Matthew A. Cronin, Ph.D.

Written Testimony of Matthew A. Cronin for the U.S. Senate Energy and Natural Resources Committee, 2 November 2017.

I am Matthew A. Cronin, and provide the U.S. Senate Energy and Natural Resource Committee this testimony regarding oil and gas development in the 1002 Area of the Arctic National Wildlife Refuge (ANWR). I will focus my comments on the on the issue of potential impacts to caribou, with some brief comments on polar bears. Included in my testimony are several papers (PDF files) that I cite in this testimony.

I first acknowledge my colleagues with whom I published several papers on the topic, especially Warren Ballard, Heather Whitlaw, Shawn Haskell, Lynn Noel, Steve Johnson, Bobbi Pierson, Jay McKendrick, John Patton, Keith Parker, and Robert Pollard. These biologists have done good research and published results in peer-reviewed scientific journals. I also acknowledge the working men and women of the oil industry who make our modern society possible.

1. **Introductory comments on science and policy**.

Senator Angus King (ME), at the Seventh Symposium on the Impacts of an Ice-Diminishing on Naval and Maritime Operations, July 2017 (https://www.youtube.com/watch?v=zgmP8U9tJ6w), stated:

> "We can't make good policy without good data…. Give us data in a form we can understand….If you can develop a shared understanding of the facts the policy prescription is pretty easy. It almost becomes self-evident if everybody understands the facts…What you're doing in terms of the science and understanding what's happening and demonstrating it to us in a way that we can understand and absorb could not be more important…Give us the data in ways that we can understand and use."

Senator King's comments reveal a critical point: science does not dictate policy, but science informs policy. I will discuss this idea further below. Senator King's comments also indicate the need for science to be presented in an understandable manner. I will attempt to do so in this testimony. Of course, the published literature that I cite should be consulted for detailed information.

2. **Caribou and North Slope oil fields.**

I will describe the relationships of caribou and the Alaska North Slope oil fields. There has been considerable controversy over the issue of oil field impacts on caribou (e.g., Cronin 2001) so I recommend thorough reading and consideration of all of the literature cited for a complete understanding of this topic. I do not cite all of the available literature in this testimony, and the references within the sources that I cite should be consulted for additional information.

Calving-Caribou calving (i.e., cows giving birth to calves) in the Alaska North Slope oil fields has been studied extensively. On the North Slope, caribou cows give birth to calves in late May and the first two or three weeks of June. Some studies reported statistically significant lower density of calving caribou within 1 kilometer (km) of oilfield roads and facilities than in areas farther from the roads and facilities (Cameron et al. 1992). Non-statistically significant lower densities of calving caribou were also observed within 4 km of roads and facilities (Dau and Cameron 1986, Cameron et al. 1992). These observations were interpreted as displacement from, and avoidance of, oil field roads and facilities. However, these studies showed that some calving occurs within 1 km and within 4 km of roads and facilities. That is, there was not complete absence of calving caribou within 1 km or within 4 km of the oilfield roads and facilities. In the study reporting displacement and avoidance of the area within 4 km of an oil field road, 44.4% of the calves occurred from 0 to 4 km of the road, and 55.6% occurred from 4 km to 6 km of the road, so there was not complete avoidance of the areas within 4 km of the roads and facilities (Cameron et al. 1992, Noel et al. 2004). A replicate study actually found higher densities of calves within 1 km of the roads than farther away from the roads (Noel et al. 2004).

These studies indicate that lower calf density sometimes occurs, and sometimes does not occur, within 1 km of roads and facilities. Factors including habitat (e.g., types of vegetation), timing of snow melt in the spring (persistent snow influences how far north caribou move as they migrate from their winter ranges that are south of the oil fields), and perhaps most importantly, habituation (caribou learn over time that vehicles, roads, and buildings are not a threat) influence where caribou calve (Haskell and Ballard 2008, Haskell et al. 2006).

General calving areas also shift over time. This has been reported for caribou herds with no oil development within their ranges and is a natural occurrence (Noel et al. 2006a and references therein). A shift of calving concentration to the south of the North Slope oil fields has been attributed to oil field expansion on the North Slope (Joly et al. 2006 and references therein). However, this is not definitive because the same factors affecting individual caribou responses to roads and facilities (e.g., timing of spring snowmelt, habitat, habituation, predators and human hunting) also affect the general areas in which caribou calve (Haskell and Ballard 2008, Haskell et al. 2006).

