

STATUS REPORT ON *LESQUERELLA ARENOSA* VAR. *ARGILLOSA*
(SIDESADDLE BLADDERPOD)
IN WYOMING



Prepared for the Bureau of Land Management
Wyoming State Office and Newcastle Field Office

By

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ABSTRACT

Sidesaddle bladderpod (*Lesquerella arenosa* var. *argillosa*) is a regional endemic known from a single area in Niobrara County, Wyoming, at the western limits of its known distribution. Systematic surveys were conducted in 2009 using a potential distribution model and photointerpretation. As a result, it is now known from about 750 acres of occupied habitat on isolated public parcels that spans roughly 50 mi², with population numbers conservatively estimated at 50,000-100,000 plants in 2009 surveys. Quarrying seems to signify a net impact to *L. a.* var. *argillosa* even though the taxa has become established in a couple roadside settings where introduced with quarried gravel. It is resilient to common management practices and some forms of disturbance including grazing and shallow blading of its habitat bordering roads, while vulnerable to any large-scale quarrying or spread of non-native species competitors.

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I. INTRODUCTION

Lesquerella arenosa var. *argillosa* (Sidesaddle bladderpod) is a regional endemic of western Nebraska, southwestern South Dakota, northeastern Colorado and eastern Wyoming where the four states come together. The status of *L. a.* var. *argillosa* in Wyoming was previously addressed in a status report (Marriott 1992) and more recently addressed throughout its range (Beatty et al. 2003). Needs for an expanded baseline survey of *L. a.* var. *argillosa* and updated status information in Wyoming were identified based on two main considerations:

- The two most recent records of *Lesquerella arenosa* var. *argillosa* in Wyoming were from roadsides (*Ebertowski 1076, West s.n.*), where the taxon apparently came in with gravel quarried from its habitat rather than being present naturally in the landscape. This raised alternate possibilities that *L. a.* var. *argillosa* has less vulnerability or greater threat than previously known.
- A potential distribution model was developed for *Lesquerella arenosa* var. *argillosa* (Fertig and Thurston 2003) which identified additional areas of potential habitat which has not been used in surveys. Digital orthophotographs also became readily available for use in aerial photointerpretation of habitat, with or without models and other digital information.

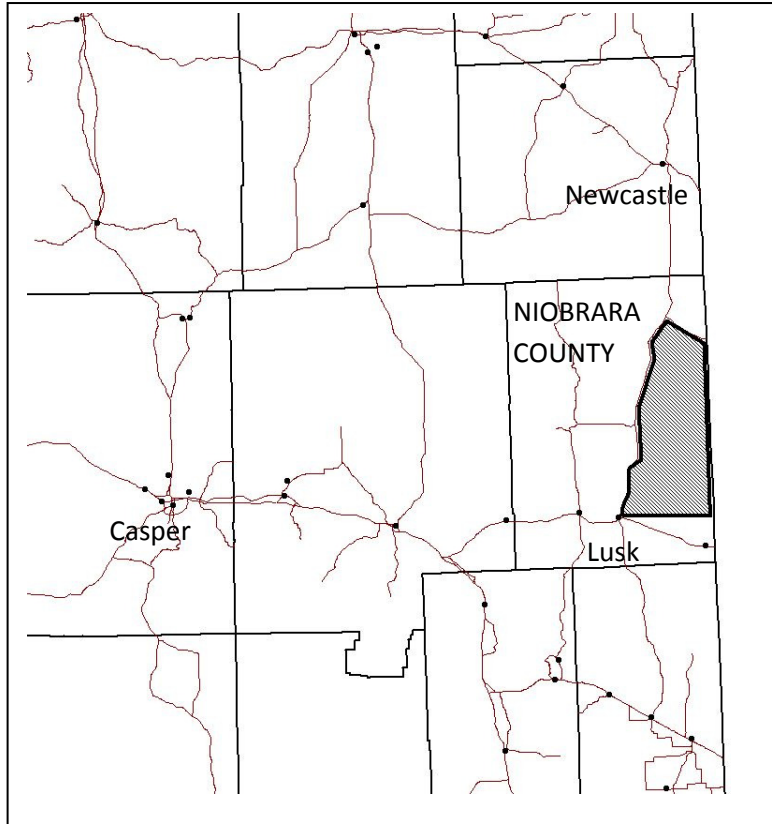
This study also addressed the need for expanded *Lesquerella arenosa* var. *argillosa* inventories identified in the regional species conservation assessment (Beatty et al. 2003). The primary objectives of this study were to conduct *de novo* surveys of *L. a.* var. *argillosa* using both the potential distribution model and aerial photointerpretation, update what is known about potential threats on public lands, and synthesize results in updated state status information.

