. While pleased finally to receive this document it is unclear why it was not completed and provided prior to the working meeting so that the Panel could have discussed it together. As it is, an initial review shows that it is not in complete accord with the WGWAP-15 recommendations, for example with respect to (a) now allowing for shooting of some A-lines at night and (b) the lack of application of restrictions to all animals, not just mother-calf pairs, after 15 July – although not yet in the revised Sakhalin Energy MMP seen by the Panel, the Company has recently confirmed that it will apply mitigation to all gray whales after 1 August in accord with its response to the WGWAP-15 recommendations[5], not just mother-calf pairs. In terms of the practical implementation of the MMP in 2015, the Panel has a number of important difficulties in assessing the readiness of the company. The implementation of the MMP is complex as witnessed during the 2010 survey. Major challenges face the newly-appointed leader of the survey command centre, who did not participate in implementation of the 2010 MMP or in development of the 2015 MMP. The Panel remains concerned about: (a) the experience and capabilities of the leaders of the four behaviour observation teams (who are still unknown to the Panel); (b) the lack of advanced field testing of the new technology (e.g. night vision) and a protocol for such testing (this is not anticipated to occur until the Lunskoye survey early in the season); lack of information in the revised MMP on the role of the chase vessel in the proposed pre-dusk scans and whether MMOs will be on board and when; (d) installation of the 'Big-Eye' binoculars and training of the operators; (e) the ability of the MMOs on-board the vessel(s) to carry out their many duties and have adequate rest periods (while expected, the daily schedule for MMOs has not yet been received); and (f) the communication protocols – hardware and software to be used to integrate, visualise and archive data in the field and how a smooth communication process will be achieved among the various monitoring teams and platforms. The Panel recognises that operational matters are the responsibility of the Company. However, the Panel can only **conclude** at this time that it is not confident the outstanding logistical and practical issues can be resolved in the limited time available before the survey begins.

A positive point with respect to the proposed 2015 survey is that Sakhalin Energy has agreed to allow an Independent Observer (appointed by and reporting to the IUCN, acting in cooperation and under advice from the Panel) to monitor all aspects of MMP implementation during the survey and indeed the Company will provide all necessary support to allow this individual to carry out his responsibilities. The Independent Observer's report will be reviewed by the Panel and made publically available on the WGWAP web site.

ENL 2015 surveys

ENL has stated in a number of forums that its seismic survey MMP meets 'IUCN guidelines' (presumably meaning Nowacek *et al.*, 2013 and an associated brochure produced by IUCN in collaboration with the Panel[6]). Whilst we welcome ENL's acknowledgement of the value of the approach that has been developed collaboratively by the Panel, Sakhalin Energy and IUCN, we stress that ENL has not provided the Panel with any detailed information on its MMP or on how it was developed (in spite of repeated requests that it do so). Therefore the Panel cannot verify whether

[5] http://iucn.org/wgwap/wgwap/recommendations/

[6] https://www.iucn.org/wgwap/best_practices/

ENL's MMP does or does not conform to the 'IUCN guidelines'. To the Panel's knowledge, there is also no plan for an Independent Observer to be present.

Conclusions

The Panel is not in a position to evaluate the feasibility of either Sakhalin Energy or ENL modifying its MMP at this late stage. Nor can the Panel assess the consequences of any such modifications on gray whales off Sakhalin without the necessary information.

However, the Sakhalin Energy survey alone will result in considerably greater cumulative sound exposure of whales on the Piltun feeding/nursery area than previously estimated for this survey alone (Cooke, 2014), given the later start time for the survey. This also calls into question the decision to allow relaxation of some of the provisions in the 2010 MMP that was made when the Panel believed that the survey would take place one month earlier.

We recognise there are major business and financial implications for the Company in delaying the survey until 2016 and we acknowledge and appreciate the fact that Sakhalin Energy has demonstrated a great deal of co-operation and openness compared to other operators. Nonetheless, given the circumstances described above and from a precautionary scientific perspective, further to its recommendation WGWAP15/-008 that Sakhalin Energy 'reconsider' its plan to conduct the seismic survey in 2015, the Panel now **concludes** that from a precautionary perspective, Sakhalin Energy should not conduct the survey in 2015 but should postpone it to 2016. This would allow: (1) the survey to begin as early in the season as ice conditions allow; (2) more time to prepare fully for effective implementation of the MMP; and (3) less overall sound exposure of gray whales during the 2015 season (i.e. only the ENL surveys would occur).

The Panel **stresses** that this unfortunate state of affairs that major seismic activities from several companies can take place without an integrated environmental impact assessment should not allowed occur again. The Panel **strongly believes** that the importance of more dialogue among the operators, the authorities, other stakeholders and the Panel on how to address the issue of cumulative acoustic impacts on gray whales off Sakhalin in a multi-operator context is greater than ever before.

Appendix III

Company response in relation to WGWAP Statement of 8 May 2015

Sakhalin Energy 2015 Piltun-Astokhskoye 4D Seismic Survey

Sakhalin Energy plans to conduct a 4D Seismic Survey in July 2015 with objectives to undertake seismic monitoring of hydrocarbon production and water injection at the Piltun-Astokhskoye field, and to provide a 3D image for planning of future production wells from the existing facilities. Reservoir monitoring seismic surveys are required to contribute to efficient and effective production of hydrocarbons from the fields that the Company operates.

On 8 May 2015, the Western Gray Whale Advisory Panel (WGWAP) issued a public Statement relating to the planned 4D Seismic Survey of Piltun-Astokh.

Sakhalin Energy has extensively and openly engaged with external stakeholders, and continues to engage actively with the WGWAP. The Company welcomes the comment of the Panel that they "*acknowledge and appreciate the fact that* ***Sakhalin Energy has demonstrated a great deal of co-operation and openness*** *compared to other operators*."

- A large quantity of information has been shared and openly discussed at meetings of the Noise Task Force and WGWAP since 2013, and on other meetings where representatives of the Panel were present, as shown in Appendix 1.
- In particular, the draft Monitoring and Mitigation Plan for the survey was provided to the NTF-7 in October 2014 (NTF-7/4), has been further discussed in detail on subsequent meetings, and the latest version of the document (with a limited number of changes) was provided following discussions at the April Working Meeting.
- It was regrettable that some key reports and information was not provided by the Company prior to the April Working Meeting, to allow for review by the Panel. Ways to prevent this occurring in the future have been discussed and agreed amongst IUCN, the Panel and the Company.

Sakhalin Energy's **Monitoring and Mitigation Plan** (MMP) adopts best practices and adequately mitigates risks. State Environmental Expert Review has issued a positive decision supporting the environmental impact assessment for 2015 seismic survey including proposed monitoring and mitigation measures.

- *Start date and survey timing*. Initially the Company planned to commence the 2015 4D Seismic Survey as early as practicable following ice free conditions (that is, an expected start date of 10 June).

As recommended by the Panel, and in consultation with Exxon Neftegas Limited (ENL), the Company gave serious consideration to postponement of survey activities into 2016. However, particularly in the light of details of future ENL/other company activities that became available after the Panel's statement, it was determined that postponement was not feasible because those activities for 2016-2017 (including construction activities, presence of vessels, materials reloading, and movement of modules through the mouth of Piltun lagoon), will make it either technically infeasible or impractical for the Company to record a seismic survey at that time due to an unknown degree of data quality degradation and unknown operational delays (longer survey period, re-recording of lines), with no practical reduction in potential exposure for marine mammals. The Company stresses that many development activities are critically dependent on 4D seismic information and not having this information will lead to potentially sub-optimal development decisions by the Company.

A key recommendation of WGWAP-14 and WGWAP-15 was that the companies work together to develop a suitable practical arrangement that will result in reduced acoustic disturbance on the feeding/nursery grounds and thus would represent an environmentally responsible way forward. The Companies decided not to pursue 24 hour time sharing across both survey areas, rather to record one survey and then the other, which leaves some relatively less-ensonified areas within the feeding ground at all times.

The environmentally most sensitive areas (A lines) for both surveys must be recorded first. It became apparent that the majority of sensitive areas are within the ENL Odoptu survey area, hence Sakhalin Energy agreed for ENL to record the Odoptu survey A lines first, and to delay the Piltun-Astokh survey to July. Currently the Company is planning for earliest start date 1 July (based on the currently observed relatively fast melt rate of ice, and based on efficient completion of the ENL Odoptu survey A lines) and a latest start date 12 July (in case of late ENL Odoptu survey A lines completion).

- *Positive development – Reduced number of A lines.* A significant improvement was achieved through optimization of the Seismic Airgun Array, reducing the size of the source from 3,250 cu-in to 2,888 cu-in. This results in a reduction in the shoreward reach of the sound exposure level contours, meaning that sound exposure levels for whales in the feeding area are reduced, and the number of high priority A lines is reduced from 24 to 19 (out of total 36 seismic acquisition lines). Furthermore, although modelling indicated a safety distance of 1600m, the Company will adopt a safety distance of 2000m in accordance with the SEER conclusion.
- *Behavioral shutdown rule.* The Panel agreed that the behavioral shutdown rule (i.e. shutdown of survey operations based on specific whale location/behavioral criteria) be applied for only mother-calf animals (not to all whales) up to 15 July (by which time whale abundance is expected to have reached at least 75% of its maximum level). The Company welcomed this modification of the shutdown rule, although the date of 15 July was not discussed with Company. The Company anticipates that it will not be practicable to record the A lines if the rule is applied for all whales on this date, because of the high number of shutdowns which would greatly delay the acquisition completion (this is in fact confirmed by Panel member Cooke's modelling).

After 1 August the mitigations discussed in the MMP would apply to all whales not just mother-calf pairs. The Company will adhere to the date of 1-August which was agreed as the time at which whale abundance probably reaches it maximum level. Prior to this date, a trade-off can be made between protection of individual whales "now" and protection of a larger group "later". Note that this issue may possibly be avoided or minimized if early start date (1 July) can be achieved.

- *Potential for night time recording.* Unfortunately, the changed start date potentially impacts the daily recording timing of the survey, as follows: (a) To avoid poor data quality due to 'feathering' of the streamers, meaning that streamers are dragged off alignment by the movement of the tide, it is important to record the line during a period of minimal tidal movement (e.g. low tide), and (b) To achieve technical data quality and comparability requirements, it is important to record each of the lines at the same time in the tidal cycle as was done for the 1997 baseline survey.

In this case, due to tidal conditions in mid-July, there may be times when the required west feathers (i.e. low tide) occur during the night (or partially during the night).

If the Piltun-Astokh survey would start late (12 July), the commitment to acquire during daylight can clash with requirement to align with tidal cycle, possibly forcing acquisition of those lines into periods of night time. Ignoring the tidal cycle would lead to feather mismatch, requiring infill lines (repeated recording) thus extending the total survey duration. Alternatively, postponing the start date until favourable tidal conditions may move the survey into peak whale numbers (August). Note that this issue would be avoided if an early start date (1 July) can be achieved. However, planning considers the range of possibilities.

- *Cumulative model*. The Company welcomes the results of the updated cumulative model (published by

Panel member Cooke http://www.iucn.org/wgwap/wgwap/meetings/wgwap_wm/ technical supplement).

The modelling results show that **night time acquisition is beneficial to cumulative distribution of maximum exposure and cumulative exposure**; this is due to the reduced overall survey duration when relaxing night time recording. The results also show that the **behavior shutdown rule has little effect on both maximum and cumulative exposure**. This conclusion is in accord with the spreadsheet modelling developed by the Company and the Task Force. The Panel's statement was released before the results of the modelling by Cooke became available.

Operational preparations involve are currently being implemented by the Company in order to achieve the requirements of the MMP.

- Information is continuing to be shared by the Company to WGWAP, such as Marine Mammal Observer(MMO) schedule, and the WGWAP Statement of 8 May included additional new requests for information from the Company. The Company continues to be open to share such information. However, the Company notes that the WGWAP engagement process (formalized Task Forces and Panel meetings) is not formally designed, to enable frequent discussion of operational details leading up to a survey or to allow the Panel to make conclusions about logistical and practical preparedness.

- Operational preparedness is firmly the responsibility of the Company. An Independent Observer is in place to verify implementation.

- As stated earlier, for future surveys and similar activities, the Company is discussing with IUCN the necessity to agree in detail what information is expected to be provided by the

Company for review of the Panel and by what time. This will be discussed and agreed at the conclusion of the survey considering feedback from all parties.

In conclusion, the Company will take all necessary and reasonable measures to implement the MMP during the 2015 4D Seismic Survey, and in particular to record high priority (A) lines as soon as possible and prior to 1 August. Revised modelling supports this approach and reveals the plans to be safer than the Panel's Statement assumed. An Independent Observer will be present in the field to report to the WGWAP on implementation of the MMP.

Appendix 1

Engagement event	**Topics relevant to 2015 4D Seismic Survey**	**Information shared**
WGWAP-13 Meeting May 2013, Tokyo	Company reported planning for 4D Seismic Survey of Piltun Astokh in 2015 as part of ongoing reservoir monitoring, and that repeat surveys may be foreseen approximately every 3 years thereafter (WGWAP-13 report).	• Multiple reports relating to mitigation and monitoring applied during the 2012 Seismic Survey.
Noise Task Force Meeting 4 (NTF-4) May 2013, Tokyo	At the initiative of Sakhalin Energy, NTF meeting was held to discuss, among other topics, the details of 2015 4D Seismic Survey.	• Summary and discussion of 2015 survey (NTF-4 report section 6.2) including survey area, planned mitigation measures, and planned survey design information.
NTF-5 Meeting Oct 2013, Amsterdam	Discussion of 2015 4D Survey status of preparation, scheme of work, design and technical parameters, EIA, and details of the MMP.	• Presentations on status, work scheme, design and technical parameters, EIA and MMP are summarized in the publically available NTF-5 report.

Engagement event	Topics relevant to 2015 4D Seismic Survey	Information shared
NTF-6 Meeting April 2014, Amsterdam	Discussion of 2015 4D Survey including update on progress, work/analyses including presentation on initial acoustic modelling, progress on consideration of appropriate sound levels with regard to mitigation in light of analyses since 2010 and case studies, MMP, and other known activities on the Sakhalin shelf.	• NTF-6/5 Presentation on 3D/4D Seismic Plans, Piltun-Astokh, Sakhalin Energy 2014-2016. • NTF-6/6 Presentation: Summary of mitigation measures for past surveys. • NTF-6/7 Presentation: Analysis of pulse levels at tracked whales in 2012 South Piltun HR2D seismic survey. • NTF-6/8 Presentation: “Initial acoustic modelling of planned 2015 Piltun-Astokh 4D seismic survey.
WGWAP-14 Meeting September 2014, Sakhalin	Company described plans for the 350 km² streamer seismic survey across Piltun-Astokh, to be a repeat of 1997 3D baseline surveys. Confirmed intention to begin the survey as early in the season as ice conditions allow, i.e. by around 10 June. ENL presented information on planned 1600 km² survey of Odoptu, Chayvo and Arkutun-Dagi licenses, as well as Rosneft’s North-Chayvo license area. Recommendation from Panel for companies to work together to synchronize surveys.	• Presentation summary of 2015 Survey plan. • Written summary from ENL on planned 1600 km2 survey of Odoptu, Chayvo and Arkutun-Dagi licenses, as well as Rosneft’s North-Chayvo license area.

Engagement event	Topics relevant to 2015 4D Seismic Survey	Information shared
NTF-7 Meeting October 2014, Sakhalin	Discussion of updates of other activities on the Sakhalin shelf in 2015, update on progress for the 2015 seismic survey by the Company including Status of tender including technical parameters (vessel size, arrays, streamers, etc.) and Project plan, update on work/analyses for the 2015 survey including progress on acoustic modelling work completed for Piltun-Astokh survey, update on appropriate sound levels with regard to mitigation, Delineated Feeding Boundary (DFB) and Perimeter Monitoring Line (PML), review of behavior and distribution monitoring, and review of the proposed revised MMP.	• NTF-7/3 2015 4D Survey Technical Note by Sakhalin Energy. • NTF-7/4 **2015 Monitoring and Mitigation plan for the 2015 Piltun-Astokh 4D seismic survey.** • NTF-7/6 -1,2,3 Presentation: 2015 Survey simulations, including two detailed spreadsheets (with update and 2010 line register shared after NTF-7). • NTF-7/7 Presentation: Discussion proposal for a revised behavioural protection approach for Piltun-Astokh 2015 4D survey.

Engagement event	Topics relevant to 2015 4D Seismic Survey	Information shared
NTF-8 Meeting Nov 2014, Washington	Discussion of update on survey logistics, details of the accepted tender including technical parameters, progress on time-sharing options, analyses for the 2015 survey including acoustic modelling, review of the simulations modelling work, review of behavioral criteria for shutdowns, review of the MMP, and discussion on independent observer.	• NTF-8/3 Sakhalin Energy Line register of 2010 4D Astokh survey. • NTF-8/4 (Revised, version 2) Comprehensive map of 2015 seismic survey theatre and information on onshore behavioural sampling protocols to be conducted during 2015 4D seismic survey, submitted ahead of NTF-8 with updates made during NTF-8 meeting. • NTF-8/5 Set of modelling output maps for 2015 P-A 4D seismic, based on the latest airgun array source design with the annotation, submitted ahead of NTF-8. • NTF-8/7 Presentation: Update on 2015 4D Survey. • NTF-8/8 Presentation: Modelling 2620 and 3255 in3 airgun arrays: Horizontal directivity patterns and comparison between Nucleus and AASM vertical signatures. • NTF-8/9 Presentation: Updated acoustic footprint modelling of planned 2015 Piltun-Astokh 4D seismic survey. • NTF-8/16 -1,2 Two versions of MMO shifts for 2015 4D seismic survey.

Engagement event	**Topics relevant to 2015 4D Seismic Survey**	**Information shared**
WGWAP-15 Meeting, December 2014 Virtual teleconference	Discussion of items arising out of NTF-8 and formal Panel findings, conclusions and recommendations.	• WGWAP-15/6-2 Written update received from Sakhalin Energy with the latest update since NTF-8 on OBN & time-sharing issues in response to the ENVIRON comments (WGWAP-15/6-1). • WGWAP-15/7 Written response received from Sakhalin Energy with regards to the Panel's questions on OBN survey issues.
Environmental Impact Assessment public consultations, January 2015	Public consultation conducted in accordance with environmental and social impact assessment requirements.	
Biodiversity Group Meeting of Sakhalin Oblast MNR, March 2015, Yuzhno - Sakhalinsk	ENL and Sakhalin Energy presented an overview of their combined schedule for the 2015 seismic surveys, and the Companies presented an overview of their respective mitigation plans, to an audience including IUCN representatives and a member of the WGWAP.	• Presentation by ENL. • Presentation by Sakhalin Energy.
Interdepartmental Working Group MNR Meeting April 2015, Moscow	ENL and Sakhalin Energy presented an overview of their combined schedule for the 2015 seismic surveys, and the Companies presented an overview of their respective mitigation plans, where a member of WGWAP was present.	• Presentation by ENL. • Presentation by Sakhalin Energy.

Engagement event	Topics relevant to 2015 4D Seismic Survey	Information shared
WGWAP Working Meeting April 2015, Gland	Update on 2015 Seismic Survey planning preparations and MMP, including feedback from MNR/IWG, Survey scope of work, details of time scheduling and synchronization of ENL and Sakhalin Energy surveys avoiding simultaneous seismic survey activity at Odoptu and Piltun-Astokh, Survey specifications including reduced source sizes and modelling results resulting in reduced number of A lines, summary of implementation of the MMP, and key changes in mitigation measures including reduction of the number of A lines, changed start date to follow Odoptu survey, and resultant change in influence of tides on acquisition timing (mid July).	• Presentation and discussion including updated information as listed.

