

# Assessment of the Potential for Bison Introduction and Grazing in McCarthys Marsh

Kyle Joly



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## **Cover Photo**

Death Valley, just east of McCarthys Marsh, Seward Peninsula, Alaska. All photos by the author.

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## BACKGROUND

The Bureau of Land Management's Northwest Management Framework Plan (1982), which covered management of public lands on the Seward Peninsula, did not address herding domestic animals other than reindeer. However, local residents have also considered herding American bison (*Bison bison*) in the region. The BLM initiated this study of McCarthys Marsh to obtain information for new planning efforts and to prepare for potential permit applications. The Kobuk-Seward Peninsula Proposed Resource Management Plan and Final Environmental Impact Statement (2007) incorporates the study's results; the new plan, which upon finalization will replace the management framework plan, limits commercial grazing on BLM-managed public lands to reindeer (*Rangifer tarandus*).

Bison have been extinct in Alaska for hundreds, if not thousands, of years. The most recent physical evidence of bison from eastern Interior Alaska dates back more than 1200 years (Stephenson et al. 2001). Specimens from further west are even older. In fact, bison are thought to have been extinct in eastern Beringia before the start of the Holocene (Rasic and Matheus 2007). While bison were the most common large land mammal in Alaska thousands of years ago, all of Alaska's existing wild bison came from the 20 animals released near Delta Junction in 1928 (Griffin and Johnson 1994). These animals were plains bison (*B. b. bison*) transplanted to Alaska from Montana. Natural emigration and transplants have now created additional herds at Copper River, Chitina River, and Farewell (Griffin and Johnson 1994). In mid-1985 Alaska had approximately 700 feral plains bison (Griffin and Johnson 1994). No wood bison (*B. b. athabascae*) currently roam the state, but the Alaska Department of Fish and Game is considering introducing them to the Yukon Flats, Minto Flats, and/or the Innoko Flats areas.

The bison is the largest native land mammal in North America (Griffin and Johnson 1994). Wood bison can be 15% larger than plains bison. A full-grown bull stands 6 feet (1.8 m) at the shoulder, measures up to 10 feet (3.3 m) long, and can weigh more than a ton (907 kg). Full-grown cows are smaller, but

have been known to weigh more than 1,200 pounds (544 kg). Cows are sexually mature at 2 years of age and give birth to single calves twice in three years. The gestation period is approximately 270 days. Bison in Alaska have been known to live to a relatively great age compared to other ungulates; a bull killed in the Copper River area was over 20 years old.

Bison are migratory animals by nature (Griffin and Johnson 1994). Alaska's wild bison do not remain in single herds, but scatter alone or in groups ranging up to 50 animals or more. In the Delta Junction area, they move onto farms, remaining throughout the winter and sometimes causing damage to unharvested crops. Alaska's other wild bison herds also have seasonal movement patterns.

Bison are grazing animals and in Alaska find only limited amounts of food along rivers, in recent burns, and sedge potholes (Griffin and Johnson 1994). Their diet consists mainly of various grasses and forbs like vetch (*Vicia* spp. and *Astragalus* spp.), a favored summer food found on gravel bars. They also consume sedges, silverberry (*Elaeagnus commutata*), willow, and ground birch. Good bison range is limited in Alaska, making it unlikely that large numbers of bison could sustain themselves in today's environment as they did millennia ago.

## SUPPORTING INFORMATION

### Personal Interviews

**Robert Stephenson, Alaska Department of Fish and Game (ADFG)** – Fairbanks, phone conversation, July 2004

Robert Stephenson was a long-time ADFG Area Biologist for northeastern Alaska. In his current position as Wood Basin Project Biologist, he has been working intently on introducing wood bison to the Yukon Flats region for the past several years. He stated that he thought that McCarthys Marsh would not suit bison, and that the State of Alaska had come to the same conclusion on several previous occasions when the idea had been considered. Bison make trails into wet areas, and the marsh is obviously quite wet. Stephenson suggested Maria Berger as someone knowledgeable about the effects of bison introduction into the area.

In the summer, bison prefer grass but eat sedges and some newly emerging willows. In winter bison still eat grasses, but they prefer sedges. Beaked sedge (*Carex rostrata*) and slough sedge (*C. atherodes*) offer high-quality forage and water sedge (*C. aquatilis*) offers low-quality feed. Bluejoint (*Calamagrostis canadensis*) is also a low-quality forage grass. Tussock tundra does not provide good food for bison (**Figure 1**).