Summer-After the calving period, caribou do not avoid the oil fields and travel through them regularly (Pollard et al. 1996a, Cronin et al. 1998a, Noel et al. 1998, 2006b). Pipelines and roads can block or deflect caribou movements, but elevating pipelines above the ground, separating pipelines and roads, and other measures minimize this impact. There is intense mosquito and fly harassment of caribou during the summer, and caribou will travel to the coast where there is more wind, and also often congregate on the oil field roads and gravel pads and in the shade of buildings and pipelines to escape the insects (Pollard et al. 1996b, Noel et al. 1998). There is no hunting allowed in the oil fields, which gives caribou protection. Proper design and operation of oil fields has actually enhanced caribou habitat in important ways.

Impacts to calf production and numbers of caribou in herds-It has been hypothesized that the oil fields have negatively affected caribou reproduction and recruitment (i.e., calf birth and

survival) and the number of animals in the Central Arctic herd (NRC 2003 and references therein). In particular, a decline of the Central Arctic herd of 5,344 animals between 1992 and 1995 (Table 1 and Figure 1) was partially attributed to oilfield impacts (NRC 2003 and references therein). Several lines of data do not support this hypothesis (Cronin et al. 1997, 1998b, 2000, Haskell and Ballard 2004, Noel et al. 2006a). First, note that the decline in the Central Arctic herd was small relative to the overall changes in the four Arctic Alaska herd numbers over time (Tables 1-4, Figures 1-4). Increases or decreases of the magnitude seen in the Central Arctic herd between 1992 and 1995 are well within the natural variation of herd numbers. Second, note that the Teshekpuk herd also declined by a similar amount (8,951 animals) in the same time period (between 1993 and 1995) without oil fields in its range (Table 3, Figure 3). Third, consider that the caribou of the Central Arctic herd spend about 10 months of the year in ranges away from the oil fields where many other factors affect their survival and fitness (Cronin et al. 2000). It is becoming apparent from studies of population genetics and population dynamics that inter-herd movements substantially affect the numbers of caribou in each herd, and data do not support the hypothesis that oil field impacts have caused a population decline (Cronin et al. 1997, 1998b 2000, 2003, 2005, ADFG 2016).

The Central Arctic caribou herd has grown since the oil fields and Trans Alaska Pipeline were developed. There have been fluctuations in numbers (Table 1, Figure 1), but neither the increases nor decreases can be attributed to impacts of the oil fields as noted by the Alaska Department of Fish and Game:

> "The impact of oil infrastructure on CAH (Central Arctic herd) has also been considered, but *is not thought to be contributing to the decline* since the herd grew substantially during peak oil development." (ADFG 2016, my italics).

In contrast, there is empirical evidence that emigration contributed to a decline in the numbers of caribou in the Central Arctic herd between 2013 and 2016:

> "From 2013 to 2015, extensive mixing occurred between the CAH (Central Arctic herd), Porcupine, and Teshekpuk herds after calving and during the winter. Several thousand caribou left CAH and joined other herds." (ADFG 2016).

This is seen in the herd numbers (Table 1). The number of caribou in the Central Arctic herd census in 2013 was actually about 70,000 but there were animals from the Porcupine caribou herd present, so the herd estimate was adjusted downward to 50,753 (Parrett et al. 2014, Lenart 2015). The decline between 2013 and 2016 was likely due in part to high female mortality and emigration (Bohrer 2017, Cotten 2016).

The numbers of caribou in the Central Arctic herd reflect habitat, winter severity, inter-herd emigration and immigration, population density, and other factors described in the published literature. The hypothesis that changes in herd numbers are due to oil field impacts has not been supported considering all of the available data.

3. Oil development in ANWR

The status of caribou in the North Slope oil fields has been good. Caribou continue to use the oil field areas as habitat, and the herd has grown substantially since the oil fields were developed. As the oil fields developed, new technology and insights resulted in a much smaller area of development (e.g., with directional drilling) and better mitigation of impacts with elevated pipelines, separation of roads and pipelines, and other measures.

I think that oil and gas development in the 1002 Area of ANWR can be done with limited impacts on caribou by using proven mitigation measures. First, the Porcupine caribou herd does not calve in the 1002 area every year. Second, because the primary concern is impacts during the calving period, simple adjustment of timing of oil field activity can greatly mitigate possible disturbance to caribou during this time. Restrictions on vehicle and aircraft traffic and loud drilling activities during the calving period can be implemented. Likewise, burying or elevating pipelines and separating pipelines and roads can minimize obstruction of movements. By identifying a clear management objective of minimizing disturbance and loss of habitat to caribou, I believe that oil exploration and development can be done in the 1002 Area of ANWR with minimum impacts to caribou.