Appendix IV

Jasco Model

Appendix V

SOME ASPECTS OF COMMUNICATIONS REGARDING THE 2015 SEISMIC SURVEY

Note that this includes requests for advice that may lead to action (items 1 and 2) and items simply concerning provision of information (items 3 and 4)

(1) 'Advisory Group'

An Advisory Group of Panel Members has been established, as for the 2010 survey, comprising Donovan, Nowacek, Reeves, Southall, Vedenev and Weller. The primary purpose of the Group is to be available to provide advice to the Company, if for example circumstances lead the Company to consider modifying its MMP. The Independent Observer (IO), Grisha Tsidulko, may also seek formal advice from the Advisory Group should he so wish following a similar process to that detailed below for the Company.

One rationale for establishing such an Advisory Group for the 2010 seismic survey had been to assist with the interpretation of the sound source verification (SSV) experiment to determine the size of the exclusion zone; this had to be done within 24hrs of the experimental results becoming available. A similar process was also intended for the 2015 survey but the SEER decided recently that the exclusion zone would be set at 2km. The Company has therefore decided that a SSV experiment will not take place – that aspect of the Advisory Group's work has thus been removed.

It is recognised that if *formal* advice is sought on any matters, it is likely that a quick response will be required; it is also recognised that the availability of individual members of the Advisory Group will vary throughout the seismic survey period. Hence, it has been decided that two members is considered 'quorate' and the following approach should be followed if the Company decides to seek advice:

(1) an email will be sent by the Central Commander (Di Matteo) to all members of the Advisory Group – this will be cc'd to van der Veen, Lock, Carbone and Berzina;

(2) the Advisory Group members will respond immediately to indicate their availability;

(3a) assuming that at least one or both of Reeves and Donovan are able to respond, he/they will arrange for an 'Advisory Group' view to be sent to the Company in writing within 1-2 days – this will comprise the views of those who indicated that they are able to respond within the timeframe and may be the result of a conference call or written exchange of comments;

(3b) in the unlikely event that neither Reeves nor Donovan is able to respond, then the Advisory Group members who are available will arrange for a single response to be sent within the 1-2 day timeframe.

(2) Important issue(s)1 identified by the IO regarding MMP implementation or ability to perform his duties

The IO will immediately inform the Central Commander, van der Veen and Lock via available means of communication (preferably in writing, however in cases this is not possible at the time, this will always be followed up in writing as soon as feasible thereafter), cc'd to Carbone, Berzina, Reeves and Donovan. The Company will respond in writing within 24 hours and cc this response to the IO, Carbone, Berzina, Reeves and Donovan; if they deem it necessary, IUCN may also organise a conference call.

(3)) Weekly summary report from the IO

The weekly report shall be sent to IUCN (Carbone) and cc'd to Lock, van der Veen, Di Matteo, Donaghy, Berzina, Donovan, Reeves, Hancox and Mate, as well as to the full Advisory Group.

(4) Items for information only from the Company and/or the IO to IUCN and the Panel Co-chairs

Items that are for information only (e.g., events that required fast/immediate decisions in the field without an opportunity for formal consultation, other important-to-know observations, events or decisions) that IUCN and the Panel Co-chairs should be aware of, but for which formal advice is not required/possible, shall be sent to IUCN (Carbone) and cc to van der Veen, Lock, Berzina, Donovan and Reeves. This will be shared with the full Advisory Group at the discretion of IUCN and the WGWAP Co-Chairs.

List of contact emails referred to above

IUCN: Giulia Carbone (giulia.carbone@iucn.org, + 41 79 956 7905; +39 366 714 6867); Anete Berzina (anete.berzina@iucn.org, +41 79 174 61 86).

IO: Grigory Tsidulko (iosakhalin@gmail.com)

Advisory Group: Greg Donovan (greg.donovan@iwc.int); Randy Reeves (rrreeves@okapis.ca); Douglas Nowacek (doug.nowacek@duke.edu); Brandon Southall (Brandon.Southall@sea-inc.net); Alexander Vedenev (vedenev@ocean.ru); Dave Weller (dave.weller@noaa.gov)

Company: Stephanie Lock (S.Lock@sakhalinenergy.ru, +7 914 7599838); Antonio Di Matteo (Antonio.DiMatteo@shell.com); Marko van der Veen (Marko.vanderVeen@sakhalinenergy.ru, +7 914 7594180); Mike Donaghy (mike@donaghy.eu)

Lender representatives: Jon Hancox (JHancox@environcorp.com); Bruce Mate (bruce.mate@oregonstate.edu)

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1 Small matters that can be fixed promptly will be dealt with in person by the IO with the Central Commander

Appendix VI

Sakhalin Energy Monitoring and Mitigation Plan for Piltun-Astokh 4D Seismic Survey

April 2015 Version

INTRODUCTION

The planning for the 2010 Astokh and 2015 Piltun-Astokh 4D seismic surveys represented a major investment of time by the Western Gray Whale Advisory Panel (WGWAP), Sakhalin Energy and the Seismic Survey Task Force (SSTF) and Noise Task Force (NTF) of the WGWAP.

Fundamentals of 2010 MMP

The 2010 Monitoring and Mitigation Plan (MMP) continues to be one of the most complete whale-focused MMPs developed for a seismic survey anywhere in the world[7]. The 2015 MMP is based on the 2010 MMP. The fundamental rationale behind the mitigation component in 2010 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 2010 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 had 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 Seismic Survey Task Force (SSTF) in drawing up the 2010 MMP.

Scope and timing of 2015 Seismic Survey

The 2015 Sakhalin Energy survey will be conducted offshore Sakhalin, covering an area of some 350km^2 around Piltun and Astokh platforms beginning in July 2015. The 2015 seismic survey will consist of longer survey lines than the 2010 survey, which covered only the Astokh field which was 145km^2.

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[7]Nowacek, D.P., Bröker, K., Donovan, G.P., Gailey, G., Racca, R., Reeves, R.R., Vedenev, A.I., Weller, D.W. and Southall, B.L. (2013). Responsible practices for minimizing and monitoring environmental impacts of marine seismic surveys with an emphasis on marine mammals. *Aquatic Mammals* 39(4), 356–377. doi:10.1578/AM.39.4.2013.356. , http://www.iucn.org/wgwap/best_practices/

The 2015 survey is predicted to last approximately 30 days (±10), including uncertainty in timing due to weather, fog, mitigation for whales, and other oil field activities that may be ongoing in the area.

Fundamentals of 2015 MMP

This document incorporates changes to the 2010 MMP that are applicable to the planned 2015 seismic survey. The MMP developed for the 2010 Astokh 4D survey forms the basis for the MMP for the 2015 survey, with modifications based on advances in both knowledge and technology in the intervening years.

The mitigation components of the 2015 MMP focus on survey design (e.g. the Company has minimized the survey area and the sound levels expected to reach areas of highest whale density) and on measures to be implemented during the survey. In terms of the latter, as for 2010 the primary mitigating principle remains starting as early as possible in the season and finishing the survey as quickly as possible , such that the survey occurs when fewest whales are present while still ensuring key protective measures.

The present document outlines the 2015 MMP as developed by the end of NTF-8 and updated in April 2015. For further details, refinements and the rationale for changes from 2010, the reader should consult the full series of SSTF and NTF reports which are available on the IUCN website[8]. The changes relate to aspects of the distributional and behavioural monitoring, the addition of information on the command centre, the refinement of the concept of A- and B-zones, and a change in protection afforded to whales within the behavioural threshold from all whales to only mother-calf pairs (NTF-8, Item 5) prior to 1-Aug 2015.

Survey schedule coordination with ENL

Exxon Neftegaz Limited (ENL) plans to conduct a seismic survey in 2015 on nearby Odoptu. ENL and Sakhalin Energy have cooperated to schedule the surveys, to avoid simultaneous surveys and to enable the environmentally most sensitive areas and lines (A Lines) to be recorded first.

ENL plan to start at Odoptu mid-June or as early as ice-free conditions allow. Sakhalin Energy's survey vessel will move to Piltun-Astokh as soon as possible, expected early July 2015, and will commence following completion by ENL of Odoptu A Lines, avoiding simultaneous seismic survey activity at Odoptu and Piltun-Astokh. The schedule as developed leaves at least some relatively less-ensonified areas within the feeding ground at all times during the seismic survey(s).

ENL and Sakhalin Energy presented an overview of their combined schedule for the 2015 seismic surveys, and the Companies presented an overview of their respective mitigation plans, at the Biodiversity Group meeting at Sakhalin Oblast MNR on 4 March 2015, and to IWG meeting 22 April.

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. Moreover, most of the monitoring measures are essential for implementation of the mitigation measures for the 2015 seismic survey.

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[8] http://www.iucn.org/wgwap/wgwap/

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 at locations where whales are observed (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 gray whales, to add to the existing knowledge base, and to contribute to the design of mitigation strategies for future seismic surveys.

Shore-Based Command Centre

It is essential for the efficient and successful implementation of the 2015 MMP that the key information from all sources is assembled in one place in near real-time to allow informed management decisions to be taken in a timely manner. A key component of the 2015 MMP is therefore a Command Centre that fulfils this consolidation role.

(1) The Command Centre (sometimes called the Base Camp) will be established on shore to coordinate implementation of the MMP and to ensure efficient communications among all teams at the various observation platforms and outposts;

(2) The Command Centre will be equipped to enable it to receive all real-time data and other appropriate information that is considered essential for overseeing MMP implementation including fact-based decision making;

(3) The Company will appoint a qualified MMP Coordinator who will be accorded single-point responsibility for implementation of the MMP. The MMP Coordinator will be able to maintain 24-hour contact with the seismic vessel and all monitoring teams on active duty as part of the MMP;

(4) The MMP Coordinator will be based at the shore-based Command Centre;

(5) An Independent Observer will be appointed and contracted by IUCN prior to the seismic survey and he or she will be deployed in the field and report on the implementation of the MMP. The Independent Observer will be housed at and will also operate from the Command Centre when not on inspection visits and will be granted full access to information in accordance with the terms of reference (e.g. to observation platforms).

Acoustic monitoring (perimeter and within area)

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

(1) Real-time monitoring of acoustic levels using sea-bottom receivers (automated underwater acoustic recorder (AUAR) stations) deployed on the PML will be undertaken during all periods of seismic source activity.

(2) There will be ten telemetric AUAR stations (some used in line of sight RF mode, others in Iridium satellite mode, others potentially in redundant dual mode) along the PML, with three-station clusters at each end and the remaining four optimally spaced in the intervening length.

(3) Functional integrity of the real-time monitoring infrastructure will be maintained by reactivating any failed node as soon as feasible. Subject to this underlying guideline, the following rules apply (for a definition of A and B lines please see a later section):

(a) If the failed station is a non-clustered one, normal acquisition can continue for a 48 hour period following the failure, after which only "safe" B lines (i.e. any line that is offshore of the boundary between A and B lines identified by the most recent model case plus a 3dB buffer) can be acquired until the failed node is restored;

(b) If the failed station is part of a three-unit cluster, normal acquisition can continue as long as no other station fails anywhere along the PML. If any second station fails, normal acquisition can continue for a 48 hour period following the failure, after which only 'safe' B lines can be acquired until both failed nodes are restored;

(c) Any partial A line can be acquired as if the PML was fully operational if the failed node(s) are behind the starting point of the partial line.

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

(5) There will be a direct radio link between the real-time acoustic monitoring acoustician outpost, which receives and processes the telemetry from the PML, and the MMP Coordinator.

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, at least three recording acoustic monitoring buoys will be deployed in the feeding area on or near the 10m isobath 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)

Behavioural and distribution monitoring will be conducted in the entire area inshore of the seismic survey area, supplemented by at least occasional observations to the north and south. Monitoring will commence at least one week before the start of the seismic survey and will continue during the survey and for at least one week after its completion. 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 survey operations occur.

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

(1) Behavioural and distribution monitoring will be conducted from the fixed shore-based platforms located along the area of coastline facing the seismic survey area. The entire potentially affected area shoreward of the PML must be covered. Monitoring will be conducted by four teams, each comprising four visual survey experienced specialists with directly relevant experience. Each team will consist of one a theodolite operator, one computer operator and two observers using reticle

binoculars. The distribution of the whales in the areas to the north and to the south of the seismic survey region (see the NTF-8 report) will be monitored occasionally by the photo-ID teams (see (2) below).

(2) Onshore photo-ID efforts will be made opportunistically in order to collect information about individual whales. As the coastal area is divided into two spits by the mouth of Piltun Lagoon, two vehicle-based photo-ID teams will be mobilised who will also carry out the occasional distribution monitoring (see (1) above).

(3) All onshore teams must report to the Command Centre in a timely manner i.e., at least daily but immediately if they have information to report that is of potential relevance to real-time mitigation.

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

(1) Gray whale distribution will also be monitored from the seismic vessel. Two Marine Mammal Observers (MMOs) are required for the task of 'distant' distribution monitoring (i.e. to detect whales near or shoreward of the PML) in addition to four MMOs who are responsible for monitoring the exclusion zone (insert distance) in close proximity to the seismic vessel. To ensure adequate coverage shoreward of the PML area, a pair of Big-Eye binoculars (one unit) will be mounted on the deck of the seismic vessel for use by MMOs trained in their use. These big-eye binoculars should be mounted such that they have an unobstructed view of the area near or shoreward of the PML whether the survey vessel is sailing in a northward or southward direction.

(2) Vessel-based MMOs must report to the Command Centre in a timely manner i.e. at least daily but immediately if they have information to report that is of potential relevance to real-time mitigation.

(3) Experienced MMOs will be stationed on the seismic vessel for the duration of the survey.

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

b) Single-point authority for operational shutdown related to marine mammal protection will lie with the on-shift Senior MMO on the seismic vessel;

c) The Command Centre will have direct radio access to the on-shift Senior MMO;

d) The MMOs will be located on the bridge or at the highest elevation available on the seismic vessel with the maximum viewable range from the bow to 90˚ port/starboard of the vessel;

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

f) There will be a minimum of two MMOs on watch on the seismic vessel for 20 minutes before start of ramp-up, at any given time during ramp-up, and shooting and throughout line acquisition for the 20 minutes before the start of ramp-up;

g) Occurrence and behaviour of whales will be documented in accordance with existing Marine Mammal Protection Plan (MMPP) 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. Actual start date is dependent on ice/weather and ENL completion of Odoptu A Lines (refer Section 1.4).

(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 in relation to whales (other than those observed in the exclusion zone near the seismic vessel) should be applied in the A zone 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) The area for which the additional mitigation measures are in effect (A zone) is defined by the overlap of the region inshore of the PML and the maximum shoreward extent of the 156 dB per-pulse sound exposure level (SEL) isopleths for the current acquisition line, bounded by the perpendiculars to said line tangent to the projection on the PML of the 156 dB per-pulse SEL isopleth for the current acquisition point.

(2) Before any lines are shot within the range currently predicted to exceed 156 dB per-pulse 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 re-tuned to match the observed levels. Based on the updated model predictions, shot lines for which an overlap is predicted between the 156 dB per-pulse SEL 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 PML, and, where indicated, retuning of the acoustic model, shall be repeated at regular intervals during the survey.

(4) In the event that the 156 dB per-pulse SEL threshold is exceeded at any receiver on the edge of the feeding ground while shooting a B line, the line shall be reclassified as an A line immediately.

Measures within the proximity of the seismic vessel – entire survey

(1) After more than 20 minutes of inactive source, ramp-up procedures will be followed 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 the exclusion zone of the source i.e. the circular area that encompasses the region ensonified above 180 dB RMS

SPL. The size of this zone is set at 2.0 km in accordance with the State Environmental Expertise Review conclusion.

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

(4) Various types of remote-sensing equipment[9] will be installed onboard the seismic vessel to try to detect marine mammals during periods of 'poor visibility'[10] (e.g. night, fog).

(5) 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.

Additional considerations for Zone A

A considered trade-off is thus required between avoiding the potential disturbance of a smaller number of animals present early in the season (i.e. prior to 1-Aug) against a larger number of whales that present later in the season (i.e. after 1-Aug) if operations are still ongoing due to temporary stoppages early in the season. Based on the available information and simulations (NTF-8, Items 3.2 and 5), the following conditions will apply for 2015[11]:

(1) A number of the survey lines (13 lines) positioned closest to shore, sailed from south to north in the 1997/2010 baseline surveys, will be acquired during daylight hours in 'good visibility', i.e. the PML must be within the effective sighting distance of a shore station or a distance monitoring team. If a choice is to be made between postponement (e.g. by two weeks to get a feather match between the line to be acquired and the baseline survey) or acquiring in poor visibility conditions, then that choice is made on the day weighing up all available information. If acquisition is planned to take place in poor visibility conditions then a pre-dusk scan will take place and it must confirm that no mother-calf pairs are present in the A-zone.

(2) No acquisition will occur if mother-calf pairs are observed in Zone A.

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[9] Including technology that blends images from different type of sensors, e.g. thermal, low-light and day light.

[10] "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 zone.

[11] This is a compromise necessitated by the fact that in 2015 survey lines are extending further north than in 2010, getting closer to Piltun Bay. If a future survey is restricted to Astokh again, the restrictions imposed on the A-zone may be reviewed once more.

Appendix VII

Behavioural Monitoring Protocol for 2015 4D Seismic Survey

Background

This document provides a brief summary of the current data collection and anticipated analytical approach for the proposed behavioural monitoring of 4D seismic survey that will be conducted near the gray whale feeding grounds during the summer of 2015. The objective of this study aims to 1) record potential subtle indicators of response of western gray whales in relation to vessel activity and sound levels associated with the survey, 2) identify obvious aberrant behaviour of western gray whales and communicate these observations to the senior Marine Mammal Observer (MMO) on the seismic ship, and 3) identify both inshore and offshore sightings of western gray whales to minimize their proximity to the seismic activity.

Observation Platforms

Behavioural monitoring will be conducted by the separate teams. Two or three teams consisting of a minimum of three people per team will conduct shore-based observations directly inshore of the seismic activity in areas that are expected to have the highest exposure levels.

Shore-Based Behavioural Monitoring

Shore-based behavioural monitoring will be consistent with previous (2002-2010) behavioural data collection protocols (see Gailey *et al.* 2008 for more details). Four separate methodological techniques will be employed:

1) Scan Sampling, 2) Focal-Animal Follow, 3) Theodolite Tracking, and 4) Shore-Based Photo-Identification.

Scan Sampling - To monitor the relative number and distribution of gray whales in the near-shore waters, scan sampling methods will be conducted hourly when focal behaviour sessions are not being conducted.

- Two observers use hand-held binoculars (7x50 with reticule and compass) to progressively scan the study area from North to South.
- Scan duration will be approximately 19.3 minutes with a rate of 9.33 °/min.

- Once an observer sights a whale or whales, then the number of whales, angular distance between the whale and the horizon (based on binocular reticules), magnetic bearing, and estimated distance from the station will be recorded.
- The special software, will be used to 1) inform the observers of the approximate region they should be scanning for every 10° magnetic North, 2) provide a data entry form to record sighting information and 3) calculate geographic position and visually display sightings in real-time.