Productive range could support 5–10 bison/square mile. Agricultural fields in Delta offered high-quality range (where the bison overwintered), but the summer range south of Delta was low-quality, providing bluejoint and vetch.

Bison use their heads to sweep away soft snow up to 30 inches deep. They can get through crusted snow of lesser depth but need much higher forage biomass/quality to make it worthwhile.

**Catherine “Kate” Persons, ADFG** – Nome, interview, July 2004

Kate Persons recently retired as an Area Biologist for the Nome area. She said McCarthys Marsh area is important moose winter range. Given the moose population, anything

that might hinder moose population recovery would not be considered favorably within the ADFG; competition between moose and bison could negatively affect moose recovery efforts. Competition might also develop between bison, caribou, and muskox. Persons thought that the State would be against a bison introduction because of negative local sentiment expressed about the muskox introduction that occurred on the Seward Peninsula in the 1970s and 1980s. People still fear muskoxen, and bison are much larger animals.

Plains bison have been relocated to four locations in Alaska: Delta, Copper River, Chitina, and Farewell. Persons said the ADFG generally opposes transplanting plains bison to additional areas, including the Seward Peninsula. As for wood bison, the ADFG opposes their relocation in many areas of Alaska, including areas outside of known historic range. No Holocene bison remains have been found on the Seward Peninsula.

**Stephen DuBois, ADFG** – Delta Junction, phone conversation, August 2004

Stephen DuBois is the Area Biologist for the region in which Alaska’s first bison introduction occurred. Bison management is



**Figure 1.** A typical Lichen Tussock Tundra ecological site in McCarthys Marsh. The average 35% sedge and grass biomass of this site, located immediately north of Study Site 2004-09, provides low forage quality.



a significant part of his workload. DuBois is most familiar with the Delta Bison Herd, which forages primarily on grasses in native/natural conditions during the summer. However, in the winter the bison move to agricultural fields in the region and feed on domestic forage because the planted crops have much higher nutritional value than native grasses there. DuBois believed the bison could tolerate deep snows as long as enough forage was present. He also stated that the bison can make significant trails, up to 20–30 feet (6–10 m) wide if used repeatedly. Bison wear the trails down to mineral soil (i.e., the trails are devoid of vegetation).

DuBois also noted that habitat disturbance can come from wallows that may reach 10–15 feet (3–5 m) in diameter. Bison prefer sandy soils for their wallows. DuBois also mentioned that moose may shy away from areas occupied by bison. This competition is allayed in human-altered situations, such as where both species have come to forage on planted oats.

**Maria Berger, formerly University of Alaska Fairbanks** – Fairbanks, phone conversation, August 2004

Maria Berger researched bison for her Master's degree. She said she conducted range work on the Yukon Flats National Wildlife Refuge and conducted reindeer-related range work in McCarthys Marsh. Berger said that the biomass of bison forage species is significantly lower in McCarthys Marsh than in the Yukon Flats. In fact, she felt it was low enough to warrant concern about the acceptability of the area as bison range. The marsh's "dry" lake beds (which are typically quite wet) have higher biomass, but these areas are too wet for the bison in the summer (see also *Ground Reconnaissance of McCarthys Marsh, July 26, 2004*, below). She thought that the bison could damage the wet areas by creating trails and that McCarthys Marsh lacked sandy spots, which bison favor for wallowing. While wet areas of higher forage biomass would be easier to reach when the water froze during winter, they pose two potential problems. One is that the lake beds are depressions and may retain more snow, making it

harder for bison to access them. Berger said that snow deeper than 3 feet (1 m) would prevent the bison from foraging. She also noted that the dry lake bed habitat patches are fairly small and isolated. She said that the energy expended moving from one isolated area to another might be too great for the bison, especially given the low biomass even in the lake beds.

Berger discussed reports from bison ranges in the Northwest Territories by Reynolds and others (1978) that document forage biomass in wet areas to around 3,500 lbs/acre (3930 kg/ha) and 1,750 lbs/acre (1965 kg/ha) in dry meadows. The forage in both these areas was dominated by high-quality species. Note how these figures dwarf the biomass found in McCarthys Marsh (see *Ground Reconnaissance of McCarthys Marsh, July 26, 2004*, below).

