Response from Donald Reid to remaining public questions from the Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing public proceedings May 28, 2014

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Do you have information on road kill rates to calculate the potential impact on wildlife if traffic increases?

I do not have data on road kill rates in the Yukon. I have not seen any compilation of such data for the Yukon, though I believe that the Ministry of Environment would have some record of big game road kills (caribou, moose and bears) along the Alaska Highway. The kill rates will vary with road type (e.g., Alaska or Klondike Highway, Dempster Highway; high grade bush road; spur road) and would need to be measured by ground surveys along the various road types. The majority of individual animals killed will be species of smaller body size (red squirrels; grouse; ground squirrels; finches). Data would have to come from Yukon roads because the distribution of species and their relative abundances may well be quite different in Yukon compared to Northwest Territories or British Columbia.

Should seismic exploration be allowed in areas where the Porcupine Caribou Herd overwinters?

There are two aspects to this issue: (i) the immediate disturbance caused by noise and activity during the seismic exploration; (ii) the longer-term impact of having the seismic lines on the ground. In general, I think that seismic exploration could occur in the Porcupine Caribou Herd winter range without significant detrimental effects if certain conditions were imposed on the activity.

First we have to discuss the issue of avoiding the overlap in time of seismic exploration and caribou presence. This is possible because: (a) the winter range is a very large area, (b) large portions of that historical winter range are of poor quality as winter range at any one time because of recent forest fires (no ground lichens for caribou to feed on), (c) caribou have some knowledge of where the good range is and are somewhat predictable in their winter movements, (d) seismic activities, though quite extensive, do not have to take place over large portions of the winter range in any one year, and have a short time span. The management response then should be to keep track of the general distribution of the herd, allow seismic activity in portions of the range which are currently poor quality for the herd (e.g., recently burned areas or adjacent range), avoid seismic activity (or other development activities) in portions of the winter range that are currently in good condition and have been used extensively by caribou in recent years, close down the seismic operations when caribou show major shifts in winter range use that bring them close to the seismic operations. Also, we will have to track all human activity through the entire winter range (both countries) to ensure that levels of human activity on the good quality range are not detrimental to the herd (At present we do not have quantitative measures of what that range-wide threshold of sustainable human activity might be, though recent work in the Northwest Territories tells us quite a bit about avoidance of mine roads). In other words we, as managers of the land and the seismic operations, have to be flexible in our activities. We may have to postpone seismic operations in certain landscapes (portions of the winter range) for many years.

Secondly, there is the question of long-term impact of seismic lines. In the range of boreal caribou (not barren-ground caribou like the Porcupine herd) seismic lines and oil and gas roads have led to caribou declines because predators (wolves and bears) can more easily find caribou by travelling on these linear corridors created by people. This pattern holds because the predators live in the landscapes year-round, the caribou are not migratory, there are lots of primary prey (moose and deer) for the predators (the caribou are secondary prey) year-round, and because humans are using many of the lines (seismic and roads) in winter and packing down the snow. This ecological pattern is not the case in much of the winter range of the Porcupine herd. The caribou are migratory, and so are the moose to some extent. The predators are less abundant, partly because of the migratory behaviour of their prey. There is much less likelihood that the predator-prey relationship that has occurred for boreal caribou will be repeated on barren-ground caribou winter range. There will be some risk of increased mortality to caribou, and reduced food intake by caribou, if an oil and gas field is developed in the Porcupine caribou herd winter range. This is because wolves will be able to travel more readily along packed lines in winter and caribou may avoid those linear corridors and the food in them. Once again the best management approach, from a strategic point of view, is to allow such development in portions of the winter range that are of relatively low value to caribou at the time development is anticipated and for a few decades afterwards.

Barren-ground caribou go through large fluctuations in numbers over many decades, and these appear to be driven by food availability. These caribou tend to overpopulate their range when at high densities. This overpopulation may be driven by extensive fires reducing the quality of the winter range and/or by the densities exceeding the ability of their foods to recover annually. The net result is that their reproduction and survival suffer. The Porcupine herd is currently at high numbers and we can expect their numbers to decline, especially because large portions of their winter have been burnt in recent decades.

What effects could development have on the Porcupine Caribou Herd (PCH)?
A significant portion of my answer to this question is in the response to the question above.

The factor that has most influence on whether development would affect the PCH is whether the development overlaps in time and space with activities of this migratory group of animals.
The calving and post-calving grounds are the most crucial because they are relatively limited in space, and are very specific landscapes with particular food resources necessary for the caribou to raise robust calves. It is also difficult to imagine a set of human developments on these arctic tundra landscapes that could be closed down during the calving and post-calving seasons, so that the presence of caribou and human activity do not overlap in time. If development were to be contemplated on these landscapes, the human presence with activity on the ground should only occur in winter.