Focal-Animal Follow – Focal behaviour sessions of behaviour and respiration events will be conducted on individual gray whales.

- Focal behaviour sessions will be initiated when all observers determine that a single whale could be monitored continuously and reliably enough so that respiration and critical behavioural events would not be missed;
- At least one behavioural observer would follow individuals with the aid of the hand-held binoculars (7x50); Behavioural observers verbally states each behavioural event (blow, peduncle arch, dive, breaching, etc.), and a computer operator records the event into a laptop computer;
- Observers are limited to 30 minute sessions before another observer takes their place in order to minimize observer fatigue;
- Most focal follow sessions are conducted simultaneous with theodolite tracking information thereby providing positional information associated with focal observation data.

Theodolite Tracking - The spatial and temporal movement patterns of gray whales will be monitored with a theodolite with 30-power monocular magnification and 5-sec precision. The theodolite tracking technique converts horizontal and vertical angles into geographic positions of latitude and longitude for each recording.

- Theodolite tracking sessions will be initiated when a single or an individually recognisable gray whale in a group could be identified;

- Individuals will be continually tracked until the animal is lost, moved beyond 5 km distance from the station, or when environmental conditions hampered further tracking;
- For each theodolite recording, the date, time, and vertical and horizontal angles are stored in a Microsoft Access database with the relative distance, bearing referenced to true North, and geographic position calculated in real-time;
- Behavioural states (travelling, feeding, feeding/travelling, socialising, etc.) are recorded with each focal and tracking session.

Shore-Based Photo-Identification - A digital camera with a lens will be used to photographically capture individual gray whales from shore. The typical distance of successful captures range up to 1-2 km depending on environmental conditions.

- Photographs are taken opportunistically from the station where behavioural observations are being conducted that day or in route to the station;
- Photo-identification can be conducted simultaneously with theodolite tracking and/or focal behavioural work;
- For each photographic session, the date, time, group number, corresponding number of behavioural track/focal observation, behaviour, group size, geographic location, card and frame numbers will be recorded.

Environmental Data - Environmental conditions will be recorded several times per day to ensure consistent and reliable results for all methodological techniques employed by the shore-based monitoring teams.

- The relative visibility, glare concentration and horizontal angles, swell heights, cloud cover and sea state (Beaufort scale values 0-4, with 3 being small whitecaps and > 3 generally unacceptable for most analyses except for movement patterns and when whales are < 2 km from the observation point) will be recorded;
- Hand-held weather stations will be used at each station to automatically record temperature, barometric pressure, wind speed, wind direction, humidity, and several other

environmental parameters at 10-min intervals throughout each day of effort at each observation station;

- Temperature and barometric pressure information are used to estimate a refraction correction for calculations of distance approximation.

Explanatory and Response Variables

Both explanatory and potential response variables derived from the scan, focal, and theodolite tracking data are currently being proposed to be similar to the multivariate analyses conducted previously (Gailey et al. 2013). Table 1 and 2 provides a brief overview of the proposed variables for analysis.

Table 1. Response variables derived from scan, focal follow and theodolite tracking observations.

	Variable	Definition
Movement Parameters	Leg Speed	Distance travelled between two sequential fixed points within a trackline divided by the time interval between the two points
	Acceleration	Changes within leg speed to determine if an animal is generally increasing or decreasing speeds within a trackline
	Linearity	An index of deviation from a straight line, calculated by dividing the net geographic distance between the first and last fix of a trackline by the cumulative distances along the track
	Mean Vector Length	A directionality index r dependent on angular changes - range from 0 (great scatter) to 1 (all movements in the same direction)
	Reorientation Rate of	Magnitude of bearing changes, calculated by the summation absolute values of all bearing changes along a trackline divided by the entire duration of the trackline in minutes
	Distance-from-Shore	Distance of animal from the closest perpendicular distance from the nearby coastline

	Ranging Index	Measure the minimal diagonal area of the whale's track incorporating its course and track duration
Respiration Parameters	Blow Interval	Times less than 60 s between subsequent exhalations per surfacing
	Dive Time	Any interval where exhalation period is greater than 60 s
	Surface Time	Duration the animal remains at or near the surface
	Percent Surface time	Percent of time an individual remained at or near the surface
	Number Blows/Surfacing	Total number of exhalations per surfacing
	Surface Blow Rate	Mean number of exhalations per minute during a surfacing
	Dive-Surface Blow rate	Number of exhalations per minute averaged over the duration of a surfacing-dive cycle, using the dive previous to the surfacing
Scan Parameters	Number of Whales	Number of whales observed during a scan session
	Number of Pods	Number of pods observed during a scan session
	Distance-from-Shore	Distance of an animal from the closest perpendicular distance from the coastline.

Table 2. Environmental and impact explanatory variables proposed to examine potential disturbance effects of western gray whales in relation to the 4D seismic activity in 2009.

	Variable	**Definition**
Environmental	Station	Name of observation station where effort was conducted
	Date	Day of the season
	Time of day	Time of the observation
	Behaviour	Animal's behavioural state during observation bin (feeding, travelling, feeding/travelling, mixed)
	Subject	Individual composition of focal group (mom-calf, calf, yearling, unknown)
	Beaufort	Sea state measured on the Beaufort scale
	Visibility	Visibility conditions estimated at the time of observation. Distance-from- Station Distance of whale from the observation platform
	Depth	Water depth during observation
	Tide Height	Tide level (m) during observation
	Wind Direction	Categorical wind direction (N, E, S, W)
	Wind Speed	Speed of the wind (m/s) during observation
	Swell Height	Swell height (m) in vicinity of station
Impact	Energy2h	Total amount of received sound energy 2 hours preceding scan at a location 2 km from station
	Energy8h	Total amount of received sound energy 8 hours preceding scan at a location 2 km from station
	Energy 1d	Total amount of received sound energy 24 hours (1 day) preceding scan at a location 2 km from station
	Energy 3d	Total amount of received sound energy 72 hours (3 days) preceding scan at a location 2 km from station
	Sound Level (nearshore vessels)	Predicted underwater sound level (db re 1µPa) from nearshore vessels at the mid-point location of the observation bin.

Sound Level (Seismic)	Predicted underwater sound level (db re 1μPa) from seismic vessel at the mid-point location of the observation bin.
Number of Vessels	Total number of operational vessels within 5 km of the mid-point location of the observation bin.
Closest Vessel	Distance of the closest approach vessel to the mid-point location of each observation bin.
Vessel Type	Type of vessel closest (within 5 km) to the mid-point location of the observation bin

Appendix VIII

Section from 2010 Piltun Astokh Seismic Survey EIA

5.9 Marine Mammals

There are two major groups of marine mammals living around Sakhalin Island: Cetaceans (whales and dolphins) and Pinnipeds (seals and sea lions). At least 23 species may occur in the PA license area, including 17 species of cetaceans and 6 species of pinnipeds (Table 5.6 and Table 5.8). Most marine mammals are seasonal inhabitants; the waters of northern and north-eastern Sakhalin Island and surrounding areas are summer feeding grounds for many species. However, some cetaceans (e.g. bowhead and beluga whales) and pinnipeds may be more abundant during winter or early spring due to their association with ice.

This section provides baseline information on the species composition, status, distribution, abundance, and seasonal dynamics of marine mammals of the Sakhalin Island and Sea of Okhotsk region and, specifically, in the vicinity of the PA field. It also provides detail on the critically endangered western gray whale. Information on marine mammal hearing is included in Chapter 6, §6.4.1.

5.9.1 Cetaceans

Seventeen species of cetaceans are known to occur in the Sea of Okhotsk and may be observed in the vicinity of Sakhalin Island:

- Western gray whale (Eschrichtius robustus)
- North Pacific right whale (Eubalaena japonica)
- Bowhead whale (Balaena mysticetus).
- Fin whale (Balaenoptera physalus)
- Minke whale (Balaenoptera acutorostrata)
- Beluga/White whale (Delphinapterus leucas)
- Sperm whale (Physeter macrocephalus)
- Orca/Killer whale (Orcinus orca)
- Baird’s beaked whale (Berardius bairdii)
- Cuvier’s beaked whale (Ziphius cavirostris)
- Dall’s porpoise (Phocoenoides dalli)
- Harbour porpoise (Phocoena phocoena)
- Pacific white-sided dolphin (Lagenorhynchus obliquidens)
- Short-beaked common dolphin (Delphinus delphis)
- Bottlenose dolphin (Tursiops truncatus)
- Short-finned pilot whale (Globicephala macrorhynchus)
- Northern right whale dolphin (Lissodelphis borealis)

Populations of four of these species viz. bowhead whale, North Pacific right whale, fin whale and western gray whale, have been greatly reduced through decades of mechanized, unregulated, and in some instances, illegal commercial whaling. Five species are currently listed in the Red Book of the Russian Federation, and six species are listed as Endangered, or Vulnerable in the IUCN Red List of Threatened Species (2007).

The cetaceans most likely to be encountered near the PA field in summer-autumn are western gray whales, minke whales, orcas, and Dall’s and harbour porpoises. Beluga whales are most likely to be seen during their spring migration. Sightings of endangered cetaceans (excluding the western gray whale) from the Sakhalin Energy MMO database are shown in Figure 5-6, and sightings of non- endangered cetaceans are shown in Figure 5-7.

During winter, no cetaceans are expected to be present in the vicinity of the PA field, with the possible exception of bowhead whales and beluga whales that can occur near the pack ice edge.

Table 5.6 Cetacean species potentially found in the vicinity of the Piltun-Astokh area (green highlighted species are most likely to be encountered near the project area).

Taxon (SubOrder, Family)	Taxon (Species, Common Name)	Region of Maximum Abundance	Season of Maximum Abundance	Local Abundance	Activity	Total Numbers in Sea of Okhotsk	Russian Red Book Category* [1] (2000)	IUCN Classi-fication*[2] (2004)
Baleen Whales - Mysticeti								
Balaenidae	Balaena mysticetus, Bowhead Whale	Nabil Bay, near the ice edge	February – March	50—100	Wintering	300–400	1	LR-cd
	Eubalaena japonica, North Pacific Right Whale	Sea around Terpeniie Point	July – September	150–200 off Terpeniie Point	Feeding	Up to 800	1	EN-D
Balaenopteridae	Balaenoptera acutorostrata, Minke Whale	Sea along the entire east coast of Sakhalin Island	June – September	3,000– 3,500 off eastern Sakhalin Island	Feeding	Up to 19,000		LR-nt
	Balaenoptera physalus, Fin Whale	Sea around Terpeniie Point	June – September	400–600	Feeding	~ 2,700	2	EN-A1abd
	Balaenoptera musculus Blue Whale	-	June-September	Few	Feeding	Few dozen	1	En-A1abd
	Megaptera novaeanglia Humpback Whale	-	June-September	Unknown, few	Feeding	~15	1	VU-A1ad
Eschrichtidae	Eschrichtius robustus, Gray Whale (western)	East of Piltun and Chayvo Bays	June – September	50–120 at Chayvo and Piltun bays and north	Feeding	<150	1	CR-D
Toothed Whales - Odontoceti								
Monodontidae	Delphinapterus leucas, Beluga (White Whale)	Sea along the northeast coast of Sakhalin Island and Tatar Strait	May – June	400– 500 off NE Sakhalin	Feeding	20,000–25,000		VU-A1abd
Phocoenidae	Phocoena phocoena Harbor Porpoise	East coast of Sakhalin Island and Sakhalin Bay	Summer	Common	Feeding	Common		VU-A1cd
	Phocoenoides dalli, Dall Porpoise	Sakhalin Island	June – September	3,500 – 4,000 off eastern Sakhalin	Feeding	20,000–25,000		LR-cd
Delphinidae	Lagenorhynchus obliquidens, Pacific White- sided Dolphin	Tatar Strait	Summer	Up to 2,000	Feeding	Up to 5,000		LR-lc
	Tursiops truncates, Bottlenose Dolphin	South Sakhalin Island	Summer	Unknown	Feeding	Few		DD
	Delphinus delphis, Common Dolphin	Southeast Sakhalin Island	Summer	Unknown	Feeding	Few		LR-lc
	Lissodelphis borealis, Northern Right Whale Dolphin	East of Terpeniie Bay and La Perouse Strait		Unknown	Feeding	Few		LR-lc

Taxon (SubOrder, Family)	Taxon (Species, Common Name)	Region of Maximum Abundance	Season of Maximum Abundance	Local Abundance	Activity	Total Numbers in Sea of Okhotsk	Russian Red Book Category*[1] (2000)	IUCN Classi-fication*[2] (2004)
	Orcinus orca, Orca (Killer Whale)	Entire Sakhalin Island	June – October	300-400	Feeding	1,500–2,000		LR-cd
	Globicephala macrorhynchus, Short-finned Pilot Whale	La Perouse Strait	Summer	Unknown	Feeding	Few		LR-cd
Ziphiidae	Berardius bairdii, Baird's Beaked Whale	Aniva Bay	June – October	250 – 300	Feeding	1000–1500		LR-cd
	Ziphius cavirostris, Cuvier's Beaked Whale	Southern Sakhalin Island	Summer	Unknown	Feeding	Few	3	DD
Physeteridae	Physeter macrocephalus, Sperm Whale	Sea around Terpeniie Point and Cape Aniva	June – September	200 – 300	Feeding	~1,000		VU-A1 bd

*1 Category 1: endangered species whose abundance has decreased to critical levels, under threat of extinction in near future.
Category 2: vulnerable species whose numbers are constantly decreasing, could be moved to Category 1 in near future. Category 3: rare species where population numbers are low, species inhabits limited territory or sporadically distributed over larger area.
*2 Codes for IUCN classifications: EN = Endangered; VU = Vulnerable; Lr-lc = Lower Risk-Least Concern

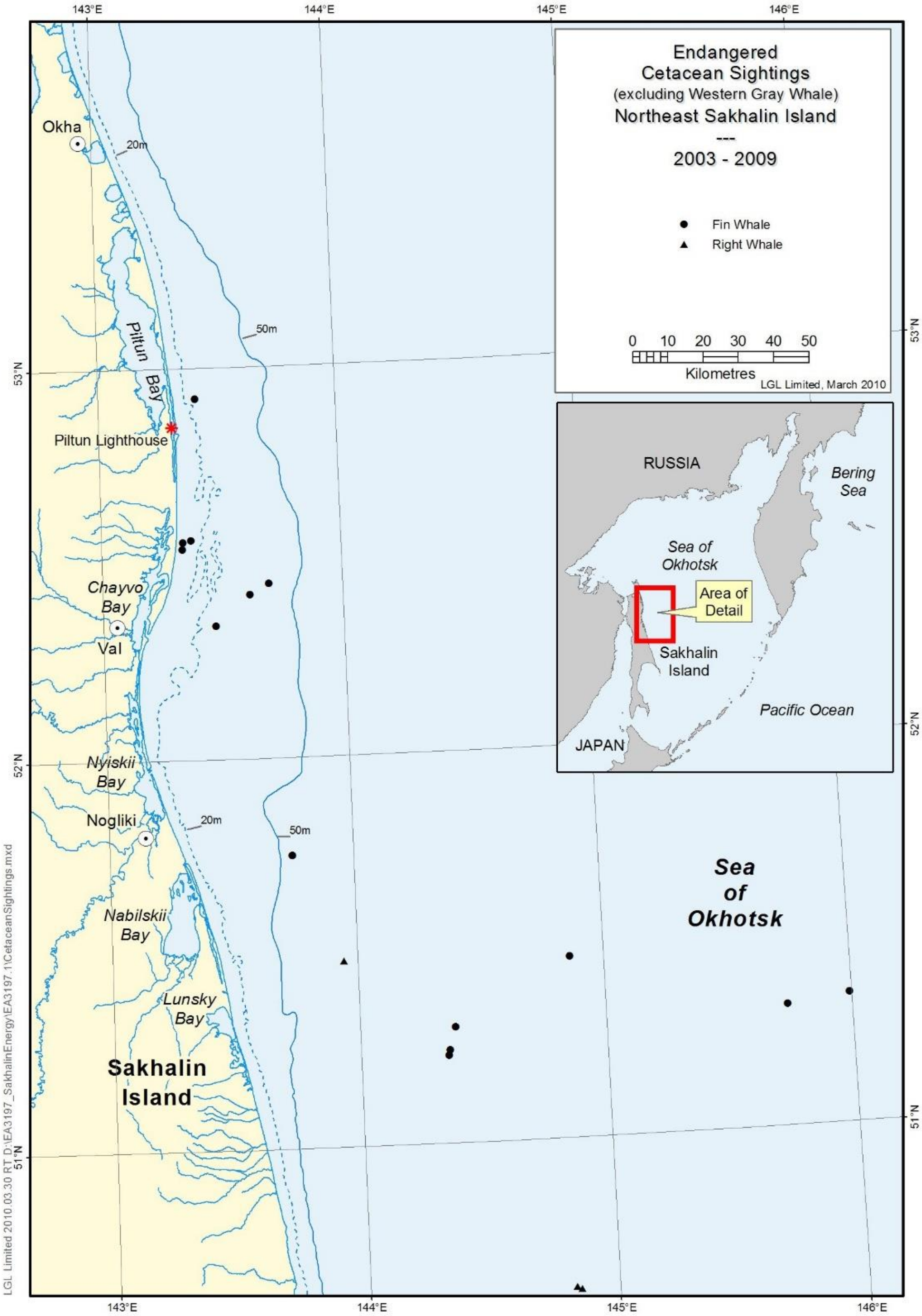


Figure 5-6 Sightings of endangered cetacean species (excluding western gray whales) from the Sakhalin Energy MMO database, 2003-2009.