Berger said that introduction of bison into this area would be risky due to the aforementioned reasons and therefore probably should not be attempted for the sake of the animals. She said that herders might attempt to use snowmachines to create trails for the bison, but she doubted the feasibility of this technique because of the great distance back to the village and the natural tendency of bison not to respond well to herding. She noted the difficult time the ADFG had in trying to move the Delta Bison Herd away from the Delta Agricultural Project, even with the use of supplemental food and salt blocks.

**Kimberlee Beckmen, DVM, ADFG**, interviewed by Kate Persons

Kimberlee Beckmen, an ADFG wildlife veterinarian, said the potential introduction of bison to the Seward Peninsula raises concerns about disease. Of particular concern would be the crossover of diseases from bison to muskox because of the two species' susceptibility to many of the same diseases. Beckmen reported that the following diseases would likely have the most serious impacts on wildlife health if infected captive-raised bison were ranched on the Seward Peninsula: tuberculosis, bovine viral diarrhea, infectious bovine rhinotracheitis, parainfluenza 3, Johne's disease, and various nematode parasites.

## Ground Reconnaissance of McCarthys Marsh on July 26, 2004

While conducting annual reindeer range assessments, Karin Sonnen (Natural Resources Conservation Service [NRCS]), Randy Meyers (BLM), and Kyle Joly (BLM) visited McCarthys Marsh via helicopter from Nome. We utilized the NRCS range survey (Swanson et al. 1985), which divided and mapped the region into differently coded ecological sites (ES), to determine study locations, which are shown in **Figure 2**. We decided that the Breached Lake Bed ecological site (coded ES-56) had the greatest potential for high bison forage biomass. These wet areas generally have greater biomass than drier ecological sites. We also looked at Sedge Wet Meadow (ES-52), Lichen Tussock Tundra (ES-60) and Mixed Shrub Tundra (ES-32) sites.

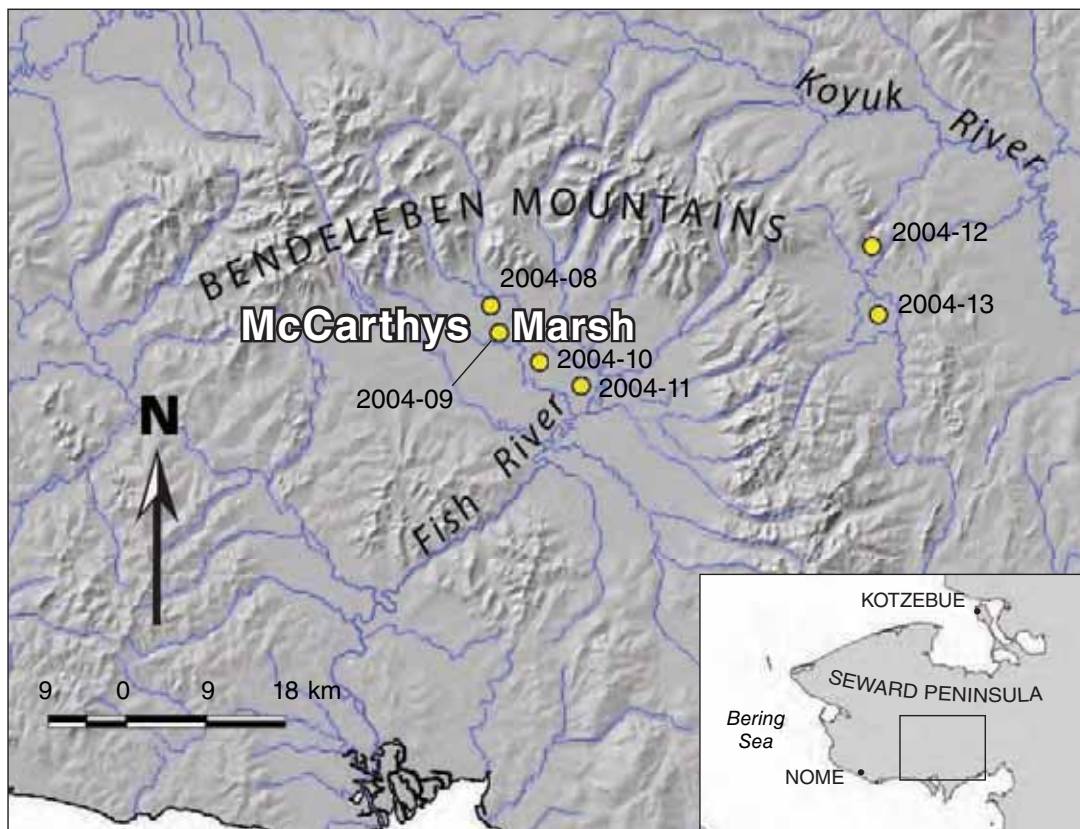
McCarthys Marsh covers approximately 887,000 acres (359,000 ha). Less than 0.4% of this falls in the Breached Lake Bed type (ES-56 and ES-56-57), whereas 5.3% is Sedge