II. METHODS

At the start of this project, information on the habitat, known distribution, and potential distribution model of *Lesquerella arenosa* var. *argillosa* was compiled and reviewed (Marriott 1992, Beatty et al. 2003, Fertig and Thurston 2003). Regional floristic work was also reviewed (Hartman and Nelson 1995, Ebertowski et al. 2004) and specimens studied at the Rocky Mountain Herbarium (RM). In preparation for fieldwork, the known *Lesquerella arenosa* var. *argillosa* distribution, potential distribution polygons, and public land layer were overlain on digital orthophotos in ArcMap to ascertain habitat signatures and public land access. Section lines were also superimposed. The whitish rocky habitat of *Lesquerella arenosa* var. *argillosa* exhibits high reflectance, so tracts of public land were identified for survey if they were part of known distribution (one tract), in polygons of potential distribution (Fertig and Thurston 2003), or other areas in the vicinity that had chalky rocky habitat as evidenced by high reflectance. The survey area was contained within the BLM Newcastle Field Office, targeting specific tracts of

public land within a portion of the eastern third of Niobrara County (Figure 1). The study area was entirely east of U.S. Highway 85, and between U.S. Highways 18 and 20.

Figure 1. *Lesquerella arenosa* var. *argillosa* study area – eastern Niobrara County, Wyoming



Digital orthophotographs were printed out that contained known and potential *L. a.* var. *argillosa* distribution and public land boundaries, at a quarter-quad scale that corresponded closely to that of U.S.G.S. topographic maps (7.5'), for reference in the field. USGS topographic map, BLM land status maps, and geologic maps (Love and Christiansen 1985) were also used to access survey areas and conduct surveys. The study area is predominantly private land, so landowner access permission was necessary to visit all of the public land tracts that could only be accessed by crossing private lands. Coordination with the State Land Department and with BLM was also sought for contacting the leaseholders of public land parcels.

Surveys of *Lesquerella arenosa* var. *argillosa* were conducted by the author between June 8-11, 2009, at a time in the growing season when it is ordinarily in late flowering and early fruiting stages. Where *L. a.* var. *argillosa* was found, estimates of plant numbers were made by censusing segments of the total area, field maps were marked with approximate area boundaries, and GPS coordinates were recorded for geo-referencing boundaries more accurately for later digitizing as polygons. Information on habitat, phenology, and plant associates were recorded on WYNDD

survey forms and later entered into the Biotics program as permanent electronic spatial and database records. Specimen vouchers were collected to represent the extent of distribution and photographs taken. Survey routes are reported in Appendix A.