4. Insights on Science and Management

As Senator King's quote above indicates, science and policy (and management) are not the same. Science can inform policy and management, but does not dictate it. For example, here are four potential management objectives for the 1002 Area of ANWR:

1. All of ANWR, including the 1002 Area be designated as wilderness. No oil or other development allowed.
2. Oil leasing and development in accordance with past leasing practices, with mitigation to minimize impacts on wildlife (i.e., multiple-use management).
3. Exploration to document what resources are present for potential development later (e.g., Senator Sullivan's 2013 exploration plan, developed when he was Commissioner of the Alaska Department of Natural Resources).
4. Develop oil and gas resources in the 1002 Area of ANWR immediately to provide funding for the Department of Defense (DoD). I developed this proposal in 2013 when DoD was under severe budget constraints due to sequestration (Cronin 2013).

Each of these management objectives is favored by some people and opposed by others. Science has nothing to do with whether one favors one objective or another. Science can be used to implement any of them (except the first which entails no actual management). Claims that science somehow supports a particular objective are simply not correct. People choose management objectives, science can be used to achieve them.

Science is often invoked by anti-development advocates as the so-called "precautionary principle" which states that if an action or policy has a suspected risk of causing harm (to the environment), in the absence of scientific consensus (that the action or policy is not harmful), the burden of proof that it is *not* harmful falls on those taking that action. This is simply a way for anti-development advocates to present their management objective as a "principle", when it is really just what they want. One could just as easily create a "precautionary principle" defined by potential harm to the economy or peoples' jobs. It is of primary importance to clearly identify management objectives, and then suggest ways that science can be used to achieve them.

5. Comments on Polar bears

Polar bears can be impacted by onshore oil field development because of conflicts with people, and disturbance to denning female bears (Amstrup 2000). Mitigation measures in the North Slope oil fields have been implemented including control of garbage and other human foods, training of oil field workers about the danger posed to them and to polar bears by interactions, and by avoiding disturbance of dens aided by detection methods such as forward-looking infrared devices (FLIR).

There is also research regarding the overall condition of polar bears as a species, and its predicted extinction and endangered species listing. Cronin and Cronin (2015) stated:

> "The Arctic Ocean is undergoing rapid climatic changes including higher ocean temperatures, reduced sea ice, glacier and Greenland Ice Sheet melting, greater marine productivity, and altered carbon cycling."
>
> "If, as DNA and fossil evidence suggests, polar bears and their primary prey, ringed seals and other prey such as walruses, have existed for at least 125 ka (ka = thousand years) and likely hundreds of thousands of years, then they experienced extreme climate conditions of glacial periods as well as partially or completely summer sea-ice-free interglacial periods (MIS 11, MIS 5 and the early Holocene)."

Diminishing sea ice can have serious impacts to polar bears and marine mammals. However, polar bears and other species associated with sea ice survived previous ice-free periods as described by Cronin and Cronin (2015). These observations may be useful in the current assessments of impacts from recent declines in sea ice.

References (several of the papers cited below are included as part of this testimony as separate PDF files)

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Table 1. Central Arctic caribou herd numbers 1975-2016.

Year	Number of Caribou
1975	5000
1978	5000
1980	5000
1981	8537
1983	12905
1985	15000
1989	18000
1991	19046
1992	23444
1995	18100
1997	18824
2000	29519
2002	34211
2008	66666
2010	68442
2013	50753
2016	22630