Wet Meadow (ES-52, ES-52-32, ES-52-43, and ES-52-54) and 12.2% is Lichen Tussock Tundra (ES-60, ES-60-34, ES-60-54, ES-60-55, and ES-60-56). R. Meyers and K. Joly documented the assessments.

### Bison Range Assessment Site 2004-08, ES-56-57 (65° 07.70' N, 163° 17.04' W)

This drained lake bed site appeared as a green “island” of about 40–50 acres (16–20 ha) surrounded by a large, active tundra fire. Its high moisture probably preserved it from burning in the active fire. Bluejoint (*Calamagrostis canadensis*) formed a dense stand of approximately 15–20 acres (6–8 ha) on slightly higher, but still moist ground. The dominant species in the lower areas of

\* NOTE: Most of the locations shown for *Carex rostrata* in Eric Hultén’s *Flora of Alaska and Neighboring Territories* (1968) are actually for *Carex utriculata*. *Carex rostrata* (beaked sedge) does occur in Alaska, but is quite rare (pers. com., Tony Reznicek, Alaska Cyperaceae Workshop, 31 July – 2 August 2003). See also pages 117 and 121 in *Wetland Sedges of Alaska* (Tande and Lipkin 2003).



**Figure 2.** Map of study locations in McCarthys Marsh, Seward Peninsula, Alaska. Sites are shown in yellow.

saturated substrate and some standing water were Northwest Territory sedge (*Carex utriculata*)\*, tall cottongrass (*Eriophorum angustifolium*), water horsetail (*Equisetum fluviatile*), and water sedge (*Carex aquatilis*). Given the extremely dry summer in 2004, the moisture content of this ecological site would most likely be even higher in a year with more normal rainfall

Based on her experience at the Fox River Flats exclosures near Homer, Karin Sonnen said that if bluejoint was grazed at up to 30%

removal, it could generally persist. However, if grazed at a higher rate, about half would come back the following year. If high grazing intensity continued, it would not recover. If allowed to rest, however, bluejoint would recover to good production levels in a few years.

The moist-to-wet substrate at this site would not provide suitable access terrain for bison use during summer and fall, even though the wetland sedges and bluejoint grass species present could support limited grazing (**Figure 3**).



**Figure 3.** Study site 2004-08, a breached lake bed. A tundra fire burns actively in the background. The wet nature of this site probably prevented it from burning.



**Figure 4.** Study site 2004-09, a breached lake bed. Note the standing water even in this dry year.

**Bison Range Assessment Site 2004-09,  
ES-56 (65° 06.070' N, 163° 15.392' W)**

Shallow standing water 4–8 inches deep (10–20 cm) with dense stands of water sedge and creeping sedge (*Carex chordorrhiza*) characterized this breached lake bed site of approximately 20–25 acres (8–10 ha). Also present in the water were lesser amounts of tall cottongrass, bladderwort (*Utricularia* sp.), marsh fivefinger (*Potentilla palustris*), and Sphagnum moss (**Figure 4**). Scattered bluejoint and round sedge (*Carex rotundata*) were growing on a low bank adjacent to the standing water.

Karin Sonnen assessed the emergent stand of water sedge as very productive at approximately 800 lb/acre (898 kg/ha). In comparison, the adjacent ES-60 (Lichen Tussock Tundra) to the north was drier, with much less water sedge biomass at about 300 lb/acre (337 kg/ha) (**Figure 1**). Water sedge is replaced by Bigelow's sedge (*Carex bigelowii*) in Lichen Tussock Tundra in higher, drier areas.