III. RESULTS - SPECIES INFORMATION

A. Classification

1. Scientific name: *Lesquerella arenosa* (Richardson) Rydb. var. *argillosa* Rollins & Shaw, (Rollins and Shaw 1973)
2. Synonyms: *Physaria arenosa* ssp. *argillosa* (Rollins & Shaw) O’Kane & Al-Shehbaz, comb. et stat. nov. (Al-Shehbaz and O’Kane 2002)
3. Common name: Sidesaddle bladderpod, also called Great Plains bladderpod
4. Family: Brassicaceae (Mustard family)
5. Size of genus: The *Lesquerella* genus was recognized as a large, New World genus centered in North America consisting of over 80 species (Rollins 1993). However, recent molecular and morphological work supports the union of this genus with the earlier-published *Physaria* genus, which consists of 22 New World species (Al-Shehbaz and O’Kane 2002). Taxonomic revisions and revisionary circumscription of the united *Physaria* genus place 98 North American species in the genus. This is the new nomenclatural convention that will be followed in the Wyoming species of concern list after the publication of the Flora of North America (Volume 7), expected out in 2010.
6. Phylogenetic relationships: The relationships within the *Lesquerella* genus and the entire Mustard family are interesting from a phlogenetic viewpoint because of the importance attached to what seem to be minute characters (Payson 1921). The author identified 13 characters as basis for placing the genus within the family, and proposing three sections and 15 subsections within the genus. More recent treatments of the genus (Rollins and Shaw 1973, Rollins 1993) do not recognize formal sections and subsections, though identify informal groups. *Lesquerella arenosa* is placed by these authors in the very large Group 7 that includes *L. alpina* and *L. ludoviciana*. *Lesquerella arenosa* is closely related to the *L. ludoviciana*, but can be distinguished by the smaller size, flat rather than involute basal leaves, and siliques which are almost always glabrous on the interior (Rollins and Shaw 1973). Both *L. arenosa* var. *arenosa* and *L. ludoviciana* are widespread, whereas *L. a.* var. *argillosa* is geographically restricted to the vicinity of the Black Hills, a distribution pattern which may indicate that it is derived. This is consistent with chromosome data documenting that *L. arenosa* var. *arenosa* is a diploid (n=5) and *L. a.* var. *argillosa* is a polyploidy (n=15; Rollins and Shaw 1973).

B. Present legal or other formal status

1. National legal status
 - a. Fish and Wildlife Service: None.

b. Bureau of Land Management: Sensitive (USDI BLM 2001, 2002).

Note: A review of the plant and animal species on the BLM Wyoming sensitive species list is underway, but results are not yet available.

2. Global Heritage rank: G5T4.

3. State Legal status: None.

4. State Heritage rank: S1

C. Description

1. General non-technical description: Sidesaddle bladderpod is an annual or short-lived perennial with several semi-prostrate, densely-pubescent stems 10 to 20 cm long. The basal leaves are 2-10 mm wide, oblanceolate, and long-petioled while the stem leaves are elliptic, 1-4 mm wide, and entire. Flowers are 6-8 mm long with four yellow petals that may dry to reddish or lavender. The spherical fruits are borne on recurved pedicels positioned along one side of the flowering stem (secund) and are pubescent with tightly-appressed hairs (Rollins and Shaw 1973; Marriott 1992; Fertig et al. 1994; Figures 2-5).
2. Technical description: Plants annual or short-lived perennials; more or less densely stellate pubescent, trichomes sessile or on a short stalk, roughly granular, stems (0.5) 1-2 (3) dm long, several, prostrate and straggling to erect, usually unbranched, often with a purplish pigmentation, arising from a several-branched caudex. Basal leaves 1.5-5 (7) cm long, 2-10 mm wide, entire to shallowly dentate, oblanceolate and narrowing to a slender petiole, up to 2X longer than the blade, or the blades obdeltate or narrowly rhombic, subacute to acute and flat; cauline leaves (0.5) 1-2.5 (3) cm long; 1-4 mm wide, elliptic to linear, usually entire. Inflorescences dense, buds ovoid to ellipsoid; sepals 4-6 (7) mm long, elliptic to oblong, the lateral ones barely saccate, the median thickened at the apex and cucullate; petals 6-8.5 (9.5) mm long, 1.5-3 (3.5) mm wide, yellow or with varying areas of reddish or lavender pigmentation when dry, spatulate with little distinction between blade and claw or with blades obovate and narrowing gradually to a broad claw; filaments little dilated at the base, paired stamens 4.5-7 (8) mm long, single stamens 3.5-6 (7) mm long; glandular tissue roughly pentagonal around the single stamens and subtending the paired, absent between the latter. Infructescences elongate, loose and usually second; pedicels 5-15 (20) mm long, stout and usually sharply recurved, but occasional only divaricately spreading or nearly horizontal. Silicles (3.5) 4.5-5 (6.5) mm long, sessile or nearly so, subglobose, obovoid or broadly ellipsoid, the valve exterior densely pubescent with spreading or closely appressed trichomes, the valve interior glabrous, or rarely very sparsely pubescent; septum entire and smooth or slightly wrinkled longitudinally, the funiculi attached about ½ their lengths; styles 3-5 (6.5) mm long and slender, the stigmas expanded; seeds 2.2-2.7 mm long, flattened and suborbicular or slightly wider than long, red-brown, lacking margins or wings. Stellate trichomes on the silicles with the rays closely appressed (Great Plains Flora Association 1986).