On the rest of the herd's ranges, road developments are the biggest concern. Roads create disturbances that caribou avoid. They create useful travel corridors for wolves. Caribou get killed by traffic, and are more readily killed by hunters. All of these impacts can be sustained by the herd up to a certain threshold at which the cumulative impact of the effects will become unsustainable. We do not yet know

what that threshold might be, but biologists are working on that issue. Much depends on the total length and intensity of traffic on all roads throughout the entire range, and how the spatial pattern of roads overlaps good quality range and repeatedly-used migratory corridors. It is crucial that managers from both Alaska and Yukon jointly assess ongoing human activities.

What effects can the seismic lines in Eagle Plains have on local wildlife populations?

The main effects are: (i) disturbance during the time that the seismic work is done, and (ii) longer-term changes to the vegetation. Much depends on when the lines are placed in time, and how they affect the local vegetation. Doing seismic work in winter is a good management approach because many migratory wildlife species are absent. There will be disturbance to those species that stay in winter. To reduce this disturbance, do the seismic work when the animals are far from the site (in their general movements – e.g., caribou…see my response above), or design the layout of the seismic lines to avoid the very important winter habitats (bear denning areas, moose wintering areas) if these are known.

Regarding effects on vegetation, the issue is whether seismic lines are cut through the current vegetation (shrubs and scattered trees) significantly reducing the height of shrub cover or even disturbing the soil, or whether they leave the vegetation mostly intact. When the vegetation is significantly removed, the net result can be creation of a line of different habitat to the surrounding landscape (that may take decades to recover), or a line of different vegetation structure that will gradually grow back over a decade or two. The current management intent, with winter seismic, is to reduce the risk of disturbing the ground vegetation. So, the most likely change in vegetation is a potential reduction in height of shrub cover, and presence of trees along the line. These changes may allow some animals to travel more readily through the landscape. The main ecological effect would be in allowing some predators to find prey more easily because the predator can more systematically hunt the site and can travel faster. Examples might be wolves searching for moose, or red foxes searching for bird nests or voles. With the re-growth of shrubs on the lines, these effects will fade away. The only exception is when humans repeatedly use the seismic lines as travel routes (continuing to keep the vegetation low in stature, and/or packing the snow in winter, year after year). When humans open up seismic lines (or other linear corridors) as full-time travel corridors then all sorts of animals will use them with a wide diversity of effects. These are not necessarily a major upset to the local ecology unless the network of human-used lines is dense and extensive; then the increased ability of predators to find prey may significantly reduce some prey populations.

Should fracking be banned in Yukon?

In my opinion, fracking should be banned. I have reached this conclusion, not because the scientific evidence leads directly to such a conclusion, but because such decisions must be made on much more that scientific evidence.

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Regarding the science, the level of scientific knowledge of the risks of fracking is poor, as I indicated in my presentation. This is especially a problem when it comes to the risks of ground water pollution. The probabilities of contamination seem fairly high to me, but I have yet to be convinced that scientists have a thorough enough understanding of sub-surface geology and hydrology to accurately quantify those risks and point out the regions and geological formations with differing risk. Consequently, I conclude that the risk is widespread, considerable and yet imprecisely quantified. Therefore I believe it cannot be regulated or managed, and therefore should not be undertaken.

This is not ultimately a question of science, it is a question of common sense and intuition urging that precaution is a better approach than pushing ahead for economic return.

There is a more important ethical issue regarding oil and gas development, whether or not it involves fracking. In a nutshell, society cannot ethically support the development of any new sources of hydrocarbons for energy consumption. The globe cannot sustain ongoing increases in greenhouse gas emissions. We are already in a period of climate chaos that is completely removing some nation states from the globe, causing increased mortality in many regions, and severely taxing our private and public finances. Bringing new hydrocarbon developments in Yukon into circulation at this point in history would mean that we are saying we discount the right of each society to exist and we are content to contribute to an increasing incidence of climate-driven disasters in Canada and globally.

Have there been any long term studies on wildlife populations in close proximity to oil and gas wells?

I have not seen any really long-term studies on populations; most studies are shorter term and at a sub-population level. Oil and gas wells are localized impacts, and their effects will most likely be on the individual animal level. Across a region, the cumulative impacts through many individuals may be important at a population level.

The major impacts are noise inducing animals to avoid the vicinity of the well or changing their behaviour when near the well, and ponded water attracting some birds or mammals. Noise is mainly an issue during drilling and can induce birds and mammals to avoid the local habitats, thereby reducing their local density and reproductive output, and potentially affecting some of the ecological services they perform (removing insects; moving seeds around). Avoidance varies greatly by species. There could be population impacts regionally, especially when there are large numbers of wells. The impacts of noise abate somewhat when the well is in the production phase, because noise levels go down. (See: Bayne, E.M., Habib, L. & Boutin, S. (2008). Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest. Conserv. Biol., 22, 1186–1193; and Francis, C.D., Ortega, C.P. & Cruz, A.. (2011). Different behavioural responses to anthropogenic noise by two closely related passerine birds. Biol. Lett., 7,850–852. Francis, C.D., Kleist, N.J., Ortega, C.P. & Cruz, A.. (2012). Noise pollution alters ecological services: enhanced pollination and disrupted seed dispersal. Proc. R. Soc. B: Biol., 279, 2727–2735.)