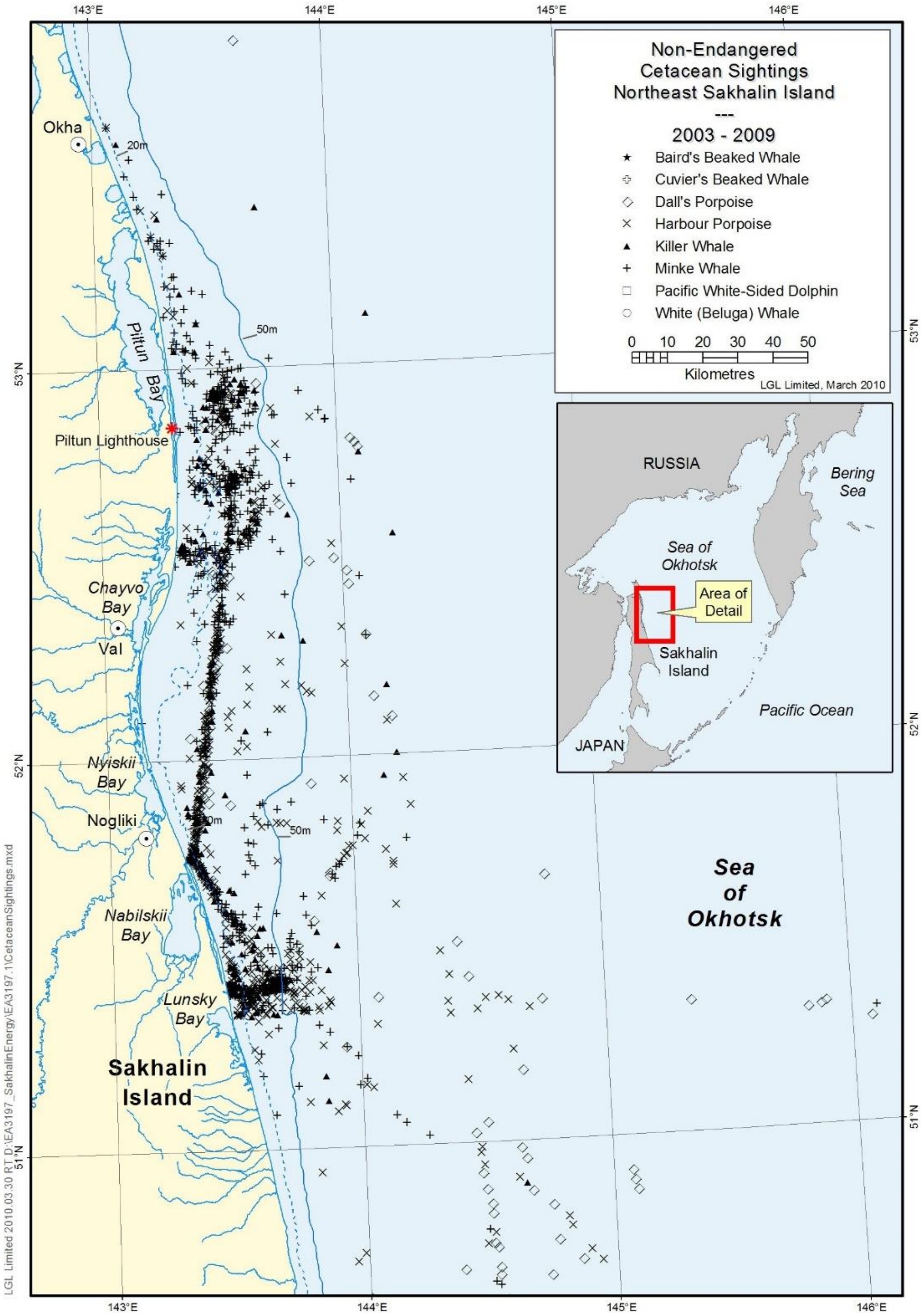


Figure 5-7 Sightings of non-endangered cetacean species from the Sakhalin Energy MMO database, 2003-2009.

5.9.1.1 Western Gray Whale (Eschrichtius robustus)

Status

Western gray whales (WGWs) are the focus of international attention on the Sakhalin Shelf. Gray whales form two distinct populations along the eastern and western margins of the North Pacific: (1) the Eastern North Pacific or California-Chukchi population and (2) the Western North Pacific or Okhotsk-Korean population (Jones et al. 1984).

The WGW is listed as a Category I (see §2.4.1 for category definitions) species in the Red Book of the Russian Federation (Krasnaya Kniga RFZ 2001). It was classified as Critically Endangered (extremely high risk of extinction) by the World Conservation Union (IUCN) (Hilton-Taylor 2000; IUCN 2007) in 2000. The main criterion on which the IUCN classification was based is the small population size with an estimated number of mature, reproductively active individuals of lower than 50 (IUCN 2001).

Distribution

Winter Breeding Area

The long-held belief that the wintering grounds for WGWs is along the south coast of the Korean Peninsula has not been substantiated (Rice 1998). Wintering grounds are now believed to be located in the South China Sea, possibly along the coast of Guangdong province and/or around Hainan Island (Rice 1998; Blokhin and Blokhin 2006; Jones and Swartz 2002, 2009; Weller et al. 2008). However, specific calving sites have never been observed.

Summer Feeding Areas

The historical centres of WGW distribution in the Sea of Okhotsk included Sakhalinskaya Bay, Ulbanskii, Shelikhov, Akademiia and Tugurskii bays, the coastal waters of Sakhalin Island, Penzhinskaya and Gizhiginskaya bays in the northern Sea of Okhotsk, and the waters west of Kamchatka (see Figure 5-8) (Krupnik 1984; Yablokov and Bogoslovskaya 1984; Perlov et al. 1997).

One of the present primary summering and feeding areas of the WGW is located off the northeast coast of Sakhalin Island (see Figure 5-8 and Figure 5-9) (Blokhin et al. 1985, 2002, 2003a,b, 2004a, 2004b; Berzin et al. 1988, 1990; Vladimirov 1994; Blokhin 1996; Sobolevsky 2000, 2001; Weller et al. 2000, 2001, 2002a,b, 2003, 2004, 2005, 2006, 2007; Meier et al. 2007; Yazvenko et al. 2007a,b; Vladimirov et al. 2005, 2006a,b, 2007, 2008, 2009, 2010). However, recent evidence indicates the presence of a second WGW summering and feeding area along the east coast of Kamchatka with both intra and inter annual movement between Sakhalin and Kamchatka (Vertyankin et al. 2004; Yakovlev and Tyurneva 2008; Yakovlev et al. 2007, 2009, 2010, Tyurneva et al. 2010). Whales were photographed feeding off the southern Kamchatka Peninsula in 2004 and 2006; some of these whales were later identified as individuals that have also been observed feeding along north-eastern Sakhalin Island (Vertyankin et al. 2004; Yakovlev et al. 2007). Additional photo-ID studies conducted in Vestnik and Olga Bays (Kamchatka) during 2008 and 2009 substantiate these observations (Yakovlev et al. 2009, 2010; Tyurneva et al. 2010).

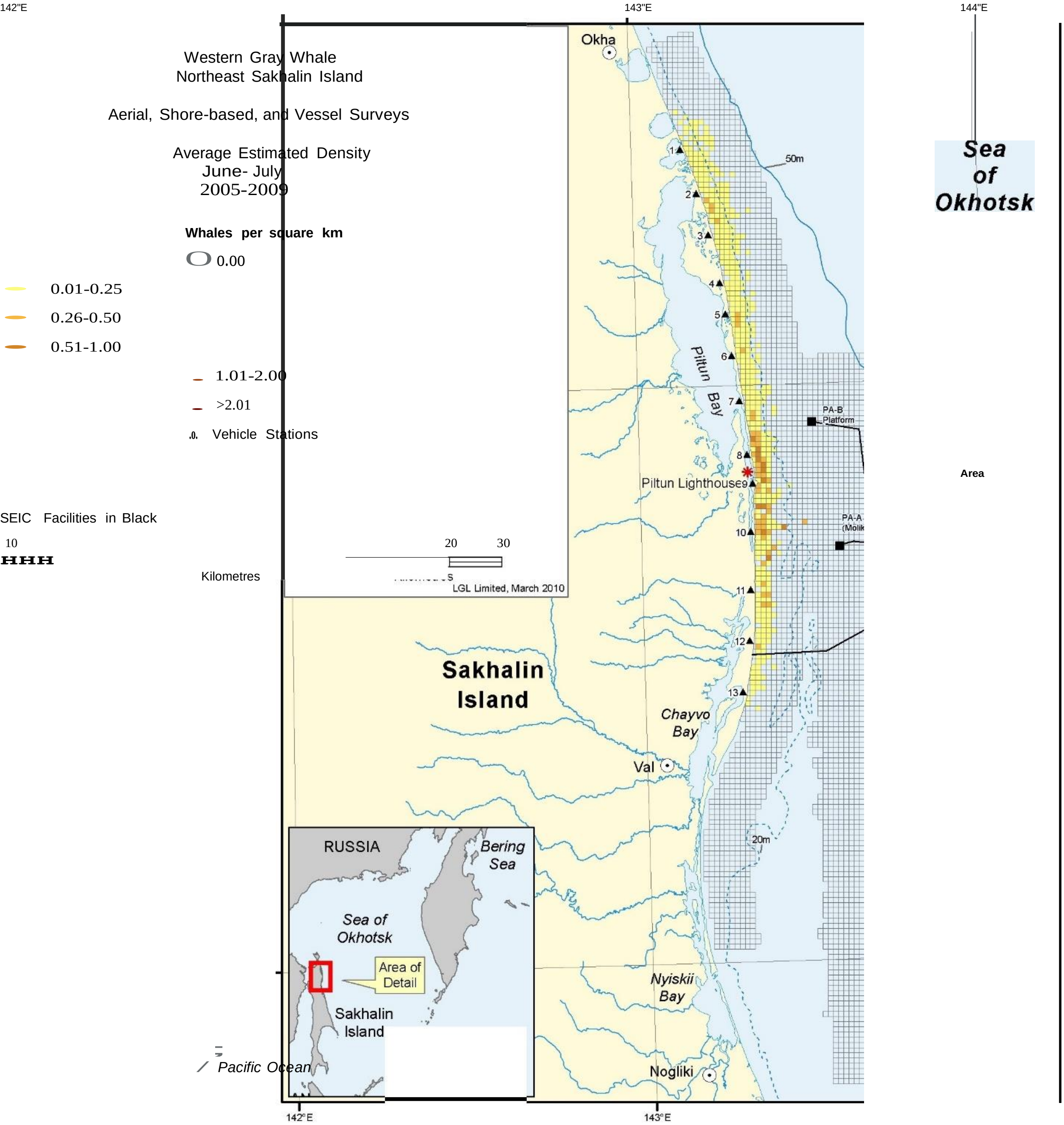
The Piltun feeding area forms a narrow strip (3-6 km wide and over 100 km long) along the Sakhalin coast adjacent to the large and highly productive Piltun Lagoon (Labaj and Pecheneva 2001). In 2001, an offshore feeding area was discovered, approximately 30-40 km seawards of Chaivo Bay in waters 30-65 m deep (Maminov and Yakovlev 2002; Meier et al. 2007); it is likely that whales used the Offshore feeding area before 2001 but survey effort there was low. Benthic studies undertaken from 2002-2009 (Fadeev 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010) indicate that this area is highly productive and likely a significant feeding area for WGWs. The numbers of WGWs using the Offshore feeding area varies from one year to the next. The highest number of WGWs were observed in the Offshore area in 2001, 2002, 2003, 2007 and 2008 (see

Figure 5-9), with relatively fewer observed in 2004, 2005, 2006 and 2009 (Blokhin et al. 2002, 2003a,b, 2004a,b; Maminov 2003, 2004; Vladimirov et al. 2005, 2006a,b, 2007, 2008a,b, 2009, 2010; Meier et al. 2007).

Photo-ID studies were conducted along the eastern coast of Kamchatka Peninsula in 2004 at Khalaktyrsky Beach south of Cape Nalycheva (53°11’ N, 159°42’ E), and from 2006-2009, in two locations that included Olga Bay (54°34’ N, 160°57’ E), and Vestnik Bay (51°28’ N, 157°34’ E). From Olga Bay in the north to Vestnik Bay in the south, these three locations are located over a distance of 600 km of rocky shores. Their shorelines resemble the Sakhalin Island coast adjacent to Piltun Bay, with slightly curving sandy beaches ~23 km long (Vestnik Bay), ~25 km long (Khalaktyrsky Beach) and ~50 km long (Olga Bay) and have small rivers flowing into them. The depths of these areas ranges from 5 to 20 meters. In all three locations described above, the northern part of each bay has a cape extending into the sea (cape Olga, cape Nalycheva, cape Zholty).

Smaller numbers of gray whales have also been observed feeding near Cape Terpeniy (southern Sakhalin Island), off Lunskii Bay, and in the vicinity of Elizaveta Cape (northern tip of Sakhalin Island) (Yakovlev and Tyurneva 2006; Yakovelev et al. 2007).

Figure 5-8. The Sea of Okhotsk—northern range of the Western Gray Whale.


142°E
143°E
144°E
Western Gray Whale
Northeast Sakhalin Island
Aerial, Shore-based, and Vessel Surveys
Average Estimated Density
June- July
2005-2009
Whales per square km
0.00
0.01-0.25
0.26-0.50
0.51-1.00
1.01-2.00
>2.01
Vehicle Stations
SEIC Facilities in Black
10
20
30
Kilometres
LGL Limited, March 2010
Okha
50m
Sea of Okhotsk
Piltun Bay
PA-B Platform
Piltun Lighthouse
PA-A
Area
Sakhalin Island
Chayvo Bay
Val
20m
Nyiskii Bay
Nogliki
RUSSIA
Bering Sea
Sea of Okhotsk
Area of Detail
Sakhalin Island
Pacific Ocean
142°E
143°E

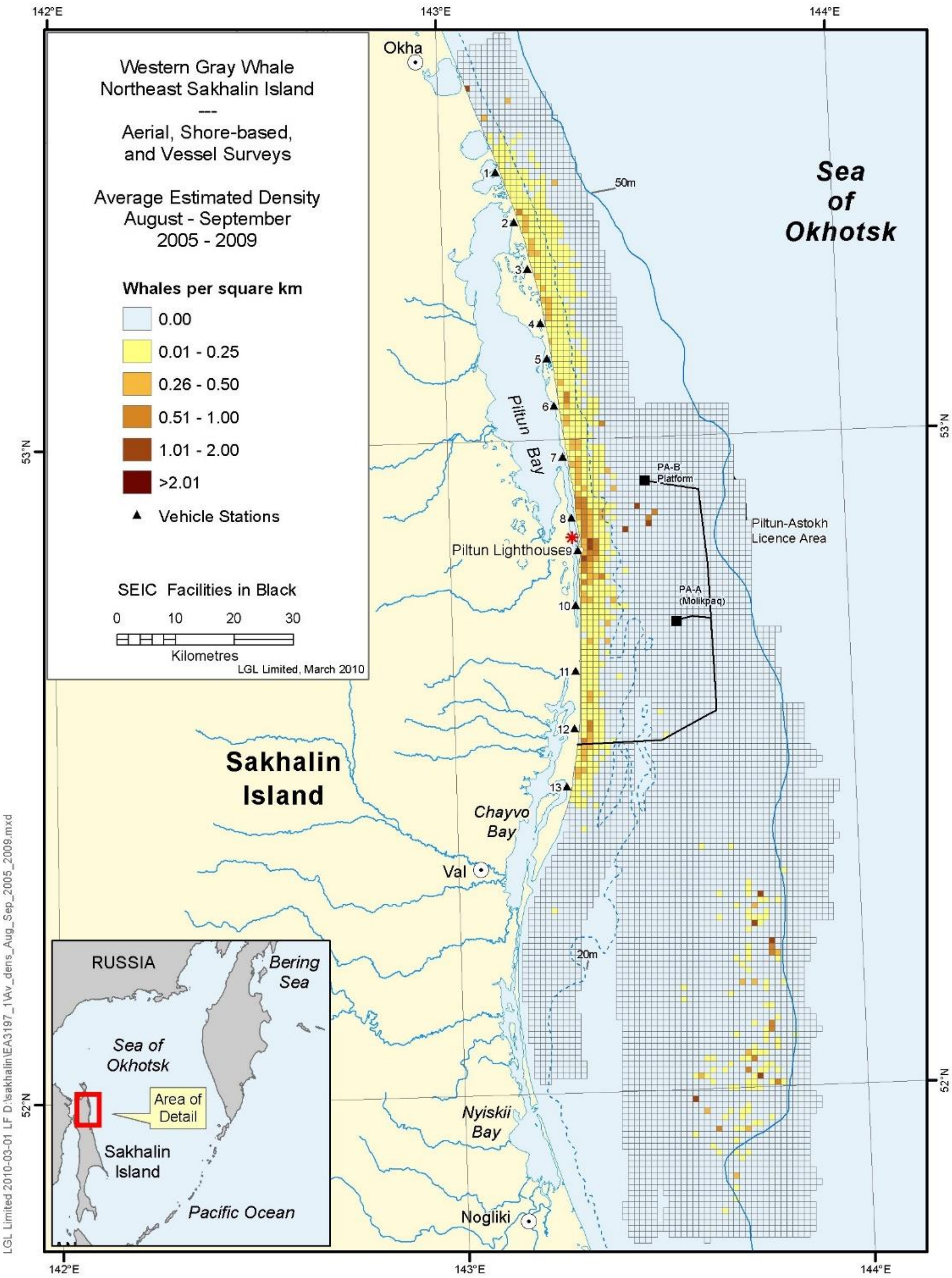


Figure 5-9 Summer WGW distribution on the northeast Sakhalin shelf. Average estimated density at a 1km^2 resolution based on 2005-2009 aerial, vessel, and shore-based observations during June-July and August-September.

Migration Routes

The WGW migration is related to ice conditions within their feeding grounds with a few whales arriving late May when the ice retreats, and a few remaining until late November/early December when the ice returns (Blokhin et al. 2003a,b, 2004a,b; Sobolevsky 2000). Their migration routes are unknown but it is suggested that the route(s) may be through La Perouse Strait (south of Sakhalin Island) or via Tatar Strait and Sakhalinskaya Bay (Yablokov and Bogoslovskaya 1984; Sobolevsky 2000). Fourteen gray whales in several groups were seen on 13 June 1982 in La Perouse Strait, all moving east (Votrogov and Bogoslovskaya 1986). In 1987, two gray whales were again sighted in the La Perouse Strait (Berzin 1995). Possibly, these were part of northward migration along the more likely east-Sakhalin route. In August and September 2003 and 2004, WGWs were observed near-shore of the Lunskoye project (Sakhalin Energy Marine Mammal Observers Database 2003, 2004), suggesting a migration route along the east side of the island. Some researchers have also suggested that whales may migrate along the north coast and then through Tatar Strait on the western side of Sakhalin Island, (Sobolevsky 2000; Yablokov and Bogoslovskaya 1984). A sighting of an unknown "large baleen whale" by an MMO working in Tatar Strait in July 2005 may be in agreement with the latter view. The whale had no fin and had "knuckles" along the spine, which is consistent with the description of a gray whale. Once the whales leave Sakhalin Island they are believed to move south through the Sea of Japan, around the Korean Peninsula, through the Yellow Sea, East China Sea, and then into the South China Sea (Wang 1984; Zhu 2002).

Movement Patterns

Western gray whales show seasonal and annual variability in their distribution and abundance in the Piltun and Offshore feeding areas (Blokhin et al. 2003a,b, 2004a,b; Gailey et al. 2004, 2005, 2006, 2007; Maminov 2003, 2004; Würsig et al. 1999, 2000; Vladimirov et al. 2005, 2006a,b, 2007, 2008a,b, 2009, 2010; Meier et al. 2007). No whales are present in the region during approximately four months of the year (January to April) when ice cover is extensive. The general pattern, with annual fluctuations because of environmental conditions, is as follows: small numbers of whales begin to arrive in the area in May, increasing in numbers during June and July. The abundance of whales fluctuates during the summer with highest numbers of whales observed in August and September, and slowly declining numbers during October and November as the whales begin their southward migration.

During the feeding period, WGWs do not form dense aggregations in the Piltun feeding area, but scatter along the coast, occasionally forming clusters. Observed group sizes range from two to ten whales, but most whales are sighted alone or in pairs (Blokhin et al. 2003a,b, 2004a,b; Maminov 2004; Gailey et al. 2005, 2006, 2007, 2008, 2009, 2010; Weller et al. 1999, 2004; Yakovlev and Tyurneva 2004a,b, 2005, 2006; Yakovlev et al. 2007, 2009; Vladimirov et al. 2005, 2006a,b, 2007, 2008a,b, 2009, 2010). Similar group sizes have also been observed in the offshore feeding area (Maminov 2004; Yakovlev and Tyurneva 2004a,b, 2008, 2009, 2010), although in 2007 the largest group of 12 animals was recorded in the Offshore feeding area. The distribution of these clusters of gray whales changes both within and between feeding seasons (Gailey et al. 2005, 2006, 2007; Tyurneva et al. 2006, Meier et al. 2007, Vladimirov et al. 2005, 2006a,b, 2007, 2008a,b, 2009, 2010). Group size and aggregations of feeding eastern gray whales have been correlated with the abundance of prey present in a location (Dunham and Duffus 2001, 2002).