Figure 2. *Lesquerella arenosa* var. *argillosa* illustration. By W. Fertig. (From Fertig et al. 1994)



It is variously described by Rollins and Shaw (1973), and by the Great Plains Flora Association (1986), as an annual, biennial, or short-lived perennial. The taproots indicate that the latter is often or only the case (Ode pers. commun. to Beatty et al. 2003). This is consistent with specimens at RM and the five sets of voucher specimens collected in the course of 2009 surveys.

3. Local field characters: *Lesquerella arenosa* var. *arenosa* can be recognized by its low, many-stemmed growth form, round fruit, fruiting stems less than 20 cm, and fruiting stems with fruiting stalks recurved and clustered to one side (hence the “sidesaddle” common name). The fruiting stalks of *L. a.* var. *argillosa* are not all in one plane, and the secund characteristic is obscured on pressed specimens. *L. a.* var. *argillosa* overlaps with *Physaria brassicoides* distribution in places. The latter differs in having inflated fruits and broad leaves. Fruits are needed for positive determination.
4. Similar species: *Lesquerella arenosa* var. *arenosa* differs in having hairs of the fruit spreading rather than closely appressed. To distinguish *L. a.* var. *argillosa* from the type variety, a 10X lens is required to see the tightly-appressed hairs on the fruit. Marriott (1992) noted that the differences between short appressed and spreading hairs are subtle, and until one sees material of each variety, identification with confidence is not possible. *L. ludoviciana* has taller stems, narrower leaves, yellow petals, and non-secund fruit. *L. alpina* is shorter stems, that barely exceed the leaves. These three other taxa are present in the same county. The *Lesquerella* genus is a difficult group. Other species of *Lesquerella* differ in having wider basal leaves or S-shaped pedicels (Dorn 2001; Table 1).

Table 1. Distinguishing characteristics of *Lesquerella arenosa* var. *argillosa*¹

Species	Orientation of fruit stalk (pedicel) with mature fruits	Shape of fruit (Silique)	Fruit hairs (pubescence)	Basal leaf shape	Stature and growth form	WY Distribution
<i>Lesquerella arenosa</i> var. <i>argillosa</i>	Uniformly curved downward, asymmetrically oriented usually on 1-side of stem	Globose	Tightly appressed hairs	Elliptic	Loosely tufted, stems usually <20cm	Northeast WY
<i>Lesquerella arenosa</i> var. <i>arenosa</i>	Uniformly curved downward; usually on 1-side of stem	Globose	~ spreading hairs	Elliptic	Usually upright, stems usually <20cm	Eastern WY
<i>Lesquerella alpina</i> ²	Curved upward but shorter to as long as basal leaves	Semi-globose to tapering and flattened toward tip	Hairy	Linear to oblanceolate or narrowly obovate	Short tufted; most taxa with stems barely exceeding basal leaves	Statewide
<i>Lesquerella carinata</i>	S-shaped or uniformly curved upward	Flattened at right angle to partition, keeled	Hairy	Rhombic or suborbicular to ovate	Loosely tufted or solitary clump	Northwest WY
<i>Lesquerella condensata</i> (<i>Physaria nelsonii</i>)	Curved upward but shorter to as long as basal leaves	Tapering and flattened	Hairy		Densely tufted	Central and southwest WY
<i>Lesquerella fremontii</i>	Uniformly curved downward	Slightly flattened parallel to partition	Hairy	Rhombic to elliptic	Loosely tufted or solitary clump	Northwest WY
<i>Lesquerella ludoviciana</i>	Spreading or straight	Globose	Hairy	Narrowly linear	Usually upright, stems usually >20cm	East and southern WY
<i>Lesquerella macrocarpa</i>	Uniformly curved downward	Globose and inflated	Sparsely hairy	Ovate to oblanceolate, some over 5 mm wide	Loosely tufted	Central and southwest WY
<i>Lesquerella montana</i>	S-shaped or uniformly curved upward	Elliptic obovate	Hairy	Oblanceolate	Loosely tufted	Central and southeast WY
<i>Lesquerella multiceps</i>	S-shaped or uniformly curved upward	Globose or nearly so	Sparsely hairy	Rhombic, ovate or subhastate; some over 5 mm wide	Loosely tufted	Northwest WY
<i>Lesquerella parvula</i>	S-shaped or uniformly curved upward	Tapering, not flattened	Hairy	Narrowly linear, <1 mm, no petiole	Short tufted	Southwest and southcentral WY
<i>Lesquerella paysonii</i>	S-shaped or uniformly curved upward	Flattened at right angle to partition, not keeled	Hairy	Elliptic to triangular	Loosely tufted	Northwest WY
<i>Lesquerella prostrata</i>	S-shaped or uniformly curved upward	Tapering and slightly compressed	Hairy	Usually deltate or hastate	Loosely tufted, decumbent	Southwest WY

