Teshekpuk Caribou Herd Movement through Narrow Corridors around Teshekpuk Lake, Alaska

By Dave Yokel, Alex Prichard, Geoff Carroll, Lincoln Parrett, Brian Person, and Caryn Rea.

Abstract

We used 17 years of satellite and GPS collar location data from the Teshekpuk Caribou Herd in northern Alaska to investigate use of two narrow land areas constricting caribou movement around Teshekpuk Lake. In the future, oil pipelines may be built in either area. We need pre-development data to mitigate impacts of pipelines on caribou movement. Caribou used the areas most during early July, when more than 73% of collared caribou entered the areas. During July, caribou movements were more rapid within the constricted zones than outside.

Photograph courtesy of authors

Figure 1. Author Lincoln Parrett restrains a female caribou while her calf looks on.

Introduction

Caribou (*Rangifer tarandus*) of the Teshekpuk Caribou Herd (TCH) calve near Teshekpuk Lake in northern Alaska (*Carroll et al. 2005, Parrett 2007, Person et al. 2007*). On the northwestern and eastern sides of the lake are narrow strips of land extending from the lake 7 mi (11 km) to the Smith Bay and 8 mi (13 km) to the Kogru River, respectively (hereafter the Smith and Kogru areas). These create constricted zones through which caribou must pass to access the area north of Teshekpuk Lake (*Figure 2*). On warm, summer days, mosquito harassment of TCH caribou can be severe; however, the area north of the lake has reduced mosquito activity, for the Beaufort Sea generally keeps temperatures lower and wind-speeds higher than in areas farther inland (*Parrett 2007*). The two constricted zones are heavily used by caribou during midsummer for travel to and from mosquito-relief habitat north of the lake (*Person et al. 2007*).

As early as 2018, the Bureau of Land Management (BLM) may hold oil and gas lease sales for the area north of Teshekpuk Lake (*USDOI BLM 2008*). Any subsequent development would include pipelines through the constricted zones; pipelines have the potential to impede or deflect caribou movements (*Lawhead et al. 2006*). If caribou cannot achieve an optimal spatial and temporal pattern of insect avoidance and foraging, the negative impact on caribou energy balance could lower survival or productivity (*Murphy and Lawhead 2000*). Baseline data on patterns of constricted zone use by caribou will be crucial for mitigating impacts through pipeline design, and testing the efficacy of mitigations following development.

Methods

Satellite Collars

We analyzed telemetry data to better understand caribou distributions and movements near Teshekpuk Lake. Over 17 years (July 1990 through August 2007), we outfitted 102 caribou (81 females, 21 males) with satellite collars (*Figure 1*). Although satellite-telemetry locations are considered accurate to within 0.3-0.6 mi (0.5-1 km), the data also require screening (*Prichard and Murphy 2004*) to remove spurious locations, e.g. duplicates, locations obtained after caribou mortality, and those for which location quality scores indicated unreliability. We also removed locations that appeared incorrect because they were far from others or were offshore.

To determine the proportion of satellite collared caribou using the constricted zones and the area north of Teshekpuk Lake, we analyzed locations to assess which caribou movements crossed each constricted zone and recorded the direction of movement (north-to-south or south-to-north). We did this for each half-month time period (e.g., 1-15 January, 16-31 January). We included only animals with six or more locations per time period to ensure we had a good record of an animal's movement for that period.

GPS Collars

In recent years, we fitted some TCH caribou with geospatial positioning system (GPS) collars, which provide more frequent locations with increased accuracy. We deployed GPS collars on 10 female caribou in July 2004, and 12 in July 2006. GPS collars remained on for one year. They recorded locations every three hours in 2004-2005 and every two hours in 2006-2007.

These data were screened and filtered as were satellite collar data. We analyzed movements of the 22 female caribou to determine how often they traveled through the two constricted zones. The high spatial and temporal resolution of these data provided relatively accurate estimates of movement paths.

We divided distance between consecutive locations by time to calculate movement rates. We also calculated the average movement rate while caribou were in constricted zones. Because movement rates are sensitive to time between locations (fix-interval), we analyzed changes in movement rate estimates with changing fix-interval. Based on the results, we increased rates estimated from three-hour fix-intervals by 5.6% to approximate rates from two-hour fix-intervals.

Weather Data

Parrett (*2007*) collected temperatures and wind speeds at two locations during summer 2004 (*Figure 2*). One was located 9 mi (15 km) south of Teshekpuk Lake and one on the Beaufort Sea coast north of Teshekpuk Lake. We obtained additional data from Barrow.