Results from the photo-identification studies have shown frequent movements of WGWs between the Piltun and Offshore feeding areas, with some whales moving over 20 km within a 50 km^2 area (Tyurneva et al. 2006, 2010; Yakovlev and Tyurneva 2003, 2004a,b, 2005, 2006, 2008; Yakovlev et al. 2007, 2009, 2010).). For example, in 2009, a total of 39 individual WGWs were recorded in the

Offshore feeding and of these, 24 were only observed in this area. Eighty five individuals were recorded in the nearshore Piltun area and of these, 66 were only recorded there (Yakovlev et al. 2010).

As mentioned above, photo identification studies have shown within and between year movements between Kamchatka and Sakhalin (Tyurneva et al. 2010). In 2009, 10 out of 11 whales photographed in Vestnik Bay (Kamchatka) were registered off the Sakhalin shore later in the season. Eight out of 64 whales identified in Olga Bay (Kamchatka) were spotted near Sakhalin later in the season, with one of these whales found dead there on a sandy beach near Chayvo Bay (Yakovlev et al. 2010).

Seasonal shifts in distribution are likely to occur as whales deplete their prey resource (i.e., top-down effects) or as the biomass and quality of prey fluctuates throughout the season (i.e. bottom-up effects). Gray whales along the eastern Pacific coast have been observed to travel within and between feeding areas and to change prey types within and between seasons, partly in response to the distribution and abundance of prey (Darling et al. 1998; Dunham and Duffus 2001, 2002; Meier 2003).

Regional Distribution

Over the past two decades gray whales have been observed elsewhere in the Sea of Okhotsk other than Piltun and Kamchatka (Berzin et al. 1988, 1990, 1991; Blokhin et al. 1985; Votrogov and Bogoslovskaya 1986; Brownell et al. 1997; Sobolevsky 1998, 2000, 2001; Würsig et al. 1999, 2000, 2003; Weller et al. 2001; Meier et al. 2007; Yakovlev et al. 2009). Data obtained in 2005 suggest that during summer some gray whales move along the coast to the north and around Elizaveta Cape, and possibly feed along that route. A small group of feeding gray whales was recorded in September 2005 in Severny Bay west of Elizaveta Cape at depths of 20-30 m, of which one individual was new to the IBM photoID catalogue (Yakovlev and Tyurneva 2006). A group of several gray whales travelling along the coast was also seen in 2005 about 30 km north of Okha (Yakovlev and Tyurneva 2006). Three of these whales were also observed feeding in the Piltun area in 2005.

Western gray whales that have been observed along Sakhalin Island have occasionally been encountered in other parts of the Sea of Okhotsk, for example, in the Shantar Islands area (Burdin 2002, pers. comm.; Weller et al. 2003; Frolov 2005, pers. comm.). One gray whale was observed near Magadan (Blokhin 2001, pers. comm.). In 2000, a gray whale was sighted in the Shantar Island Archipelago and the same animal was sighted off Paramushir Island south of Kamchatka (Weller et al. 2003). In 2006, one individual was observed feeding in waters off Kamchatka and Sakhalin Island during the same summer feeding season (Yakovlev et al. 2007). .

Abundance and Reproduction

Between 2002 and 2009, 177 individual WGWs were identified, although not all of these animals are confirmed alive or present in the study area each year (Yakovlev et al. 2010). Population modelling of photo-identification data collected from 1995 to 2008 resulted in an estimated median non-calf population size of 134 individuals for 2009, with 90% confidence limits 120-142; the median estimate of the number of mature females in 2009 is 33 with 90% confidence limits of 29-38 (Cooke et al. 2010). In comparison, a total of 138 whales (including 9 calves and 1 possible calf[23]) from the Sakhalin WGW catalogue were identified in both Sakhalin and Kamchatka in 2009 (Yakovlev et al. 2010). It should be emphasized that the entire historical range of the WGW has not been surveyed, and therefore the current population estimate is subject to change should more information become available.

[23] A "possible" calf is an unaccompanied small whale showing characteristics of a calf. However, distinguishing between a recently weaned calf and a yearling is difficult.

Western Gray Whale population recovery is likely linked to demographic constraints. Small populations are inherently more vulnerable than large populations due to stochastic changes in parameters such as sex ratio or birth rate (Clapham et al. 1999; Gilpin and Soule 1986). The estimated annual adult and calf survival rates were 0.985 and 0.69 respectively based on 1994 to 2008 data (Cooke et al. 2010). The estimated annual population growth rate was 5.0% over the 1994-2008 data series (Cooke et al. 2010). The calving rate has been found to increase in recent years, with intervals shortened from three to two years (Cooke et al. 2008). This 2-year interval is comparable with that for eastern gray whales.

The recovery of the WGW population is threatened by anthropogenic activity throughout its range. Although the WGW has been officially protected from commercial whaling since 1938, some whaling continued for at least the next two decades. Poaching in their southern range (Baker et al. 2002; Brownell and Kasuya 1999) and incidental catches in fisheries off southern China, Korea and Japan have also been reported (Kato 1998; Kim 2000; Zhu and Wang 1994). From 2005-2007, four females were killed in trap nets with a fifth female found stranded on the Pacific coast of Japan (Kato et al. 2005, Brownell et al. 2007, Weller et al. 2007, Cooke et al. 2008). Cooke et al. (2008) project that the loss of one female per year will likely cause the female population to decline to extinction (i.e. a >25% probability of population decline and a 10% probability of female population extirpation by 2050). Currently, the Fisheries Agency of Japan is exploring actions to mitigate anthropogenic effects (Brownell 2007).

In August 2009 a 5-year old male western gray whale was found dead on the beach near Chayvo Bay. This individual was seen in 2009 on the east coast of Kamchatka as well. The cause of death could not be established but there were no indications of a ship strike (IUCN 2009).

The majority of cow/calf pairs in the Piltun feeding area have been observed within 2 km of shore (Vladimirov et al. 2006b, 2007, 2008, 2009, 2010; Meier et al. 2007). No cow/calf pairs have been observed in the Offshore feeding area or in any other area where gray whales have been sighted in any of the years from 2001 to 2007 (Yakovlev and Tyurneva 2003, 2004a,b, 2005, 2006, 2008; Yakovlev et al. 2007). In 2008 however, Yakovlev et al. (2009) recorded, for the first time, one cow-calf pair offshore eastern Kamchatka[24] (the cow was observed offshore Sakhalin in previous years), and in 2009 seven additional cow-calf pairs were recorded in Kamchatka; four of these seven cows had been seen offshore Sakhalin in other years (Yakovlev et al. 2010). The number of WGW calves seen between 1997 and 2009 varies considerably and ranges from two in 1997 to a maximum of 11 in 2003 (Weller et al. 2006). Six (and two possible) calves were seen in 2007 (Yakovlev and Tyurneva 2008), four (and two possible) calves in 2008 (including one calf observed off the east coast of Kamchatka) and nine (and one possible calf) in 2009 (of which five and one possible calf were identified only in the Piltun area, two in both Piltun and Kamchatka, and two in Kamchatka only (Yakovlev et al. 2010)).

Food Resources

Gray whales are unique cetaceans in that they feed predominantly on benthic (bottom-dwelling) organisms (Zenkovich 1934, 1937; Tomilin 1971; Mizue 1951; Pike 1962; Rice and Wolman 1971; Zimushko and Lenskaya 1970; Thomson and Martin 1983; Nerini 1984). They consume their prey by ploughing into the sediment, extracting benthos by suction into the mouth and expelling sediment through the baleen plates (Ray and Schevill 1974; Oliver et al. 1983, 1984). However, gray whales are not exclusively benthic foragers. In some instances, they feed on swarms of epibenthic and nektonic organisms in the water column and on the surface, and less commonly on fish when benthic sources are inadequate or when fish biomass is greater than the benthic source (Nerini 1984; Dunham and

[24] WGW calves observed off the east coast of Kamchatka in 2008 and 2009 were associated with mothers in the Sakhalin WGW catalogue.

Duffus 2001, 2002). When feeding on benthic organisms, gray whales rarely feed in water > 80 m deep (Würsig et al. 1986).

Since gray whales have a relatively short season in which to feed, any change in distribution or quantity of their prey could result in reduced food consumption. Whales that do not eat enough may not gain weight, making them less able to complete their long migration, or for females less able to carry a foetus to term or suckle it after birth. However, eastern gray whales are known to feed during their migration when food is opportunistically encountered and it is likely that western gray whales utilize food resources encountered along their migration route.

Intensive sampling from 2002 to 2009 was conducted in sampling grids within: (1) the whale feeding area at Piltun and the offshore feeding area; and (2) in 2002 only, control zones where WGWs have not been observed feeding (Fadeev 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010). Samples were also taken opportunistically at locations where WGWs were observed feeding to provide further information regarding the identity and abundance of WGW prey. Benthic samples were collected with a van Veen grab (0.2 m^2). Epibenthic and plankton samples were collected with an epibenthic net and Jedi net, respectively. Underwater video was also taken in all sampling locations. These studies provide benthic data from wide areas along the coast between Piltun and Chaivo Bays, for water depths between 10-50 m; very limited sampling was conducted in water <10 m deep so that inferences about benthic communities at those depths should be treated with caution. Starting in 2004, sampling in waters <10 m was conducted from a small zodiac and with the use of divers (Fadeev 2005, 2006, 2007, 2008) and with a Petersen grab since 2009 (Fadeev 2010).

Prey studies conducted throughout the Piltun area since 2001 demonstrate high but patchy prey abundance. The Piltun feeding area contains abundant potential gray whale food, including small crustaceans (e.g., swarming amphipods and isopods), polychaete worms, and bivalve mollusks (Sobolevsky et al. 2000; Fadeev 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010). The prey distribution corresponds with the distribution and abundance of WGW sightings in both the Piltun and offshore feeding area; (Blokhin et al. 2004a,b; Fadeev 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010; Vladimirov et al. 2006a,b, 2007, 2008, 2009). Waters typically not used by gray whales for feeding were characterized by lower concentrations of potential gray whale prey or by unsuitable species for feeding (i.e. sand dollars).

Studied for the first time in 2002, the Offshore feeding area is highly productive dominated by benthic ampeliscid amphipods that live in tubes, sticking up 10-15 cm from the sediment surface, creating a tube forest or carpet along the ocean bottom. This feeding area is comparable in species composition and richness to eastern gray whale feeding areas in the Bering and Chukchi seas (Fadeev 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010). The lower numbers of whales in the offshore feeding area in 2004-2006 were not attributed to a lower concentration of prey in that area. Instead, the benthic data suggest that the prey conditions in the Piltun feeding area were more favourable in those two years, as evidenced in the northern parts of the feeding area where whales were observed in deeper waters around the 20 m isobath concurrent with high prey concentrations (Fadeev 2006, 2007; Vladimirov et al. 2006a,b, 2007).

Condition of Gray Whales

Systematic photo-identification surveys of WGWs present off Piltun Bay were conducted during 1997- 2009 (Würsig et al. 1999, 2000; Weller et al. 2000, 2001, 2002b, Yakovlev and Tyurneva 2003, 2004a,b, 2005, 2006, 2007, 2008; Yakovlev et al. 2007, 2009, 2010). Since 1999, some whales were observed to be emaciated, or 'skinny,' but no dead WGWs were encountered with the exception of a stranded whale found on the beach near Chayvo Bay in September 2009. The stranded whale had been identified in July 2009 in Olga Bay, Kamchatka and had a physical body condition of class 2, which is rather common early in the feeding season (Yakovlev et al. 2010).

Seasonal fluctuations in the fat stores of baleen whales are considered normal during the breeding/calving season and particularly for cows nursing calves (Perryman and Lynn 2002). However, both the US- Russian and the IBM photoID teams have encountered skinny whales during each year of their studies (Table 5.7); in 2007, 14 animals (including six nursing cows) were identified as being underweight, and most sightings of underweight animals occurred early in the season (Yakovlev and Tyurneva 2008). The Russian photo ID team was also able to document improvement in body condition of skinny whales and nursing cows as the feeding season progressed. It should be noted that the US-Russian team does not include lactating females in reported numbers of skinny whales, while the IBM team does include lactating females.

Table 5.7 Percentage of "skinny" whales observed by the US-Russian and IBM photo-identification teams, 1999-2007 offshore Sakhalin Island (Yakovlev and Tyurneva 2008, Yakovlev et al. 2009, 2010).

US-Russian Team					IBM Team		
Year	Number of Skinny Whales	Number of Individuals Observed	Percentage Skinny		Number of Skinny Whales	Number of Individuals Observed	Percentage Skinny
1999	16	69	23.2				
2000	30	58	51.7				
2001	21	72	29.2				
2002	9	76	11.8				
2003	3	75	4.0		15	82	18.3
2004	5	93	5.4		11	96	11.5
2005	14	93	15.1		10	118	8.5
2006	4	79	5.1		20	126	15.9
2007*					14	131	10.6
2008*					20	98	20.4
2009*					19	111	17.1

* US-Russian team data were not available for these years.

Similar signs of emaciation were displayed during the same period by eastern gray whales. Many apparently undernourished whales died during winter in the lagoons of Baja California and during their northward migration in 1999 (LeBoeuf et al. 2000). In 2000, nearly twice as many eastern gray whales died in the wintering lagoons of Baja California than in 1999 (LeBoeuf et al. 2000). Fortunately, high mortality in eastern gray whales was not documented during winter 2000-2001 or during the 2001 northward spring migration (Brownell et al. 2001).

The causes of emaciation in both North Pacific populations of gray whales are not clear, but several lines of evidence suggested over-exploitation of the food supply (Moore et al. 2001) and/or a possible large-scale climatic/oceanographic regime shift that affected productivity in the North Pacific region (LeBoeuf et al. 2000; Moore et al. 2001; Grebmeier et al. 2006). It is also possible that some other factor(s), such as disease or human-induced impacts during winter, migration, and/or the summer feeding period, may have simultaneously and similarly affected one or both of the populations of gray whale. The cause is considered most likely to be a complex cumulative time variable effect. However, in the case of the western gray whale population, it is highly unlikely that a population of approximately 130 whales has simply over-exploited its food supply.

5.9.1.2 North Pacific Right Whale (Eubalaena japonica)

North Pacific right whales were formerly classified as North Atlantic right whales (E. glacialis), however, recent genetic studies recognise that the North Pacific population is a separate species (Rosenbaum et al. 2000). North Pacific right whales are listed as Endangered (Category 1) in the Red Book of the Russian Federation (Krasnaya Kniga RFZ 2001), and Endangered by the IUCN (IUCN 2007). The IUCN designation is likely to change to Critically Endangered with the reclassification of the North Pacific population as a separate species. Right whales are particularly susceptible to collisions with ships because they are slow, spend much time at the surface, and utilise some habitats in the vicinity of major shipping lanes (Clapham et al. 1999). Ship strikes are a significant cause of mortality for North Atlantic right whales, and it is possible that right whales in the North Pacific are also vulnerable to this threat. Entanglements of right whales have been reported in the Sea of Okhotsk (Brownell 1999; Bukhtiyarow 2001 in Burdin et al. 2004; V.S. Strygin pers. comm. in Burdin et al. 2004), however, due to their rare occurrence and scattered distribution it is not possible to assess the threat of ship strikes and/or entanglements to the North Pacific right whales at this time.

North Pacific right whales were once abundant in the Sea of Okhotsk. Prior to industrial whaling, the number of individuals in the region was perhaps ~10,000 animals. However, over-exploitation from the 1840s to the 1920s drastically reduced the numbers of this species. At one time, population levels were so low it was thought that the species had become extinct. All right whales were protected from commercial whaling in the 1930s, and in 1946, the International Whaling Commission (IWC) declared the North Pacific population completely protected. Those measures resulted in a slow increase in the total population numbers, until by the 1970s there were perhaps 200 to 400 individuals throughout the North Pacific range. Current population estimates for the species are largely speculative and range from 100 to the low thousands, however, most authorities tend toward the lower end of this range (Brownell et al. 2001). It has been proposed that as many as 800 to 900 right whales inhabit the Sea of Okhotsk (Vladimirov 1994) and that 150 to 200 animals stay in waters off the east coast of Sakhalin Island during summer and autumn.

Migratory patterns of the North Pacific stock are unknown, although it is thought that the whales migrate from high-latitude feeding grounds in summer to more temperate waters during the winter, possibly offshore (Braham 1984; Clapham et al. 2004). In the eastern region of Sakhalin Island, North Pacific right whales have been reported occasionally, and they may rarely move through, or adjacent to, the Piltun Astokh Field. Sporadic sightings in the past 30 years have indicated that the whales use various locations throughout the Sea of Okhotsk (Kuzmin and Berzin 1975), including Sakhalin Island’s eastern coast. In 1967, approximately 70 North Pacific right whales were observed in the area of Terpeniie Bay, and solitary animals were seen along Sakhalin Island up to its northern tip (Berzin and Vladimirov 1989). Recently, both solitary individuals and small groups of North Pacific right whales have been reported off the east coast of Sakhalin Island (Shuntov 1994). In 1992, nine North Pacific right whales were observed far offshore to the south of Piltun Bay. The same year, seven whales were observed in the area between the northern end of Sakhalin Island and Cape Terpeniie, and in 1993, two individuals were observed in the area east of Cape Terpeniie. One was sighted about 95 km off Lunsky Bay in 1992 (Myashita and Kato 1998 in Brownell et al. 2001), and one individual was found stranded in Lunsky Bay in 1939 (Tomilin 1957 in Brownell et al. 2001). In 2005, during Sakhalin Energy construction activities, two right whales were observed once at Lunskoye area on 13 October, at a distance of 2000 m from the vessel. Figure 5-6 illustrates recent sightings near the project area (SEIC MMO database, 2003-2007).

5.9.1.3 Bowhead Whales (Balaena mysticetus)

Bowhead whales are listed as Category 1 “Endangered” in the Red Book of the Russian Federation (Krasnaya Kniga RFZ 2001). The IUCN categorizes the species generally as “Lower Risk- Conservation Dependent,” but also designates distinct populations independently (IUCN 2006). The Sea of Okhotsk population is classed as Endangered (IUCN 2007).

There has been some difficulty in assessing the historical distribution and abundance of bowhead whales in the Okhotsk Sea. Right whales and gray whales were sometimes misidentified as bowhead whales, and whaling records maintained during the short period of time this stock was hunted were incomplete (Bockstoce and Botkin 1983). Whales in this stock were discovered by commercial whalers in 1848 (Bockstoce 1986), but intensive hunting did not begin until 1852 when whales in the Bering Sea stock were no longer as plentiful in "traditional" whaling areas (Bockstoce and Burns 1993). By 1860, the Okhotsk Sea stock was severely depleted, and whalers had already resumed whaling in the Bering Sea (Bockstoce 1986). Mitchell estimated the pre-exploitation size of the population to be 6500 based on a total estimated catch of 3506 whales (Mitchell and Reeves 1982). Ross (1993) suggested that this estimate may be too high for the reasons stated above and offered "a conservative, though mostly speculative, compromise" of 3000 as a minimum population estimate.