¹ This table does not include all diagnostic characteristics of the fruit, like style length, or many other of the quantitative characteristics needed to differentiate species.

² Wyoming material previously identified as *L. alpina* or varieties has been split into five species: *Physaria curvipes*, *P. pachyphylla*, *P. reediana*, *P. spatulata*, and *P. subumbellata* (Al-Shehbaz and O’Kane 2002; Rocky Mountain Herbarium).

Figure 3. *Lesquerella arenosa* var. *argillosa* whole plant. By B. Heidel.



Note that the fruit stalks are lopsided (secund) on the flowering stem and may change orientation as they mature (lower left). There is also a reddish gall in the lower left

Figure 4. *Lesquerella arenosa* var. *argillosa* whole plants. By B. Heidel.



Figure 5. *Lesquerella arenosa* var. *argillosa* - close-up of one shoot. By B. Heidel.



D. Geographical distribution

1. Range: *Lesquerella arenosa* var. *argillosa* is a regional endemic of western Nebraska, southwestern South Dakota, northeastern Colorado and eastern Wyoming (Beatty et al. 2003). Its centers of distribution are in southwestern South Dakota (outside of the Black Hills) and northwestern Nebraska. In Colorado, it is known from only two sites (Beatty et al. 2003). In Wyoming, *L. a.* var. *argillosa* is known only from one area in Niobrara County (Figure 6). Reports of this taxon from the Black Hills in Crook County, Wyoming (Dorn 1992) were based on specimens that have been redetermined as *L. a.* var. *arenosa* (Marriott 1992). The most current Wyoming flora (Dorn 2001) reports it from Niobrara, Natrona and Crook counties. Reports of this species from Natrona County and Carbon County were hypothesized to have been either misidentifications or erroneous database entries (Hartman and Nelson personal communications 2002, as cited by Beatty et al. 2003).
2. Extant sites: *Lesquerella arenosa* var. *argillosa* is known from one occurrence in Wyoming, most recently surveyed in 2009 (Old Woman Hills Creek EO#001 in Table 2, below, and detailed in Appendix B). This occurrence consists of almost 20 colonies in 16 sections, treated as part of a single occurrence because photointerpretation suggests that there is potential habitat on private lands between them (Figures 6 and 7). It is also recorded as present in roadbeds where it was brought in with road surfacing material. Two instances of the latter are in the database as occurrences, though they do not technically meet the specifications because they do not contribute to species' viability and are not indigenous colonies. They are in the Rocky Mountain Herbarium database as collections, and the rather unusual nature of their origin needs to be understood for complete status reviews.