Results

Satellite Collars

The proportion of satellite-collared caribou in the area north of Teshekpuk Lake peaked at 73% during early July (*Figure 3*). This proportion dropped sharply during other periods to nearly zero in winter. The proportion of caribou in the Kogru Area was higher than in the Smith Area. A similar pattern was observed for GPS-collared caribou traversing across constricted zones. An

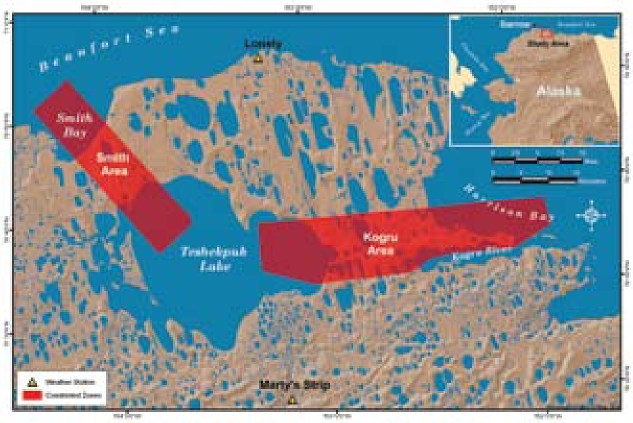

Figure 2. The locations of constricted zones around Teshekpuk Lake, Alaska, and two weather stations recording temperature and wind-speed during summer, 2004.

estimated 38% and 50% crossed the Smith and Kogru areas, respectively, during early July. More moved north than south across the Smith Area, whereas the opposite occurred in the Kogru Area. The proportion of satellite-collared caribou moving across the constricted zones varied widely among years, ranging from 14-83% and 17-77% for the Smith and Kogru areas, respectively.

GPS Collars

GPS-collared caribou frequently used the two constricted zones during mid-summer, especially during 2004 (*Figure 4*). In July 2004, eight of 10 GPS-collared caribou made a circular movement around Teshekpuk Lake, moving south through the Kogru Area during 6–8 July, north through the Smith Area during 20–22 July, and south again through the Kogru Area on 27 July.

The apparent reasons for these movement patterns were supported by weather observations (*Figure 5*). Lonely was generally cooler than Marty's Strip. High temperatures (as seen for Barrow) occurred during the first days of July, and caribou moved north of Teshekpuk Lake where GPS collaring took place. It was cooler July 6-8 when eight of 10 GPS-collared caribou moved south through the Kogru Area, and generally remained cooler and windier until July 20. Then a period of warm weather and less wind followed during 21–26 July, and the eight returned north of the lake. After temperatures dropped and wind speed increased on 27 July, all 10 caribou moved south.

In 2006, five of 12 caribou traveled north and three south through the Kogru Area, and three traveled north and four south through the Smith Area. Only two caribou used the corridors in August and none between September 2006 and May 2007. Only two caribou moved through the corridors in June 2007.

Caribou moved fastest in July and slowest in June (*Figure 6*). They generally moved slower north of Teshekpuk Lake than in either constricted zone. In 2004, movement rates were slower north of Teshekpuk Lake than in the Kogru or Smith area, but there was no significant difference between the latter two. In 2006, movement rates were higher in the Smith Area than north of Teshekpuk Lake or in the Kogru Area, with no significant difference between the Kogru and north areas.

Discussion

As previously reported (*Person et al. 2007*), the constricted zones around Teshekpuk Lake are important movement corridors for caribou moving north of Teshekpuk Lake for insect relief. Satellite collar data show these areas may be used throughout the year (*Prichard and Murphy 2004*), but most movement across the constricted zones occurs in July. These patterns were generally known from field observations prior to the use of satellite collars (*Davis and Valkenburg 1979, Silva et al. 1985*), but our data quantify both use and variation among years.

Both satellite and GPS collar data show a tendency for TCH caribou to move in a clockwise pattern around the lake, although caribou do move both directions through both corridors. Temperature and wind speed may explain the timing of movements to the north of Teshekpuk Lake, and wind may also influence this clockwise pattern. We hypothesize that during low insect activity, caribou tend to move with the prevailing northeasterly winds as

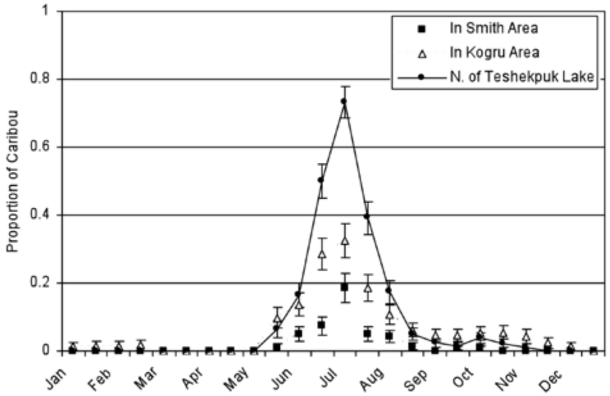

Figure 3. The mean proportion (+/- 1 standard error) of satellite-collared caribou with at least one location in the constricted zones or north of Teshekpuk Lake, during each 2-week time period, 1990-2007.

they forage and head away from insect relief areas. When insects increase, caribou return to relief areas heading upwind. Headwinds decrease insect harassment during the return trip to insect relief areas.

GPS collar data best describe specific movement paths and rates of movement. Observed variation in movement rates is consistent with use of the area north of Teshekpuk Lake for insect relief. Movement rates are fastest during July, when mosquito activity is greatest. During July, movements are slower north of the lake, where mosquito activity is lower, than inland where greater mosquito harassment occurs.