In the north-eastern Okhotsk Sea, whales were found in Penzhinskaya Gulf and Gizhiginskaya Gulf. The next area of concentration was to the southwest in Tauyskaya Bay. Farther south, the best whaling grounds were within the gulfs and bays south of the Shantarskiye Islands and west of Sakhalin Island. Fedoseev (1984) observed bowhead whales deep in the ice north of Sakhalin Island in 1969, 1981, and 1983, in addition to one sighting east of Sakhalin Island in 1981 and another a little over 200 km south of Tauyskaya Bay in 1982. Berzin et al. (1991) noted that by mid-November, bowhead whales were no longer found in the Shantarskiye region, despite the waters being ice-free. Almost all of the areas where summer concentrations of bowhead whales occurred in the past are still occupied today. As recent as August 1995, during joint Russian-American surveys, a few dozen bowhead whales were observed in a feeding aggregation south of the Shantarskiye Islands. Berzin et al. (1990) estimated the population in this area to be at least 250-300 animals. An estimate of abundance of 300-400 was made for the entire Okhotsk Sea based on data collected since 1979 (Vladimirov 1994). However, "no quantitative data are available to confirm" these estimates. There is some speculation as to whether animals found during the summer in the north-eastern Okhotsk Sea form a distinct population from those in the Shantarskiye region. The winter distribution of both of these groups is unknown.

During February and March, 50 to 100 bowhead whales may be present close to the ice edge along the north and east coasts of Sakhalin Island (Vladimirov 1994). In April 2007, 2 bowhead whales (a cow and calf) were observed along the edge of the ice southeast of Tyuleniy off Sakhalin Island’s east coast (ENL, pers. comm., 2007).

5.9.1.4 Fin Whales (Balaenoptera physalus)

Fin whales are listed as Vulnerable (Category 2) in the Red Book of the Russian Federation (Krasnaya Kniga RFZ 2001), and classified as Endangered by the IUCN (IUCN 2007). The fin whale used to be one of the most numerous species of great whales. The population was drastically reduced by intensive whaling, but has since gradually increased in size and at present is estimated to number approximately 2700 individuals in the Sea of Okhotsk (Vladimirov 1994), of which 400 to 600 inhabit the waters of eastern Sakhalin Island during the summer and autumn. Fin whales feed on fish, cephalopods, and planktonic crustaceans. Some individuals are present year round in the Sea of Okhotsk. They move into the area from the Pacific Ocean through the straits in the Kuril Islands and from the Sea of Japan through La Perouse Strait.

In 2005, during Sakhalin Energy construction activities, a total of 19 fin whales were observed (SEIC 2006). Most of them occurred far offshore in the navigational corridors by vessels in transit. It is possible that fin whales may be observed in the vicinity of the PA field, as, although predominantly a pelagic species, individuals sometimes occur in shallow water, both along the coast and offshore (Perlov et al. 1996, 1997). Figure 5-6 illustrates recent sightings near the project area (SEIC MMO database, 2003-2007).

5.9.1.5 Minke Whales (Balaenoptera acutorostrata)

Minke whales are designated as Lower Risk/Near Threatened by the IUCN (IUCN 2007). They are the most numerous of the baleen whales remaining in the Sea of Okhotsk. They are widely distributed and tend to stay in large bays. They feed mainly on crustaceans and fish, although their diet varies greatly with the season. Minke whales are found along the entire east coast of Sakhalin Island. They are usually encountered in Terpeniie and Sakhalin bays (Sobolevsky 1984). About 19,000 individuals occur in the Sea of Okhotsk (Buckland et al. 1992; Vladimirov 1994), and 3000 to 3500 are estimated to inhabit the area east of Sakhalin Island and are commonly seen in the PA field. Minke whales are noted for their curiosity about ships (Perrin and Brownell 2002). Figure 5-7 illustrates recent sightings near the project area (SEIC MMO database, 2003-2007).

5.9.1.6 Sperm Whales (Physeter macrocephalus)

Sperm whales are not considered endangered in the Sakhalin region but are listed as Vulnerable by the IUCN (IUCN 2007). They occur throughout the eastern and southern areas of the Sea of Okhotsk, but the waters offshore from the Kuril Islands appear to be the centre of distribution for this species in the region. During the summer and autumn period, the total population of sperm whales within the Sea of Okhotsk is estimated to be 1000 individuals (Vladimirov 1994). Sperm whales mainly feed on cephalopods, but also eat some fish. Approximately 200 to 300 sperm whales are believed to inhabit waters seasonally along eastern Sakhalin Island; they are most frequently seen around Cape Terpeniy, Cape Aniva and adjacent waters. Because of the absence of focused research, most observations are anecdotal and often unreliable (Perlov et al. 1996, 1997).

Sperm whales are not likely to be encountered in the PA field area, as the whale is a deep-water species and is rarely seen over continental shelves, i.e. inshore of the shelf break.

5.9.1.7 Orca / Killer Whales (Orcinus orca)

Orcas, or killer whales, are designated as Lower Risk/Conservation Dependent by the IUCN (IUCN 2007). They have been recorded throughout almost all salt-water and some fresh-water areas, including many long inlets, narrow channels and deep embayments. These animals possess a complex vocal repertoire with variation in signals between populations and social groups (Deecke et al. 1999, 2000; Miller and Bain 2000; Thomsen et al. 2001; Yurk et al. 2002). They are found throughout the Sea of Okhotsk, especially along the coasts. This species is frequently encountered in the vicinity of the Kuril Islands, western Kamchatka, and in the northern and southern parts of the Sea of Okhotsk. In total, 2500 to 3000 animals are estimated to inhabit the Sea of Okhotsk (Vladimirov 1994). Orcas occur along the entire eastern coast of Sakhalin Island, and the total number estimated to occupy these waters may be as high as 300 to 400 animals.

There are two types of orcas in Sakhalin waters viz. residents and transients, based on morphology, ecology, genetics, and behaviour (Baird et al. 1992; Hoelzel et al. 1998; Baird 2001; Yurk et al. 2002). Residents live in large pods of six to 50 animals and prey mostly on fish, in particular, salmon

(Ford et al. 1998; Saulitis et al. 2000; Anon 2004). Transients form small pods of two to four animals and feed on marine mammals such as seals, sea lions and porpoises, and also sea turtles, sea birds, as well as sea and river otters (Baird and Dill 1995, 1996; Ford et al. 1998; Baird and Whitehead 2000; Saulitis et al. 2000).

Orcas are likely to be observed in the PA field and have been observed regularly during shore, aerial, and vessel-based distribution surveys (Sobolevsky 2000, 2001; Razlivalov 2004; Shulezhko et al. 2004; Sakhalin Energy Marine Mammal Observers Sightings Database 2006). Most sightings were of single individuals or small groups up to 30 individuals. Figure 5-7 illustrates recent sightings near the survey area (SEIC 2007, MMO database, 2003-2007).

5.9.1.8 Beluga /White Whales (Delphinapterus leucas)

Belugas, also known as white whales or belukhas, are designated as Vulnerable by the IUCN (IUCN 2007), but are not considered endangered in the Sakhalin region. Belugas have a circumpolar distribution in the northern hemisphere. In the summer, belugas are associated with estuaries where animals moult. In autumn they are driven away from bays and estuaries by ice to winter primarily in polynyas near the edges of pack ice or in areas of shifting ice. They are abundant throughout the Sea of Okhotsk, although their distribution is variable. There are three populations of belugas in the Sea of Okhotsk (Perlov et al. 1996, 1997):

- Sakhalin-Amur population (7000 to 10,000 individuals);
- Shantar population (3000 to 5000); and
- North-Okhotsk population (about 10,000).

The total number of belugas inhabiting the Sea of Okhotsk during the summer and autumn is estimated to be 20,000 to 25,000 individuals (Vladimirov 1994). Belugas do not permanently inhabit the waters off eastern Sakhalin Island, but are present in relatively small numbers (400 to 500 individuals) in the waters off north-eastern and northern parts of the island during their spring migration. Areas where belugas are known to form large and stable concentrations are Sakhalin Bay, bays in the Shantarskie Islands, and Gizhiginskaya and Penzhinskaya bays. These areas are a significant distance from the eastern coast of Sakhalin Island, but observations made more than a century ago indicated the existence of belugas in Terpeniie Bay and in the Poronai River. Arsen'ev (1939) reported that in the 1930s, belugas were sometimes observed along the eastern coast of Sakhalin Island. Adult animals mostly feed on fish, whereas young animals also feed on invertebrates.

TINRO scientists conducted numerous surveys of the eastern coast of Sakhalin Island in the 1980s, and belugas were only found in 1989 when approximately 100 animals were observed among large ice floes near and southeast of Cape Elizabeth, at the northern tip of the island (Perlov et al. 1996, 1997). On 2 June 1989, up to 30 individuals were found in Nyiskii Bay, and about 50 animals moving northwards were seen north of the bay (between Chaivo and Piltun bays). Nyiskii Bay is likely to be the southern limit of the distribution of this species in the Sea of Okhotsk (Perlov et al. 1996, 1997).

Belugas are only expected to be seen off north-eastern Sakhalin Island during their spring migration and should not be encountered during the proposed survey. Figure 5-7 illustrates recent sightings near the project area (SEIC 2007, MMO database, 2003-2007).

5.9.1.9 Dall's Porpoises (Phocoenoides dalli)

Dall's porpoise is designated as Lower Risk/Conservation Dependent by the IUCN (IUCN 2007). It is endemic to the Northern Pacific and one of the most numerous species of cetaceans in the Sea of Okhotsk (20,000 to 25,000 individuals). They rarely form large concentrations, and feed on schooling fishes and cephalopods. Although sometimes seen near land, Dall’s porpoises are most often observed far offshore in waters > 180 m deep. The western North Pacific population of Dall’s porpoise follow a well-defined annual migration in which the Japanese population moves northward to summer in the Sea of Okhotsk and around the Kuril Islands.

About 3500 to 4000 individuals occur in waters along the entire eastern side of Sakhalin Island, (Shuntov 1995). Dall’s porpoises are apparently more common south of Cape Terpeniie. In 1965 to 1971, A.E. Kuzin and A.S. Perlov regularly observed Dall’s porpoises southeast of Terpeniie Bay during the spring and summer, and east of Aniva Bay during the autumn and winter. Most observations have occurred between those two bays (Kuzin et al. 1984). Surveys in September 1990 revealed the presence of several groups of Dall’s porpoises north and northeast of Cape Elizabeth. Twenty-one groups totalling 80 animals were recorded on 11 September, and 13 groups of 70 individuals were recorded on 12 September. In 1993, Dall's porpoises were seen singly and in small groups (three to five animals) between Terpeniie Bay and Aniva Bay. Shuntov (1995) observed them in and around Terpeniie Bay, and east of Aniva Bay, while. Sobolevsky (2000) observed them often in Terpeniie Bay and to the northeast of Cape Terpeniy.

Dall’s porpoises are not likely to be commonly encountered in the vicinity of the PA field, as they prefer deep, offshore waters (Jefferson 2002). However, Dall’s porpoises have been sighted in shallow (~ 20m) waters off Piltun Bay. Figure 5-7 illustrates recent sightings near the project area (SEIC 2007, MMO database, 2003-2007).

5.9.1.10 Harbour Porpoises (Phocoena phocoena)

Harbour porpoises are designated as Vulnerable by the IUCN (IUCN 2007). The harbour porpoise is a fairly abundant species and prefers shallower, inshore waters of the continental shelf (Bjørge and Tolley 2002). In the Sea of Okhotsk, the species inhabits waters near the Kuril Islands, along the west coast of Kamchatka, along the east coast of Sakhalin Island, in Sakhalin Bay, and north of the Shantarskie Islands (Perlov et al. 1996, 1997). Sobolevsky (2000) reported seeing single individuals and small groups in coastal areas adjacent to Lunsky Bay. Numerous sightings of harbour porpoise have been recorded in waters along Piltun Bay by Sakhalin Energy marine mammal observers. Harbour porpoises are expected to be observed within the PA field. Figure 5-7 illustrates recent sightings near the survey area (SEIC 2007, MMO database, 2003-2007).

5.9.1.11 Baird's Beaked Whales (Berardius bairdii)

Baird's beaked whales are not considered endangered in the Sakhalin region but are designated as Lower Risk/Conservation Dependent by the IUCN (IUCN 2007). Baird’s beaked whales are endemic to the North Pacific. The eastern and western Pacific populations are migratory, arriving at the continental slope in summer and autumn. They can usually be found in deep waters over the continental slope, but they do occur in shallow waters in the Sea of Okhotsk (Kasuya 2002). Approximately 1000 to 1500 animals occur in the Sea of Okhotsk along the islands of the Kuril archipelago, the coast of Kamchatka, east Sakhalin Island, in Sakhalin Bay, near Shantarskie and Ion islands, and in the southern part of the Sea of Okhotsk. About 250 to 300 individuals occur in waters along the southern part of Sakhalin Island, mainly in Aniva Bay and east of Cape Aniva. Recent observations of this species are scarce, and most of them have been made in the southern part of the

Sea of Okhotsk near the southern coast of Sakhalin Island, in La Perouse Strait, and east of Cape Terpeniy (Perlov et al. 1996, 1997). In winter-spring 2007 and early winter 2008, observers reported >30 Baird's beaked whales (during 13 separate sightings) in heavy ice conditions along Sakhalin's south-east and north-east coast (ENL, pers. comm., 2007). Figure 5-7 illustrates recent sightings by Sakhalin Energy near the survey area (SEIC 2007, MMO database, 2003-2007).

5.9.1.12 Cuvier's Beaked Whales (Ziphius cavirostris)

Cuvier's beaked whales are listed as a Category 3 (rare) species in the Red Book of the Russian Federation (Krasnaya Kniga RFZ 2001), and as Data Deficient by the IUCN (IUCN 2007). According to the Red Book of the Russian Federation, Cuvier's beaked whales are found almost throughout the Sea of Okhotsk, including Sakhalin Island (Geptner et al. 1976; Tomilin 1971). In "Mammals of the Soviet Union" (v. 2, part 3, 1976), it is stated that, "based on somewhat unreliable sources, Cuvier's beaked whales have been encountered in the Kuril Islands and off the southern coast of Sakhalin Island (Sleptsov 1961)."

Perlov et al. (1997) reported that they had never recorded Cuvier's beaked whales in the Sea of Okhotsk, but that this species does occur near south-eastern Kamchatka and the Kommander Islands, where strandings occur almost every year. Cuvier's beaked whales feed mostly on deep sea squid, but also take fish and some crustaceans (Jefferson et al. 1993).

Cuvier's beaked whale is an offshore, deep-diving species (Heyning 2002), so it is unlikely to be found near the PA field. During Sakhalin Energy construction activities in 2005, three Cuvier's beaked whales were observed during transit from Vostochny port to the northeast Sakhalin coast. Two of these sightings occurred on the southeast coast of Sakhalin Island (SEIC 2006). Figure 5-7 illustrates recent sightings near the survey area (SEIC 2007, MMO database, 2003-2007).

5.9.1.13 Pacific White-sided Dolphins (Lagenorhynchus obliquidens)

Pacific white-sided dolphins are not rated in the Red Book of the Russian Federation and are classified as Lower Risk/Least Concern on the IUCN Red List of Threatened Species (IUCN 2007). This species is among the most numerous inhabiting the north-western part of the Pacific Ocean. They are often found in large groups (average of 90) but sometimes concentrate in groups of up to 3000 individuals (Waerebeek and Würsig 2002). They appear to be most common in the southern part of the Sea of Okhotsk, along the Kuril Islands, at Cape Aniva, and in La Perouse Strait (Perlov et al. 1996, 1997). Pacific white-sided dolphins are mostly pelagic, moving offshore in spring and summer in rough synchrony with movements of anchovy and other prey (Waerebeek and Würsig 2002). They do not appear to be common in shallow waters along the northeast Sakhalin coast and are likely uncommon in the PA field. Figure 5-7 illustrates recent sightings near the survey area (SEIC 2007, MMO database, 2003-2007).

5.9.1.14 Short-beaked Common Dolphins (Delphinus delphis)

Short-beaked common dolphins are classified as Lower Risk/Least Concern on the IUCN Red List of Threatened Species (IUCN 2007). They are found throughout the temperate and tropical waters of the Pacific. This species is highly gregarious and may be seen in groups of more than 1000 animals; it is the most common dolphin in offshore waters (Perrin 2002). The world population is believed to be several million strong. Short-beaked common dolphins occur in the southern part of the Sea of Okhotsk, along the Kuril Islands and in waters along the west coast of Kamchatka. This species also inhabits the waters east of Sakhalin Island and north of the Shantarskie Islands (Perlov et al. 1996, 1997).

5.9.1.15 Bottlenose Dolphins (Tursiops truncatus)

Bottlenose dolphins are classified as Data Deficient on the IUCN Red List of Threatened Species (IUCN 2007), and are fairly uncommon in the Sea of Okhotsk. They occupy the southern half of the Sea of Okhotsk and may be found up to the central Kuril Islands, and from Cape Terpeniie south to Cape Aniva and Aniva Bay (Perlov et al. 1996, 1997). Bottlenose dolphins are primarily coastal, but also occur over the continental shelf, especially over the shelf break (Wells and Scott 2002).

Bottlenose dolphins are unlikely to be found in the PA field area but do occur further to the south.

5.9.1.16 Short-finned Pilot Whales (Globicephala macrorhynchus)

Short-finned pilot whales are classified as Lower Risk/Conservation Dependent on the IUCN Red List of Threatened Species (IUCN 2007). They typically form cohesive groups of 15 to 20 animals. Northward migration in the spring/summer and southward migration in autumn/winter are timed to follow the movements of their primary prey, squid. In the Sea of Okhotsk, short-finned pilot whales are found near the Kuril Islands, north of Hokkaido, at Cape Aniva, and in La Perouse Strait (Perlov et al. 1996, 1997). They are found on the continental shelf break and in slope waters (Olson and Reilly 2002).

Short-finned pilot whales are unlikely to be found in the PA area because they prefer deeper water, and occur further south.

5.9.1.17 Northern Right Whale Dolphins (Lissodelphis borealis)

Northern right whale dolphins are classified as Lower Risk/Least Concern on the IUCN Red List of Threatened Species (IUCN 2007). They are found in the temperate waters of the North Pacific, and have been observed in the southern part of the Sea of Okhotsk. Northern right whale dolphins are deepwater dwellers, tracking the movements of squid. Groups of several thousand animals have been observed, but more typically groups range from 100 to 200 individuals. They have been seen near the Kuril Islands, off the southwest coast of Kamchatka, north of Hokkaido, east of Terpeniie Bay, at Cape Aniva, and in La Perouse Strait (Perlov et al. 1996, 1997).

Northern right whale dolphins are not expected to occur in the PA area.

5.9.2 Pinnipeds

Eastern Sakhalin Island is one of the major reproductive regions for pinnipeds in the Sea of Okhotsk. The total number of pinnipeds in this area has not changed significantly since the 1980s (Perlov et al. 1996). Six species of pinnipeds occur in the vicinity of eastern Sakhalin Island. Four species of true or ice seals viz. ringed seals (Phoca hispida), largha or spotted seals (Phoca largha), ribbon seals (Histriophoca fasciata) and bearded seals (Erignathus barbatus), are closely associated with the ice through the winter-spring season. Two species of eared seals viz. the northern fur seal (Callorhinus ursinus) and the Steller sea lion (Eumetopias jubatus), are mainly open-water visitors to the area. Although sea otters were reported from southern Sakhalin Island in the 1960s, they have not been seen near Sakhalin Island in recent years. Species accounts are given below, and the information is summarised in Table 5.8. Pinniped distributions are shown in Figure 5-10 and Figure 5-11. Pinniped sightings from Sakhalin Energy's MMO database (SEIC 2007) are illustrated on Figure 5-12 (non-endangered pinnipeds) and Figure 5-13 (endangered pinnipeds).