The potential distribution that was developed for *Lesquerella arenosa* var. *argillosa* (Fertig and Thurston 2003) based on only three data points from Marriott collection locales for

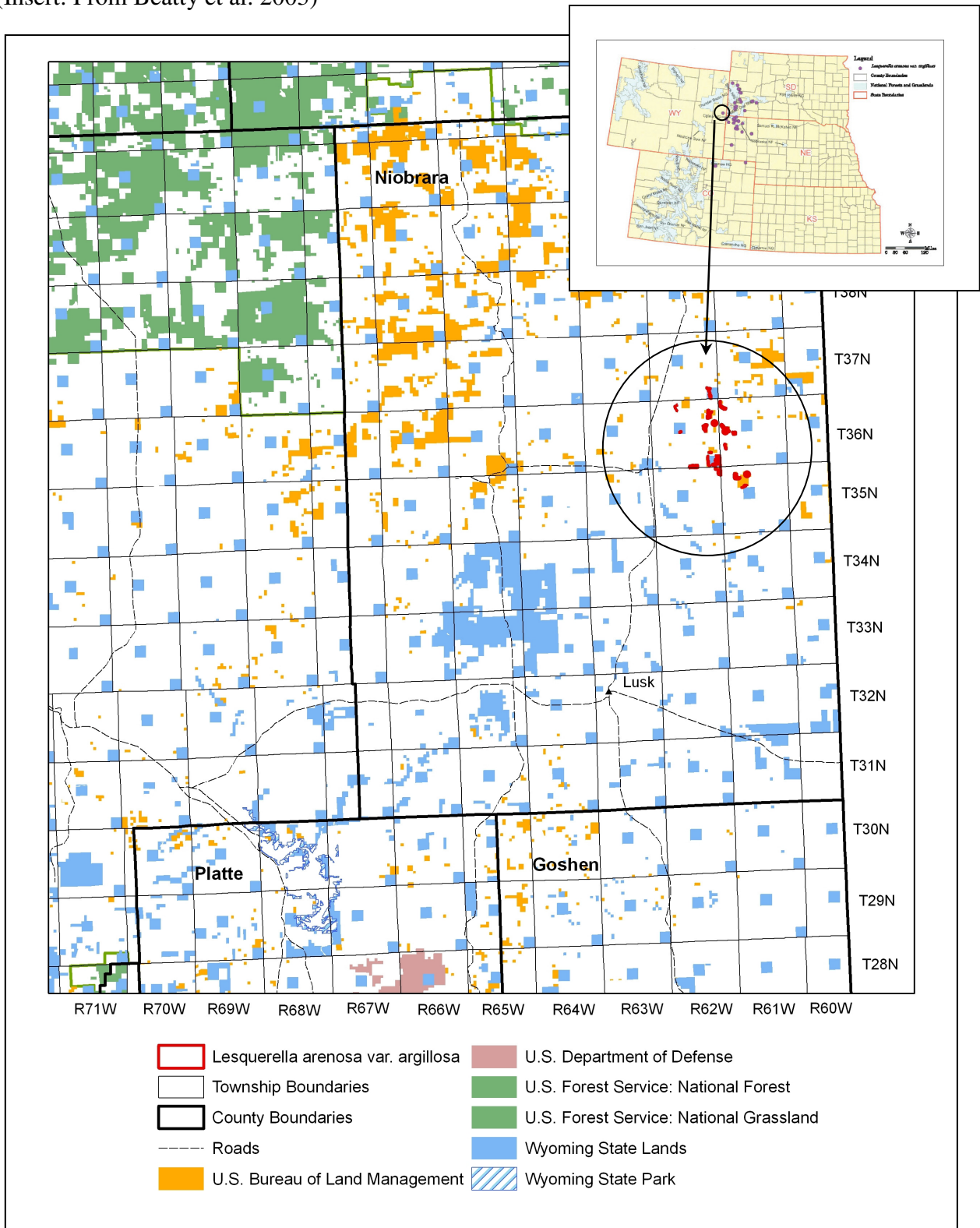
modeling purposes, so range/intersection modeling was employed. Geology and soils were the primary environmental factors that explained known distribution. Geology and soil differences in the Old Woman Hills landscape are subtle and were not mapped in detail. Therefore, the modeling did not produce reliably detailed results. The continuous and categorical variables that circumscribed *Lesquerella arenosa* var. *argillosa* habitat are reprinted from the original modeling report in Appendix C. Photointerpretation proved most effective in identifying potential habitat based on high reflectance as associated topographic relief.