Wastewater ponds are a potential issue at some well sites, because they contain contaminated water yet are attractive to waterfowl and sometimes mammals. These risks can be reduced by containing

waste water (not leaving it in exposed ponds). Effects on contaminated animals can be relatively fast death to long-term chemical contamination, but I have not seen long-term studies on individual animals exposed to contamination.

The paper by Northrup and Wittemyer (2012; Ecology Letters doi: 10.1111/ele.12009) outlines a number of measures in the planning and operational phases of oil and gas field development, that can reduce some of these impacts.

What could have been done to avoid the "environmental disaster" associated with oil and gas development in British Columbia described by the Fort Nelson First Nation?

Northeastern BC has seen a massive rush to develop oil and gas resources over a very short time period. It has been driven by a "gold rush" mentality. I do not speak for the Fort Nelson FN, and I do not know all their concerns, but my assessment of the situation overall is:

1. Development has been far too fast and extensive. The whole region should have been the subject of a strategic environmental assessment, which should have brought forward: (i) zoning so that only some portions of the region were open to development at a time and some portions were closed to any development (some zoning could rotate over periods of decades); (ii) application of the scientific knowledge of how caribou are affected by intensive oil and gas developments, which lays out thresholds beyond which development intensity should not proceed; (iii) inventories of high value habitats for a suite of species so that these sites and landscapes could be avoided or buffered from development activities; (iv) application of FN knowledge of historic and cultural sites, and key wildlife habitats, for avoidance and buffering; (v) an access management plan so that the region was not opened up to all kinds of public use, and roads were designed and laid out to minimize impacts; (vi) consideration of the range of resource extraction activities (incl. forest harvesting) that may occur along with hydrocarbon development, so that the combined impacts of these activities could be reduced by joint planning.

2. There has been an assumption that current knowledge and technology is sufficient to deal with issues and problems. The whole development exercise should have been approached more as an adaptive management or large-scale experimental situation. Learning from mistakes is crucial. This emphasises the need for undeveloped zones ("ecological benchmarks") which act as controls for the experiments going on throughout developed landscapes. It emphasis the need for the regulatory bodies to be far more influential in monitoring issues on the ground, and forcing industry to rectify problems.

3. The provincial government has seen this resource development as a windfall revenue stream and, in its over-riding desire to increase the revenue stream to government, has been lax in its licencing, regulatory and enforcement responsibilities. Political leaders in all northern provinces and territories are in a conflict of interest: they have to provide services which require tax revenue while at the same time being responsible stewards of environmental and natural resources. Development of natural resources is a primary tax revenue; being a responsible steward of natural resources means slowing down that stream of tax revenue from maximum levels it could reach. Maximizing tax revenue necessarily means that ecological thresholds will be crossed and development will occur at levels that cannot be sustained by ecosystems. The underlying problem in the mad rush to exploit oil and gas in BC has been an inability of politicians to close the door on some development, to slow it down to a manageable and sustainable pace. Politicians often reflect the sentiment and will of the people, so likewise the mad rush could also

be blamed in part on the citizens of BC who did not stand up to the onslaught. Politicians must take the inherent conflict of interest seriously, and be willing to slow down, postpone or close the door on some developments. Citizens have to realise that government will not provide every conceivable service.

What is the decibel level of fracking and what impact does the noise have on birds and other wildlife?

One impact of noise is during drilling (including fracking), but noise from compressor stations (independent of fracking) is at least as important. Noise will often force birds and some other species to move away from the source, and find a place to live elsewhere. The responses vary by species. Their local density and reproductive output will decline, and some of the ecological services they perform (removing insects; moving seeds around) may be affected in the vicinity of the noise. There could be population impacts regionally, especially when there are large numbers of wells or stations. The impacts of noise decline when the well is in the production phase, because noise levels go down at the well head itself. However, in the production phase, the most noisy sites are compressor stations. Well drilling is relatively short-term lasting from days to weeks. Compressor stations are the more pervasive source of noise pollution because they run year-round for many years and are fixed sites.
(See: Bayne, E.M., Habib, L. & Boutin, S. (2008). Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest. Conserv. Biol., 22, 1186–1193; and Francis, C.D., Ortega, C.P. & Cruz, A.. (2011). Different behavioural responses to anthropogenic noise by two closely related passerine birds. Biol. Lett., 7,850–852. Francis, C.D., Kleist, N.J., Ortega, C.P. & Cruz, A.. (2012). Noise pollution alters ecological services: enhanced pollination and disrupted seed dispersal.Proc. R. Soc. B: Biol., 279, 2727–2735.)

According to the paper by Bayne et al. (2008) cited above, noise levels from compressor stations are between 75 and 90 dB(A), but can reach 105 dB(A).