5.9.2.1 Ringed Seals (Phoca hispida)

Ringed seals are generally regarded as the most numerous northern pinniped. The subspecies (P. hispida ochotensis) is classified as Lower Risk/Least Concern on the IUCN Red List of Threatened Species (IUCN 2007), and is harvested from the Sea of Okhotsk. Ringed seals are not listed in the Red Book of the Russian Federation (Krasnaya Kniga RFZ 2001). Sealing was unregulated between 1955 and 1968 and the average annual catch during this time was about 78,500 ringed seals (Fedoseev 2000). Since then sealing has been restricted and is now subject to compliance monitoring and scrutiny by scientific review committees. The species is abundant within the Sea of Okhotsk and is found along the entire eastern coast of Sakhalin Island (Fedoseev 2000).

From aerial surveys conducted between 1968 and 1990, it is estimated that the average population within the Sea of Okhotsk was approximately 750,000, with the waters of eastern Sakhalin Island supporting a multi-year average of approximately 130,000 (Fedoseev 2000). Between year variation in the Sea of Okhotsk population was low, about 20% (Fedoseev 2000), but two surveys along the eastern coast of Sakhalin Island in 1968 and 1969 showed greater fluctuations in numbers. In 1968 and 1969, respectively, the estimated ringed seal populations were 28,500 and 138,000 on north- eastern Sakhalin Island, and 15,000 and 40,000 on south-eastern Sakhalin Island (Fedoseev 1971). More recently, a 'most likely average value' of 140,000 to 180,000 has been used by the Russian Federation to calculate a total admissible catch for eastern Sakhalin Island (V. Vladimirov, pers. comm. 2007).

Table 5.8 Pinnipeds present off the east coast of Sakhalin Island.

Taxon (Family, Species, Common Name)	Region of Maximum Abundance	Season of Maximum Abundance	Local Abun-dance in License Areas	Activity	Estimated Total Number in Sea of Okhotsk	Russian Red Book Category*[1]	IUCN Classification*[2]
Phocidae							
Phoca hispida, Ringed seal	Entire east coast of Sakhalin Island, peaks in Lun'sky Bay to Cape Elizabeth	March-May on ice; August-Oct on coast	5,000-7,000	Pupping, Molting, Feeding	540,000		LR-1c (1996)
Erignathus barbatus, Bearded seal	Entire east coast peaks in Terpeniie Bay	March –May	1,000-2,000	Pupping, Molting	180,000		
Histriophoca fasciata, Ribbon seal	Entire east coast peaks in Terpeniie Bay and north up to Lun'sky Bay and Levensh-tein Point	April – May	50-100	Pupping, Molting	350,000		LR-1c (1996)
Phoca largha, Largha or Spotted seal	Entire east coast peaks between Terpeniie Bay and Lun'sky/ Chayvo Bays	March-May – on ice; August–October on the coast	3,000-4,000	Pupping, Molting, Feeding	180,000		LR-1c (1996)
Otariidae							

Taxon (Family, Species, Common Name)	Region of Maximum Abundance	Season of Maximum Abundance	Local Abundance in License Areas	Activity	Estimated Total Number in Sea of Okhotsk	Russian Red Book Category*[1]	IUCN Classification*[2]
Eumetopias jubatus, Steller's sea lion	Robben (Tiulenii) Island off Cape Terpeniie	May – November	900-1,000	Pupping, Molting, Feeding	8,500–9,500	2	EN-A1b (1996)
	Kamen' Opasnosti Rock in La Perouse Strait	March – November	700–900	Molting, Feeding	8,500–9,500	2	
Callorinus ursinus, Northern fur seal	Robben (Tiulenii) Island	June – September	70,000-80,000	Pupping, Molting, Feeding	100,000–120,000		VU-A1b (1996)

*1 Category 1: endangered species whose abundance has decreased to critical levels, under threat of extinction in near future.

Category 2: vulnerable species whose numbers are constantly decreasing, could be moved to Category 1 in near future.

*2 Codes for IUCN classifications: EN = Endangered; VU = Vulnerable; Lr-lc = Lower Risk-Least Concern

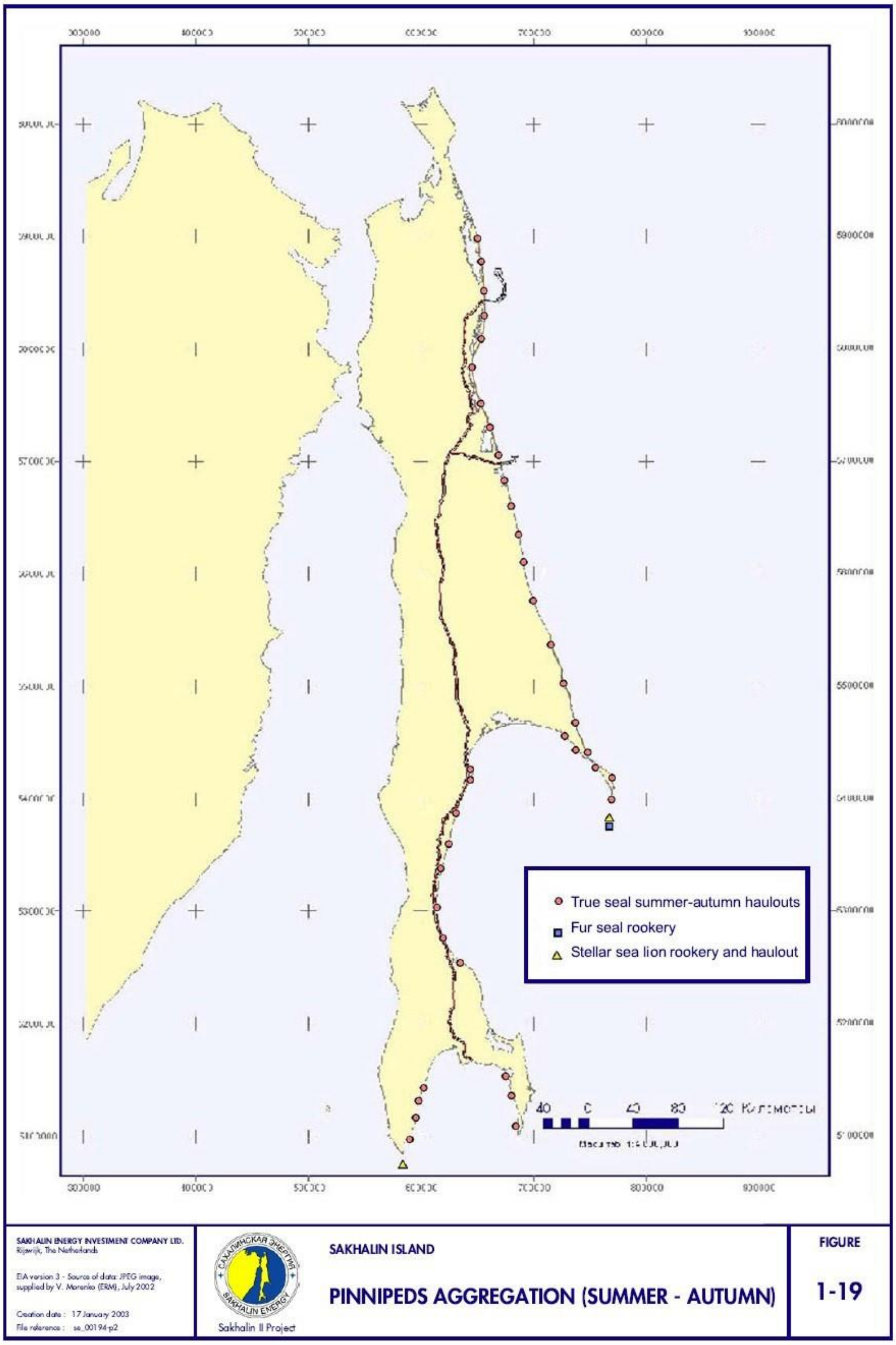


Figure 5-10 Pinniped aggregations (Summer-Autumn) (ERM 2003).

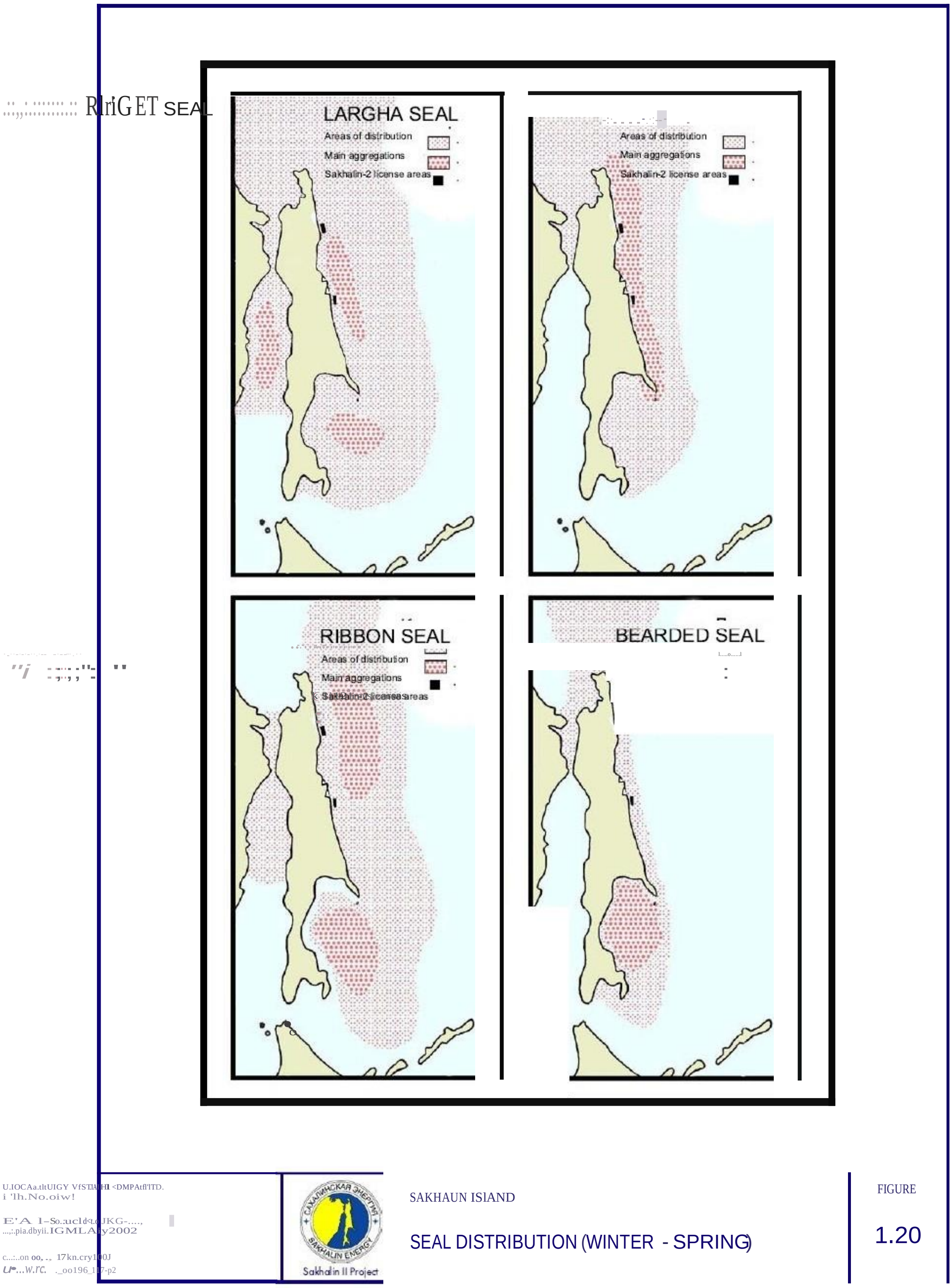


Figure 5-11 Seal distribution (Winter-Spring) (ERM 2003).

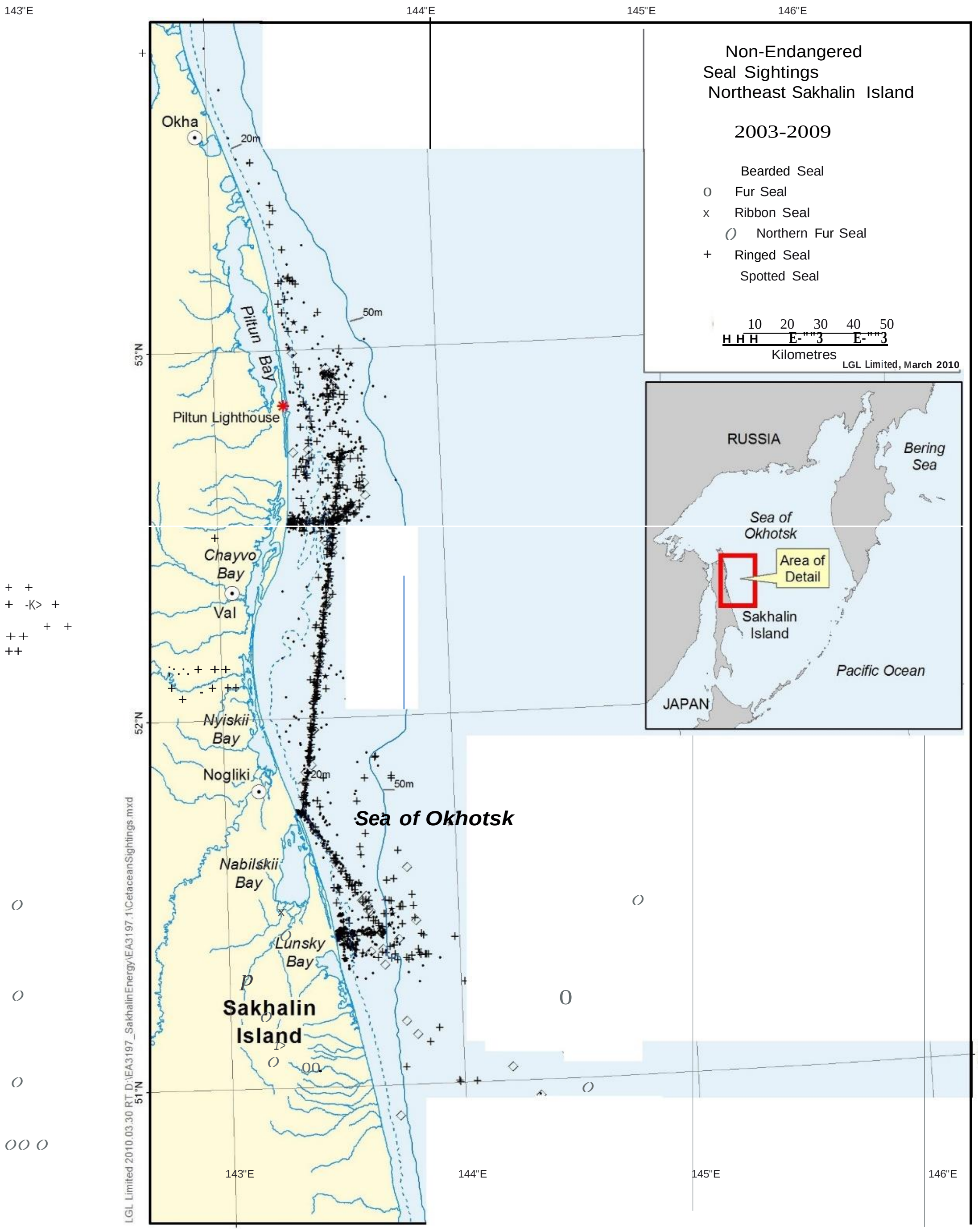


Figure 5-12 Non-endangered pinniped sightings, north-east Sakhalin Island, 2003-2009.

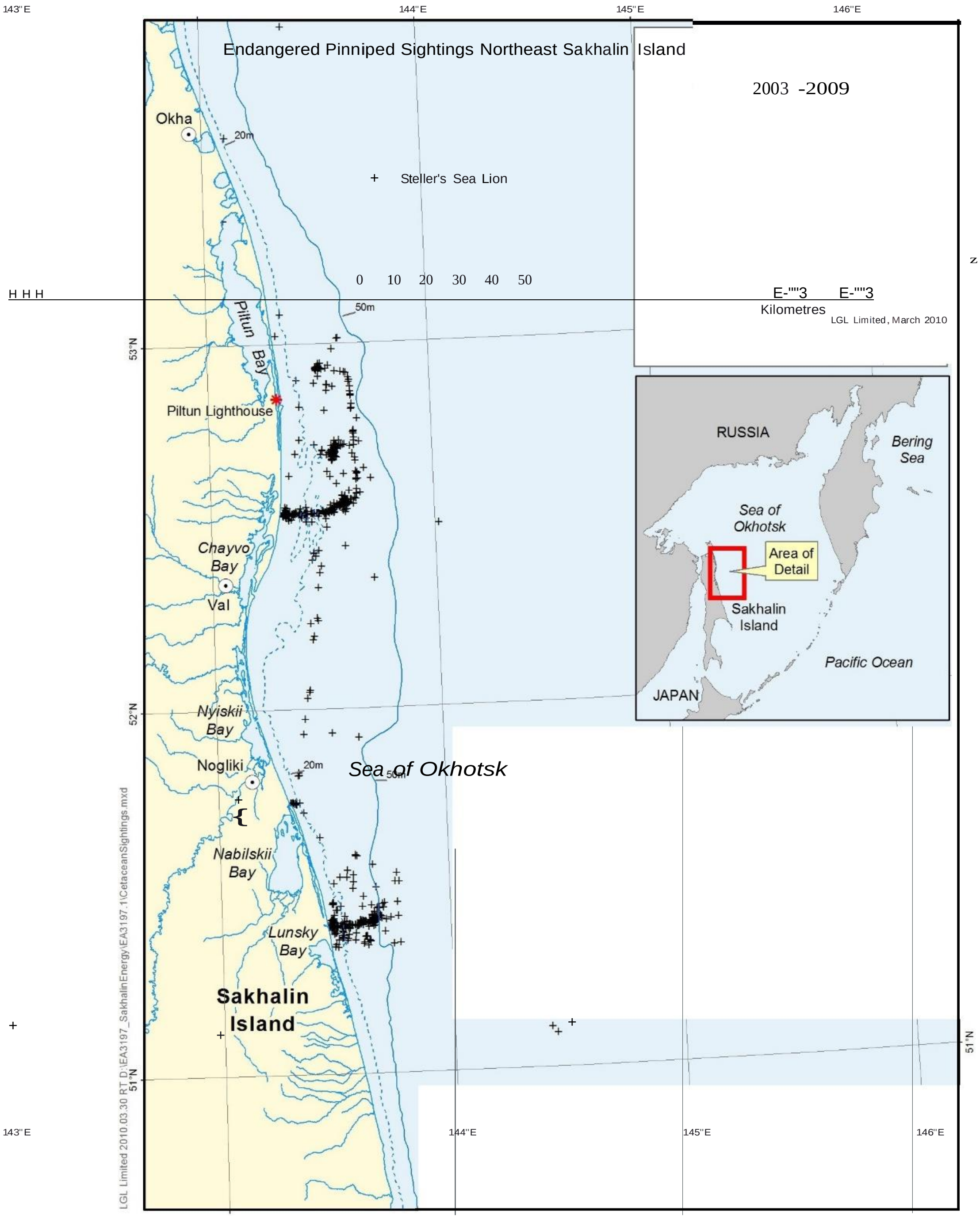


Figure 5-13 Endangered pinniped sightings, north-east Sakhalin Island, 2003-2009.