On average, 35% of total vascular plant production in the Lichen Tussock Tundra ecological site is provided by graminoids (sedges, grasses, and rushes) at approximately 200 lb/acre (225 kg/ha; Swanson et al. 1985). Lichen Tussock Tundra comprises 12.2% of the land area in McCarthys Marsh and

Death Valley, whereas the Breached Lake Bed ecological site comprises only 0.4%. The dominant graminoids in Lichen Tussock Tundra (e.g., tussock cottongrass [*Eriophorum vaginatum*], Bigelow's sedge, and water sedge) could provide reasonable summer range, even though their nutritional value is not as high as beaked sedge, Northwest Territories sedge, and slough sedge. As water froze, the breached lake bed would offer better winter range because of the easy access to high-density water sedge and creeping sedge forage, even though acreage is limited.

**Bison Range Assessment Site 2004-10,  
ES-56 (65° 04.611' N, 163° 08.660' W)**

This site is very similar to 2004-09, with standing water and dense water sedge, but with small scattered stands of bluejoint on occasional low ridges (approximately 5% bluejoint cover). Approximately 160 acres (65 ha) in size, this ecological site encompasses more acreage than 2004-09.

**Bison Range Assessment Site 2004-11,  
ES-56 (65° 03.347' N, 163° 01.784' W)**

This breached lake bed site was somewhat drier than the previous sites but still had extensive areas of saturated soil, capped with wet *Sphagnum* and *Calliergon* mosses as well as numerous clumps of tufted bul-



**Figure 5.** Study site 2004-11, a breached lake bed. Note the standing water even in this dry year.

rush (*Trichophorum caespitosum*) and a few scattered individuals of water sedge and red cottongrass (*Eriophorum russeolum* var. *albidum*). The *Sphagnum*-rich boggy area also contained dwarf shrubs adapted to cold and wet acidic soils, such as bog rosemary (*Andromeda polifolia*), leatherleaf (*Chamaedaphne calyculata*), and bog cranberry (*Oxycoccus microcarpus*).

Slightly higher and drier ground was dominated by round sedge and looseflower alpine sedge (*Carex rariflora*). Well-worn and heavily browsed patches of lichen occurred on isolated hummocks of drier peat near the lake. Forming a narrow linear fringe along portions of the lakeshore were Northwest Territories sedge and marsh fivefinger in standing water, as well as scattered stands of bluejoint in moist soil. Karin Sonnen estimated 250–300 lb/acre (281–337 kg/ha) of forage sedges and grasses were present at this site (Figure 5).

We observed more wildlife in McCarthys Marsh between this site and the last site (2004-10) than we saw during the previous 5 days of flying and driving in a much larger region west of the Bendeleben Mountains, including the Nome and Teller areas. Sightings included one grizzly bear boar wandering alone, a sow with three cubs (approximately one year old), several pairs of tundra swans, one pair of sandhill cranes, several long-tailed jaegers and red-throated loons, and numerous dropped *Rangifer* antlers.

#### **Bison Range Assessment Site 2004-12, ES-52-32 (65° 14.346' N, 162° 22.366' W)**

This site was in Death Valley, a small valley perched on the northeast shoulder of the Darby Mountains, adjacent and northeast of McCarthys Marsh. It is also included in the region where the BLM does not permit reindeer grazing. This upland, south-facing location is actually a complex of two ecological sites, Sedge Wet Meadow (ES-52) and Mixed Shrub Tundra (ES-32). From the air it had a bright green appearance due to widespread field horsetail (*Equisetum arvense*).

This site contained grasses, a diverse mix of sedges, a rush, and dwarf and low/medium shrubs and forbs. Graminoids were abund-

ant, comprising 13 (43%) of the 30 vascular plants tallied at this site. The taller, more conspicuous grasses were Altai fescue (*Festuca altaica*), wideleaf polargrass (*Arctagrostis latifolia* var. *arundinacea*), and bluejoint. Other grasses were widespread in *Equisetum*-rich areas, but short and sparse: alpine holy grass (*Hierochloa alpina*) and arctic bluegrass (*Poa arctica*). There were smaller, patchier areas where Bigelow's sedge and grasses were dominant, denser, and larger. The most abundant sedges were Bigelow's sedge, northern singlespike sedge (*Carex scirpoidea*), hairlike sedge (*Carex capillaris*), and shortleaved sedge (*Carex misandra*). Tall cottongrass occurred in small isolated stands. Scattered and infrequent cottongrass tussocks (*Eriophorum vaginatum*) assumed odd shapes—some as tall columns of peat with a tuft of young leaves growing at the top. Scattered low- to medium-height shrubs such as tealeaf willow (*Salix pulchra*), Richardson's willow (*Salix richardsonii*), and dwarf arctic birch (*Betula nana*) could provide browse at various times of the year. There was evidence of heavy use of lichens. The ground was scraped down to mineral soil and roots exposed in these areas.