Table 2. Location of known occurrences of *Lesquerella arenosa* var. *argillosa*

EO#	Site Name	County, State	Legal Description	Elevation (ft)	USGS 7.5' Quad	Location
001	Old Woman Hills Creek	Niobrara, Wyoming	T35N R61W Sec 4, 5, 8, 9 T35N R62W Sec 1 T36N R61W Sec 6, 18, 20, 30 T36N R62W Sec 12, 14, 25, 34, 35, 36 T37N R62W Sec 36	4200-4600	South Oat Creek, Coyote Gap, Oat Creek NW, Redbird	Low ridges below (east of) Old Woman Creek Hills to Seaman Hills, extending 3 miles north and 6 miles south of Boner Road, ca 4-8 miles east of US Highway 85; ca 21-30 air miles northeast of Lusk.
002	Coyote Gap	Niobrara, Wyoming	T36N R62W Sec 16	4250	Coyote Gap	Old Woman Creek Hills, ca 2.5 air miles east of US Hwy 85 on both sides of Boner Road, and within 30 meters in both directions from 2-track road into the state section, ca 38 air miles south of Newcastle.
003	Cow Gulch	Niobrara, Wyoming	T36N R62W Sec 4	4400	Coyote Gap, Redbird	Old Woman Creek Hills, ca 1 mile east of Old Woman Creek, ca 1.5 miles east of US Highway 85, ca 20 miles east-northeast of Lance Creek.

Five voucher specimens were collected to represent the range of locations and range of habitats present. All vouchers are deposited at the Rocky Mountain Herbarium.

Figure 6. Distribution of *Lesquerella arenosa* var. *argillosa* in Wyoming
 (Insert: From Beatty et al. 2003)



3. Historical sites: None known. The first collection in Wyoming was made prior to 1973 by I. Miller (1919 CAS), “22 miles southwest of Edgemont (SD)” (cited in Rollins and Shaw 1973). The year and precise location are not known, but these directions place it in the middle of the extant occurrence.
4. Unverified/Undocumented reports: None known.
5. Sites where present status not known: None.
6. Areas surveyed but species not located: Areas where the species was surveyed but not found are represented in Appendix A, including areas west of Old Woman Hills, the Hat Creek Breaks and plains south of known distribution, and areas east of Redbird north of known distribution. They were not predicted by the potential distribution model or aerial photointerpretation but identified in the field as having some level of similarities.

E. Habitat: Sidesaddle bladderpod is found on dry, open, sparsely-vegetated rocky slopes with whitish yellow or gray limestone and shale, derived from the Niobrara Formation

1. Associated vegetation: Bunchgrasses and cushion plants are local dominants in habitat occupied by *Lesquerella arenosa* var. *argillosa*, including different combinations of *Achnatherum hymenoides* (Indian ricegrass), *Bouteloua curtipendula* (Side-oats grama), and *Elymus spicatus* (Bluebunch wheatgrass). The most common cushion plant is (*Eriogonum pauciflorum* (Few-flowered wild buckwheat). In places, shrubs and subshrubs are codominant including *Rhus aromatica* var. *trilobata* (Fragrant sumac) and *Gutierrezia sarothrae* (Broom snakeweed).
2. Frequently associated species: Marriott (1992) listed the following species as associated with *Lesquerella arenosa* var. *argillosa*: *Achnatherum hymenoides*, *Astragalus bisulcatus* (Two-grooved milkvetch), *Cryptantha* spp. (butte-candle), *Dalea* spp. (syn. *Petalostemum* spp.; a prairie clover), *Eriogonum* spp. (a wild buckwheat), *Hymenopappus* spp. (a woollywhite), *Mentzelia* spp. (a blazing star), *Oenothera caespitosa* (gumbo lily), and *Packera cana* (syn. *Senecio canus*; Plains ragwort). This list is expanded below (Table 3).