Ringed seals breed, whelp and moult on the ice, often forming large concentrations during the winter to spring months. As the ice thickens in late autumn and winter, ringed seals maintain openings in ice more than 2 m wide to breathe. As snow accumulates over breathing holes the seals may excavate lairs. Ringed seals in the Sea of Okhotsk give birth on shore-fast ice, not in lairs as they do in other areas. The highest densities of breeding adults are found on stable land-fast ice, while non-breeders concentrate on the moving pack ice. Ringed seals also remain in the region during the open water period and are found hauled out on land and in near shore waters during the summer. During the spring, summer, and autumn, ringed seals spend most of their time swimming and feeding among the ice floes. Ringed seals are often described as being cautious and easily disturbed by human activity (Burns and Harbo 1972; Burns and Frost 1979; Alliston 1981; Nowak 1999).

The species has been observed regularly within Nyisky, Lunsky, Chaivo and Piltun bays, predominantly at the mouths of estuaries, rivers, straits and channels connecting north-eastern Sakhalin Island's lagoon habitats with the sea (Grachev 2006). In summer 1999, ringed seals were present at some rookeries (traditional locations of annual breeding aggregations) and scattered along the coast in the area surveyed from Niysky Bay to Piltun Bay (Sobolevsky 2000). In 2000, their distribution was similar in the larger area surveyed (Lunsky Bay to Piltun Bay), but their numbers had increased in Chaivo and Piltun bays (Sobolevsky 2001). Aggregations of between 20 and 70 individuals are often recorded. Figure 5-12 illustrates sightings of ringed seals in the Sakhalin Energy MMO database, 2003-2007 (SEIC 2007).

The species' main food sources consist of euphausiid shrimps, walleye pollock fry, Pacific herring, Asian smelt and sand lance. Shrimp and crabs represent a lesser constituent (Nikolaev and Skalkin 1975).

5.9.2.2 Largha Seals (Phoca largha)

Largha seals, also known as spotted seals, are classified as Lower Risk/Least Concern on the IUCN Red List of Threatened Species (IUCN 2007) and are harvested from the Sea of Okhotsk. This species is not listed in the Red Book of the Russian Federation. They are considered to be abundant within the Sea of Okhotsk and have been observed off the north-eastern coast of Sakhalin Island throughout the year; they are closely associated with the ice during much of this time (Sobolevsky 1984). Based on ten years of aerial surveys conducted between 1968 and 1990, estimated numbers in the Sea of Okhotsk ranged from 180,000 to 240,000, with about 15 to 20% in the waters of eastern Sakhalin Island (Fedoseev 2000). Two surveys along the eastern coast of Sakhalin Island in 1968 and 1969 showed that largha seal numbers were fairly stable during that period: 12,000 to 13,000 animals, of which 4000 individuals occurred in Terpeniie Bay (Fedoseev 1971). More recently, numbers off eastern Sakhalin Island have exceeded 40,000 (Trukhin 1999). A 'most likely average value' of 30,000 to 40,000 has been used by the Russian Federation to calculate total admissible catch for eastern Sakhalin Island (V. Vladimirov pers. comm., 2007). A breeding site between Sakhalin and Hokkaido Islands has also been established with 13,600 seals being observed in March and 6 500 in April 2002 (Mizuno et al. 2002).

Largha seals are present along the entire eastern coast of Sakhalin Island, but during the winter months they are concentrated along the northern third of the Island in Terpeniie Bay. Largha seals show an annual migration in the autumn and winter to the edge of the pack ice. Pupping rookeries are generally located offshore on drift ice, especially on hummocked floes. Breeding takes place in late winter and spring and after breeding the seals stay on the ice to moult. Pups are born between February and March, and are weaned at one month. When the ice retreats, some seals migrate from the breeding region, whilst others remain in Sakhalin coastal waters forming many haul outs along the coast. Most of these haul outs are located at the mouths of salmon spawning rivers, especially at the inlet of Chaivo Bay, Cape Popova, Tyulenii Island and Aniva Bay (Blokhin et al. 2003a). During the summer, largha seals gather at approximately 54 rookeries at the mouths of rivers and on coastal bars along the east and south coasts of Sakhalin Island, including Lunsky, Nabilskyi, Piltun and Aniva bays (Kosygin et al. 1986; Lagerev 1988; Perlov et al. 1996, Bradford and Weller 2005). In July 2000, three rookeries with a total estimated 600 to 800 individuals, and in August 2000, four rookeries with a total estimated 4000 to 5000 individuals were observed on a sand spit at the entrance to Chaivo Bay, waiting for the annual migration of Pacific salmon (Sobolevsky 2001). In 1998, 16 to 489 largha seals were counted during systematic shore-based counts in Piltun lagoon between 24 July and 31 August (Bradford and Weller 2005), and in August 2000, one rookery with more than 500 individuals was recorded at the mouth of Piltun Bay (Sobolevsky 2001). There was a noticeable peak in seal numbers in late August (1998 and 2000) that appeared to coincide with seasonal herring and salmon runs (Bradford et al. 1999; Bradford and Weller 2005). In July 2000, more than 50 individuals were recorded at the mouth of Nabilskyi Bay and 38 individuals were recorded at the mouth of Lunsky Bay. In August, numbers increased to more than 100 at the mouth of Lunsky Bay, and remained the same at Nabilskyi Bay, possibly because of the continuous presence of fishermen there (Sobolevsky 2001). Rookeries were not present at Lunsky and Nabilskyi bays in September, and almost no seals were found at the mouth of those bays in October (Sobolevsky 2001).

SakhNIRO has conducted baseline studies focused specifically on the Piltun, Lunsky and Aniva bay areas (SakhNIRO 1999a). In Piltun Bay, over 200 largha seals were observed. The majority of seals were encountered at the mouth to the bay, in the riptides and surf over the many sandbars. Beyond the bay mouth the number of sightings diminished significantly, and about 2 km from the entry to the bay there were no seals observed. SakhNIRO have noted, however, that the observed reduction in numbers beyond the bay may have been due to the presence of fishermen in the area who were fixing dog salmon nets at the time of the studies. On the shore itself, the studies recorded that the bay was isolated due to the dense covering of dwarf cedar trees, alder and bushes, and inaccessibledue to the high-energy wave environment over the sandbars when approaching from the water. These access difficulties minimise human occupation and associated disturbance that may explain the relatively high numbers of seals observed in Piltun Bay.

In Lunsky Bay, SakhNIRO reported similar observations to those made for Piltun Bay. Largha seals dominated sightings, with over 150 individuals being recorded. Animals were mainly concentrated at the bay mouth, in the surf zone, over the sandbars and along the shore. Seals were generally not aggregating into groups but were encountered singly. As in Piltun Bay, the number of seals decreased with increasing distance from the bay mouth. It was noted that the animals exhibited cautious avoidance behaviour, diving 50 to 100 m away from the survey boats and leaving the open water area for the sandbars as soon as the vessels entered the bay. This behaviour may be a reaction to local hunting (SakhNIRO 1999a).

In Aniva Bay, observed seal numbers were generally low, with only five largha seals being recorded (SakhNIRO 1999a).

Adult seals feed on fish, cephalopods and crustaceans, whereas newly weaned pups apparently feed on euphausiids and small amphipods found around the ice floes (few data are available on ice biota from this region). When hauled out on ice or land, largha seals are very sensitive to approaches by aircraft, often moving into the water when the aircraft is still at a lateral distance of 1 km (Frost and Lowry 1990; Frost et al. 1993; Rugh et al. 1993).

5.9.2.3 Ribbon Seals (Histriophoca fasciata)

Ribbon seals are classified as Lower Risk/Least Concern on the IUCN of Threatened Species (IUCN 2007) and are not included in the Red Book of the Russian Federation (Krasnaya Kniga RFZ 2001). They are harvested from the Sea of Okhotsk. The average annual catch during the period of unregulated sealing (1955-68) was up to 13,000 ribbon seals (Fedoseev 2000), but since that time sealing has been restricted. Ribbon seals are found off the northeast coast of Sakhalin Island with a concentration from Lunsky Bay to Chaivo Bay during winter-spring (Fedoseev 1997) beginning in February (Kosygin et al. 1985). Based on ten years of aerial surveys conducted between 1968 and 1990, estimated numbers in the Sea of Okhotsk ranged from 200,000 to 630,000, with an average of 350,000 to 450,000. The average in the waters of eastern Sakhalin Island was 110,000 (Fedoseev 2000). Two surveys along the eastern coast of Sakhalin Island in 1968 and 1969 showed that fluctuations in numbers might be significant for ribbon seals (Fedoseev 1971). In 1968 and 1969, respectively, the estimated ribbon seal populations were 47,000 and 27,000 on north-eastern Sakhalin Island, and 30,000 and 10,000 on south-eastern Sakhalin Island.

Between 1975 and 1990, there was a trend of rapid growth and earlier maturation (Fedoseev and Volokhov 1991), and numbers began to increase rapidly in the late 1970s. Average numbers for the 1988, 1989, and 1990 surveys were approximately 550,000 in the Sea of Okhotsk (Fedoseev 2000). More recently, a 'most likely average value' of 80,000-100,000 has been used by the Russian Federation to calculate total admissible catch for eastern Sakhalin Island (V. Vladimirov, pers. comm., 2007).

During the winter and spring, the majority of animals are concentrated offshore on hummocked flows with open water areas along the north-eastern coast between Lunsky Bay and Chaivo Bay. Rookeries may be established 200 to 240 km from the ice edge. In years where there is low ice cover or early ice retreat, the seals may move to coastal waters, where they establish moulting rookeries on drifting ice. Ribbon seals are not known to establish coastal rookeries. As the ice melts, the density of animals on the remaining ice cover increases. When the ice disappears altogether, the seals convert to a completely pelagic lifestyle, and are distributed across the entire Sea of Okhotsk. Ribbon seals are reportedly easy to approach and are not easily disturbed (Nowak 1999).

In the southern part of the Sea of Okhotsk, ribbon seals have a higher abundance than ringed seals but are less abundant than largha seals. No ribbon seals were observed during surveys conducted in Terpeniya Bay and Aniva Bay by SakhNIRO in September 1998 or by DVNIGMI in July 2001 (DVNIGMI 2002). Figure 5-12 illustrates sightings of ribbon seals in the Sakhalin Energy MMO database, 2003-2007 (SEIC 2007). Ribbon seals feed predominantly on pelagic fish such as walleye pollock, Pacific cod and capelin, cephalopods and crustaceans (LGL 2003).

5.9.2.4 Bearded Seals (Erignathus barbatus)

Bearded seals are classified as Lower Risk/Least Concern on the IUCN Red List of Threatened Species (IUCN 2007) and are not included in the Red Book of the Russian Federation (Krasnaya Kniga RFZ 2001). They are harvested from the Sea of Okhotsk and the average annual catch during the period of unregulated sealing (1955-68) was ~ 10,000 bearded seals (Fedoseev 2000), but since that time sealing has been restricted. They are strongly associated with the ice and they tend to be concentrated to the north of the Sea of Okhotsk. Fedoseev (2000) estimated that there are 200,000 to 250,000 bearded seals in the Sea of Okhotsk, including 60,000 to 75,000 in the waters of eastern Sakhalin Island. More recent estimates report 350,000 seals in the Sea of Okhotsk and 35,000 to 40,000 seals in the eastern Sakhalin region (V. Vladimirov, pers. comm., 2007).

Bearded seals are usually found in shallow waters over the continental shelf, avoiding areas of continuous, thick, shore-fast, or drifting ice, but favouring moving ice with numerous open water gaps. In winter-spring, beginning in February (Kosygin et al. 1985), they occur all along the northeast coast of Sakhalin Island (Fedoseev 1971). In summer, they are scattered along the northeast and west coasts in low numbers, occurring at some rookeries but not in large numbers; during summer 1999, bearded seals were present at some rookeries and scattered along the coast in the areas surveyed (from Niyskiy Bay to Piltun Bay), but were not common and were observed only as single individuals

(Sobolevsky 2000, 2001). In 2000, the distribution was similar in the area surveyed (Lunsky Bay to Piltun Bay), but they occurred in groups of five to 10 animals, and more were seen in coastal rookeries than in 1999 (Sobolevsky 2001). The main reproductive groups are observed between Cape Elizabeth, at the north of the island, and 50°N (approximately halfway down the island). Figure 5-12 illustrates sightings of bearded seals in the Sakhalin Energy MMO database, 2003-2007 (SEIC 2007).

Bearded seals generally tend not to congregate on ice, but occur singly on the shear zone between shore-fast and drift ice (Nikolaev and Silishchev 1982 in LGL 2003). The only known large haul-out locations are gravel beaches on the north-western coast of Sakhalin Island, where they come on shore in large numbers (~2000) during the summer to rest and moult (Kosygin et al. 1986). Bearded seals often stay close to the water when hauled out and will typically dive immediately if disturbed (Burns and Harbo 1972; Burns and Frost 1979; Alliston 1981; Nowak 1999).

Bearded seals are typically benthic feeders, feeding upon crustaceans, gastropods, bivalves, annelids and cephalopods. The seals also feed upon some fish species including walleye pollock, sand lance and plaice (Bukhtiyarov 1990 in LGL 2003). As benthic feeders, the distribution of bearded seals is restricted to depths of less than 200 m (LGL 2003).

5.9.2.5 Northern Fur Seals (Callorhinus ursinus)

Northern fur seals are listed as Vulnerable on the IUCN Red List of Threatened Species (IUCN 2007) but are not considered rare in the Sea of Okhotsk and are a harvested species in Russia. In the Sea of Okhotsk, the total population may be as high as 200,000 individuals (V. Vladimirov, pers. comm., 2007). Approximately 95,000 to 100,000 individuals are found in a rookery on Robben (Tuyleni) Island, southeast of Cape Terpeniie, and in adjacent waters eastward of the Island (V. Vladimirov pers comm., 2007). Most northern fur seals occur along the south-eastern coast of Sakhalin Island. Small numbers are reported in Aniva Bay during the ice-free season. They feed on small schooling fish and cephalopods, especially squid (Sobolevsky 1984). The northern fur seal is a highly pelagic species, with only young fur seals spending appreciable amounts of time on land. Fur seals concentrate in areas of upwelling over seamounts and along continental slopes, and are rarely encountered close to shore except in the vicinity of rookeries. Northern fur seals typically winter in the Sea of Japan, migrating north to the Sea of Okhotsk in the spring to return to established rookeries. Most pups are born from late June to late July and are weaned at three to four months. While breeding males may remain at the rookeries for the entire breeding season, females return to sea regularly.

Large numbers of fur seals were killed for their pelts in the 19th and early 20th centuries; there have also been a significant number of fur seals killed accidentally by entanglement in fishing nets (Lander and Kajimura 1982).

Northern fur seals enter Piltun Bay infrequently (Sobolevsky 2000). In summer 2000, they were observed at some rookeries during surveys from Lunsky Bay to Piltun Bay (Sobolevsky 2001). Small numbers of animals have been recorded within Aniva Bay during the spring and autumn migrations and some sightings have been made between Lunsky and Piltun Bays (DVNIGMI 2001). During surveys by SakhNIRO in September 1998 and by DVNIGMI in July 2001, animals were only observed in Terpeniya Bay (including the Poronaysk Port area and Cape Terpeniy) where they were abundant. Approximately 75,000 to 80,000 individuals were observed at the rookery on Tyuleni Island, some 20 km southeast of Cape Terpeniya, and in adjacent waters eastward of the Island (Vladimirov 2002 in LGL 2003). Figure 5-12 illustrates sightings of northern fur seals in the Sakhalin Energy MMO database, 2003-2007 (SEIC 2007).

5.9.2.6 Steller Sea Lions (Eumetopias jubatus)

Steller sea lions, also know as northern sea lions, are listed as Vulnerable in the Red Data Book of Russia (Krasnaya Kniga RFZ 2001) and as Endangered in the IUCN Red List of Threatened Species (IUCN 2007). Steller sea lions are distributed around the North Pacific Ocean rim from northern Hokkaido, Japan through the Kuril Islands and Sea of Okhotsk, Aleutian Islands and central Bering Sea, southern coast of Alaska and south to the Channel Islands, California. The world population of Steller sea lions includes two stocks divided at 144°W longitude (Cape Suckling, just east of Prince William Sound, Alaska). The stock differentiation is based primarily on genetic differences, but also on differing population trends in the two regions. Steller sea lions have undergone dramatic declines in population across large portions of their range. This is thought to be due to a combination of habitat loss, habitat degradation, invasion by alien species, and the effects of hunting. The population has declined by approximately 10% annually since the early 1990s.

Approximately 9500 to 10,000 Steller sea lions now inhabit the Sea of Okhotsk with approximately 1100 individuals in the eastern Sakhalin region (Burkanov et al. 2006; V. Vladimirov pers. comm., 2007). In 2005, more than 1500 adult and 407 newborn animals were recorded at the only known breeding rookery on Sakhalin, located on Tyuleni Island (Kuzin 2006). Two main bachelor haul outs have also been identified, on Kamen Opasnosti Rock in La Perouse Strait and Kuznetsova Cape on the south-western coast of Sakhalin Island. Kamen Opasnosti Rock is used throughout the year, with up to 700 animals congregating there and with more animals occurring in the late winter and spring. The haul out at Kuznetsova Cape is also used year-round with more animals occurring in the late winter and spring; approximately 350 to 500 animals have been observed at this location (LGL 2003; Cupakhina et al. 2004). During harsh winters when land ice or solid ice at the shore is formed, the sea lions leave the area (Cupakhina et al. 2004). A smaller haul out is also present on the harbour breakwater at Nevelsk (on the western coast, 50 km south of Kholmsk). Animals start hauling out in late January through February and abandon the location in late November (Cupakhina et al. 2004). During the summer, animals may be seen along the entire eastern side of Sakhalin Island and across the northern section of Sakhalin Island into Amurskiy Bay. In September 1982, more than 200 Steller sea lions were recorded along the western coast of Sakhalin Island in Tatar Strait (Berzin et al. 1984). Rookeries tend to be located on remote, rocky coasts and islands. The number of Steller sea lions at rookeries begins to increase in early May and reaches a maximum in July. Females give birth from mid-May to mid-July, with most births occurring in early June.

Fish, such as Atka mackerel, walleye pollock, salmon, sculpins and sandlance dominate the diet of Steller sea lions (Sobolevsky 1984; Waite and Burkanov 2004).

Steller sea lions may occur, in small numbers, near the PA license area. Their closest large rookery is more than 300 km to the south of Lunskoye. They enter Piltun Bay infrequently (Sobolevsky 2000), and were not observed in summer 2000 during surveys from Lunsky Bay to Piltun Bay (Sobolevsky 2001). In 2005, 138 observations of 151 individuals were recorded during Sakhalin Energy construction activities and it was considered a fairly common species for the project area. It was encountered in all operational areas and during transit, however most of these observations were recorded in the Lunskoye area (SEIC 2006). Figure 5-13 illustrates sightings of Steller sea lions in the Sakhalin Energy MMO database, 2003-2007 (SEIC 2007).