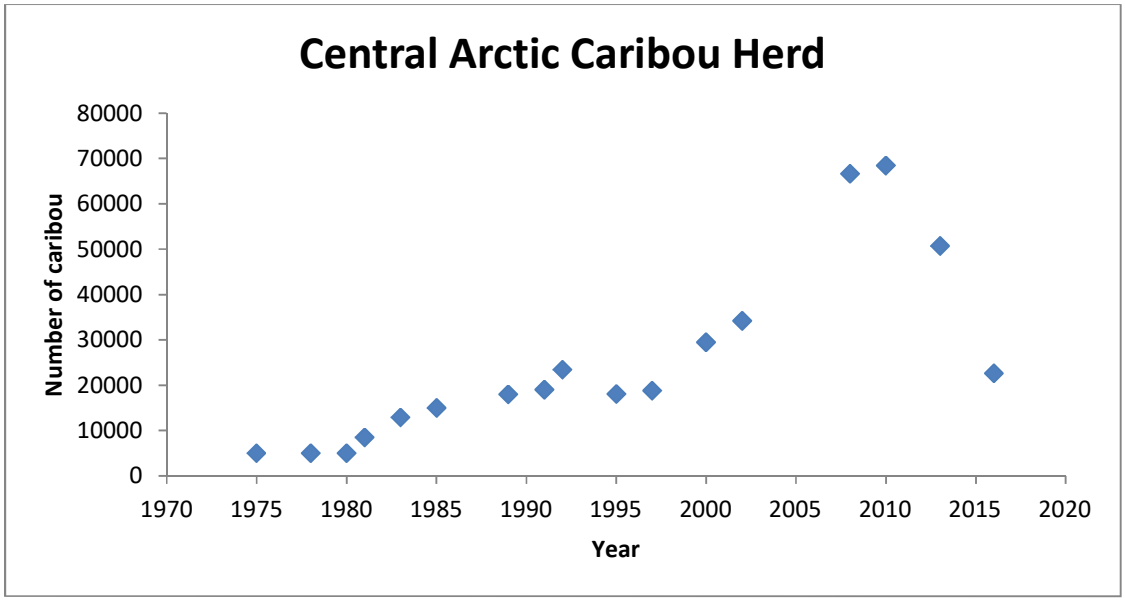

Figure 1. Central Arctic caribou herd numbers of animals from 1975 to 2016.

Table 2. Porcupine caribou herd numbers 1964-2013.

Year	Number of caribou
1964	140000
1972	99959
1977	105000
1979	105683
1982	125174
1983	135284
1984	149000
1985	165000
1986	182500
1987	165000
1989	178000
1992	160000
1994	152000
1998	129000
2001	123000
2010	169000
2013	197000

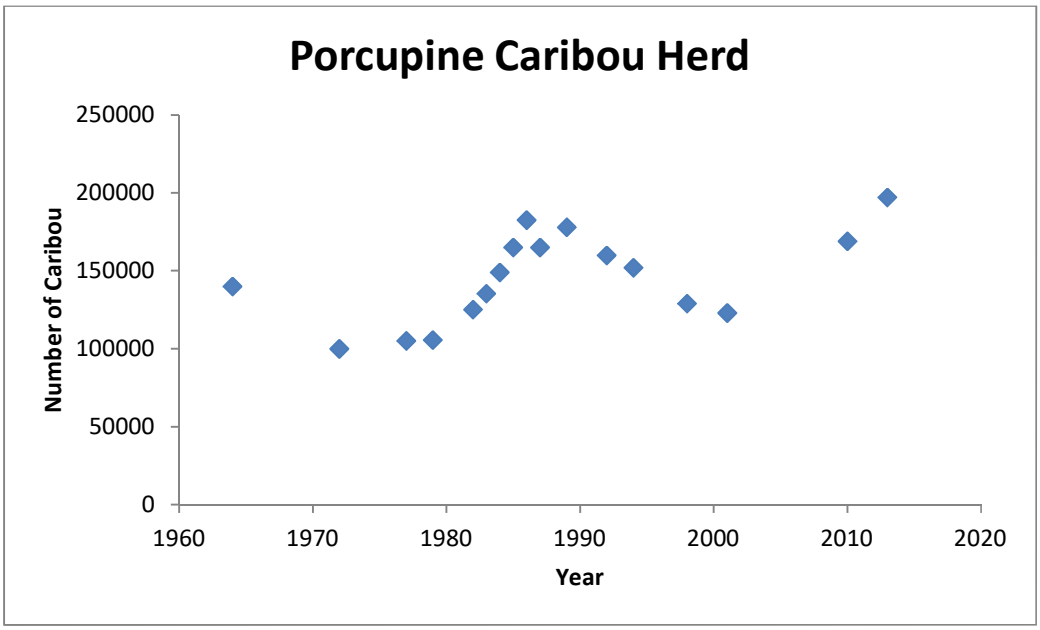

Figure 2. Porcupine caribou herd numbers of animals from 1964 to 2013.

Table 3. Teshekpuk caribou herd numbers 1981-2013.

Year	Number of caribou
1981	3009
1984	18292
1985	13406
1989	19724
1993	41800
1995	32839
1999	28627
2002	51783
2008	68932
2011	55704
2013	39172