Muskox actively seek *Equisetum* species in the spring, and other ungulate species may also find them seasonally attractive. The diverse mix of sedges, grasses, rushes, forbs and shrub species at this site, as well as its firm substrate, offers a variety of grazing and browsing possibilities. For the Sedge Wet Meadow ecological site type, graminoids account for an average of 60% of its biomass production (vascular plant), or approximately 340 lb/acre (382 kg/ha) (Swanson et al. 1985).

#### **Bison Range Assessment Site 2004-13, ES-56 (65° 10' N, 162° 20' W)**

We conducted an aerial reconnaissance of this breached lake bed site southwest of Camp Haven (in Death Valley) but did not land due to time constraints. We estimated 300–400 acres (120–160 ha) of drier, shrubbier terrain compared to the breached lake bed sites visited in McCarthys Marsh. There was much less standing water and more low shrubs, some stands of cottongrass (*Eriophorum* spp.), and generally good sedge biomass. We did not see

any stands of bluejoint. Graminoid production/ biomass seemed comparable to sites visited in McCarthys Marsh. A large bull moose, tundra swans, and numerous ducks were present.

### Ground Reconnaissance Summary for McCarthys Marsh and Death Valley

Our ground reconnaissance showed that the modest amount of Breached Lake Bed habitat in McCarthys Marsh and Death Valley is characterized by wet, soft substrate that supports a relatively low sedge and grass biomass of low forage quality. Areas with stands of sedges of higher forage quality (Northwest Territory sedge) occur in standing water, potentially available only in winter when the ground and water are frozen. Sedge Wet Meadow habitat, also limited in acreage, has drier substrate and a more diverse mix of sedges and grasses but offers relatively low biomass and forage quality.

### RECOMMENDATION

I recommend that the BLM not support the introduction and free-range herding of American plains bison (*Bison bison bison*) or wood bison (*B. bison athabasca*) to McCarthys Marsh on the Seward Peninsula for the following reasons (not in any particular order):

1. Low biomass of bison forage species
2. Lack of State of Alaska support
3. Wet summer conditions
4. Potential conflict with moose, caribou, muskox, reindeer, fish, and wetland and riparian species
5. Potential of emigration and founding of new, feral populations of bison
6. Potential spread of diseases
7. Starvation threat to introduced individual bison
8. Threats to fragile, diverse, productive, and unusual habitat
9. Lack of benefit to the majority of local people
10. Potential local opposition

### REFERENCES

- Griffin, B. and D. M. Johnson. 1994. Wildlife Notebook Series: American bison. Alaska Department of Fish and Game. Juneau, Alaska. <http://www.adfg.state.ak.us/pubs/notebook/biggame/bison.php>
- Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, California. 1008 pp.
- Rasic, J. T. and P. E. Matheus. 2007. A reconsideration of purported Holocene bison bones from northern Alaska. *Arctic* 60:381–388.
- Reynolds, H. W., R. M. Hansen and D. G. Peden. 1978. Diets of the Slave River lowland bison herd, Northwest Territories, Canada. *Journal of Wildlife Management* 42:581–590.
- Stephenson, R. O. et al. 2001. Wood bison in late Holocene Alaska and adjacent Canada: Paleontological, archaeological and historical records. In: Gerlach, S.C. and Murray, M.S., editors. People and wildlife in northern North America: essays in honor of R. Dale Guthrie. British Archaeological Reports BAR S944. Oxford, England, U.K. pp. 125–159.
- Tande, G. and R. Lipkin. 2003. Wetland sedges of Alaska. Alaska Natural Heritage Program, Environment and Natural Resources Institute, University of Alaska Anchorage. Anchorage, Alaska. 138 pp.
- U.S. Department of the Interior. Bureau of Land Management. 1982. Northwest management framework plan. Fairbanks District, Alaska.
- U.S. Department of the Interior. Bureau of Land Management. 2007. Kobuk-Seward Peninsula Proposed Resource Management Plan and Final Environmental Impact Statement. Fairbanks District and Anchorage District, Alaska.