Management Implications

The BLM has acknowledged the importance of the two constricted zones to the TCH (*USDOI BLM 2008*) by allowing only pipelines, not roads, within them. Traffic on nearby roads is the most important factor affecting pipeline crossing success by caribou (*Lawhead et al. 2006*). Our GPS collar data suggest that caribou do not consistently favor specific paths through the constricted zones, so there may not be a "best" pipeline route. However, these results are based on a relatively small sample of 22 caribou, and

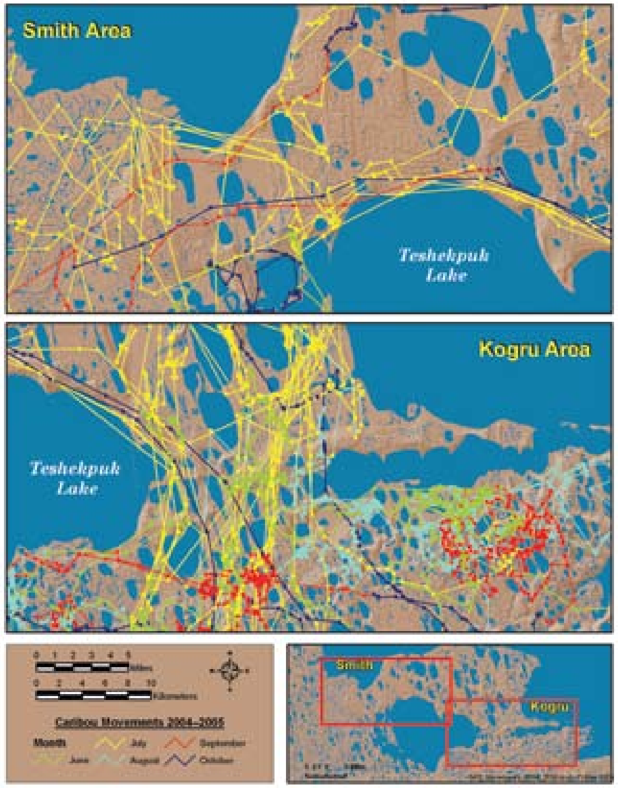

Figure 4. The locations (dots) and estimated movement paths (line segments) of 10 GPS-collared caribou (fix interval of 3 h) around constricted zones near Teshekpuk Lake, Alaska, July 2004-June 2005.

our larger, satellite collar dataset displays variability among years but longer-term trends. We require additional years of GPS data collection to discern any real trends in caribou routes.

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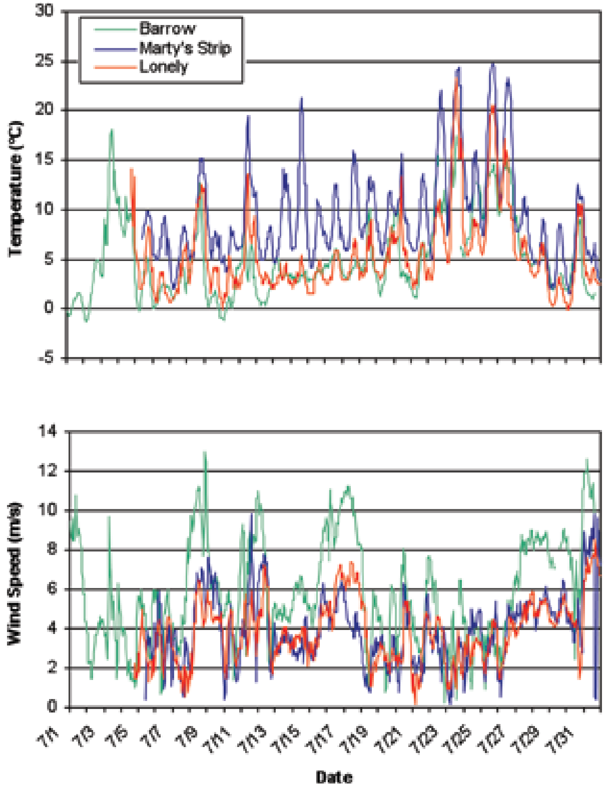

Figure 5. Temperatures (°C) and wind-speeds (m/s) at Barrow, Lonely and Marty's Strip, Alaska, during July 2004.

		North of Teshekpuk Lake		Kogru Area		Smith Area	
Year	Month	Average	*n*	Average	*n*	Average	*n*
2004	July	0.70	612	1.45	123	1.16	57
	August	0.52	25	0.40	56	-	-
2005	June	0.17	3	0.21	164	1.14	1
2006	July	0.88	430	1.02	169	1.63	38
	August	0.60	58	0.75	17	-	-
2007	June	0.18	218	0.43	52	-	-

Figure 6. Movement rates (km/h) of GPS-collared caribou north of Teshekpuk Lake and in constricted zones on either side of Teshekpuk Lake, 2004-2007. Sample size (n) is number of movement segments, i.e. pairs of consecutive locations.

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