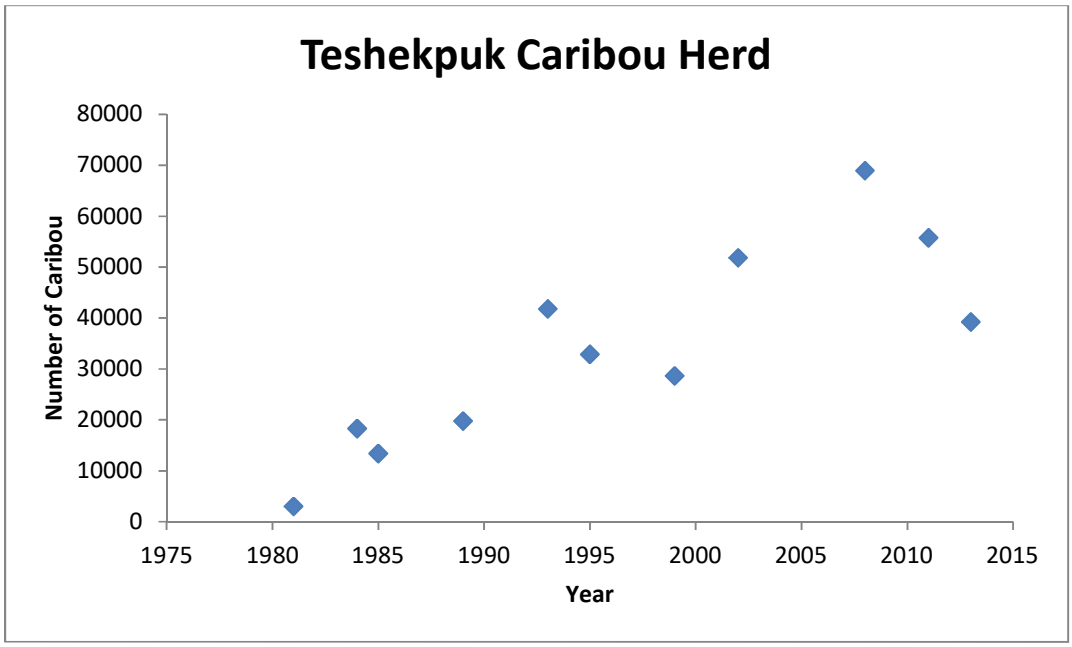

Figure 3. Teshekpuk caribou herd numbers of animals from 1981 to 2013.

Table 4. Western Arctic caribou herd numbers 1961-2013.

Year	Number of caribou
1961	156000
1962	187500
1964	300000
1970	242000
1975	100000
1976	75000
1977	75000
1978	107000
1980	138000
1982	217863
1986	229000
1988	343000
1990	417000
1993	478822
1996	463000
1999	444597
2003	490000
2007	381501
2009	355828
2011	324963
2013	234757

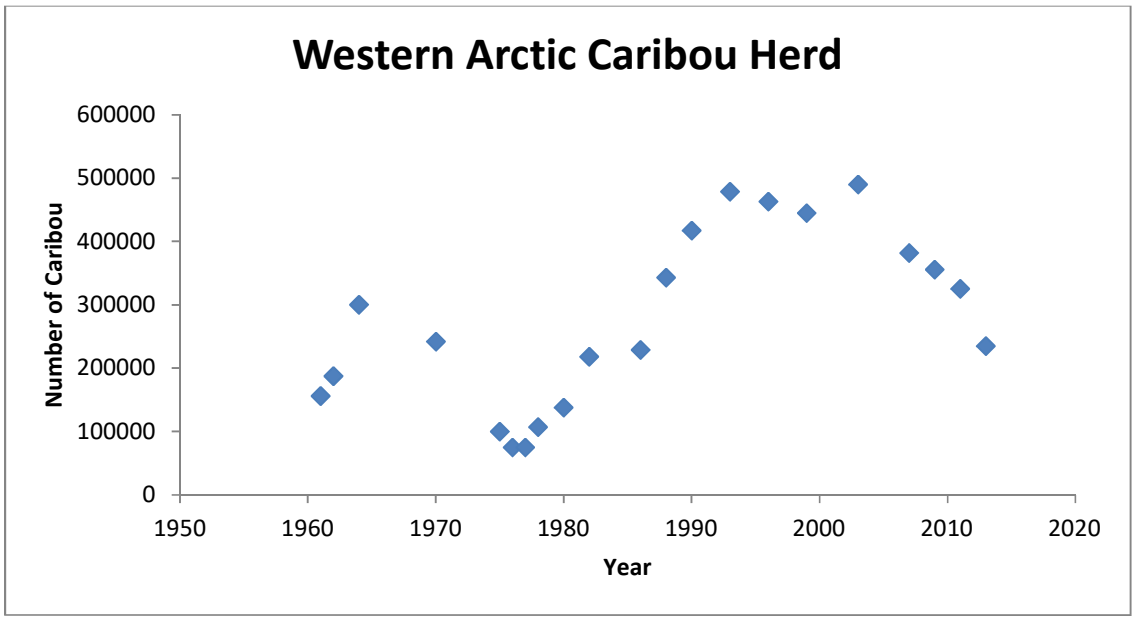

Figure 4. Western Arctic caribou herd numbers of animals 1961 to 2013.