The species associated with *Lesquerella arenosa* var. *argillosa* in Wyoming resemble the suite of those in other states, based on the limited amount of information available, as compiled in Beatty et al. 2003. However, *Astragalus barrii* (Barr’s milkvetch) is associated with it in South Dakota but is not known to overlap with it in Wyoming. The first survey for *L. a.* var. *argillosa* in Wyoming was conducted in tandem with a survey for *A. barrii* (Marriott 1992), and overlaps between these two Wyoming species of concern were not found. There is also *Astragalus racemosus* var. *longisetus* (Long-stalked racemose milkvetch) present in the vicinity of *L. a.* var. *argillosa* in Wyoming, another Wyoming species of concern, though occupying separate habitat.

Table 3. Species frequently associated with *Lesquerella arenosa* var. *argillosa*

Scientific name	Common name
<i>Achnatherum hymenoides</i> (<i>Oryzopsis hymenoides</i>)	Indian ricegrass
<i>Astragalus bisulcatus</i>	Two-grooved milkvetch
<i>Astragalus spatulatus</i>	Tufted milkvetch
<i>Bouteloua curtipendula</i>	Side-oats grama
<i>Carex filifolia</i>	Threadleaf sedge
<i>Castilleja sessiliflora</i>	Plains paintbrush
<i>Commandra umbellata</i>	Bastard toadflax
<i>Cryptantha cana</i>	Mountain cat's-eye
<i>Cryptantha celosioides</i>	Butte candle
<i>Dalea</i> spp. (<i>D. candida</i> or <i>D. purpurea</i>)	A prairie clover
<i>Echinacea angustifolia</i>	Purple coneflower
<i>Elymus smithii</i>	Western wheatgrass
<i>Elymus spicatus</i>	Bluebunch wheatgrass
<i>Eremogone hookeri</i> var. <i>pinetorum</i>	Hooker's sandwort
<i>Eriogonum flavum</i> var. <i>flavum</i>	Yellow wild buckwheat
<i>Eriogonum pauciflorum</i>	Few-flowered wild buckwheat
<i>Gaura coccinea</i>	Scarlet globemallow
<i>Gutierrezia sarothrae</i>	Broom snakeweed
<i>Hesperostipa comata</i> var. <i>comata</i>	Needleandthread
<i>Ipomopsis congesta</i> var. <i>congesta</i>	Ballhead sky-rocket
<i>Hymenoxys richardsonii</i>	Colorado rubberweed
<i>Juniperus scopulorum</i>	Rocky Mountain juniper
<i>Koeleria cristata</i>	Junegrass
<i>Machaeranthera grindelioides</i>	Rayless tansyaster
<i>Musineon divaricatum</i>	Leafy wild parsley
<i>Oenothera cespitosa</i>	Gumbo lily
<i>Oxytropis lambertii</i>	Lambert's locoweed
<i>Paronychia depressa</i>	Spreading nailwort
<i>Penstemon albidus</i>	White beardtongue
<i>Penstemon eriantherus</i>	Fuzzy-tongue beardtongue
<i>Physaria brassicoides</i>	Double twinpod
<i>Phlox hoodii</i>	Hood's phlox
<i>Prunus pumila</i>	Sand cherry
<i>Psoralidium tenuiflorum</i>	Slender-flowered scurf-pea
<i>Rhus aromatica</i> var. <i>trilobata</i>	Fragrant sumac
<i>Stenotus acaulis</i>	Stemless mock goldenweed
<i>Stephanomeria runcinata</i>	Desert wirelettuce
<i>Tetraneuris acaulis</i> var. <i>acaulis</i>	Stemless four-nerve daisy
<i>Thermopsis rhombifolia</i>	Prairie golden pea

In the potential distribution model of *Lesquerella arenosa* var. *argillosa* (Fertig and Thurston 2003), the distribution encompassed the modified Gap land cover classes of Bare rock and soil, Greasewood fans and flats, and Juniper woodland. This may reflect the coarseness of the original Gap land cover mapping and the lumped Gap land cover classes used for the model, rather than characterizing the land cover of occupied habitat.

3. Topography: *Lesquerella arenosa* var. *argillosa* is usually associated with breaks in topography, occurring on well-drained slopes and rims of buttes, escarpments and ridges. Sometimes it is not on a distinct landform but only a subtle band or segment of the landscape associated with outcrop or thin soils. At a small scale, it is also found on nearly flat upland gravelly pavement and in outwash that adjoins suitable slope habitat.

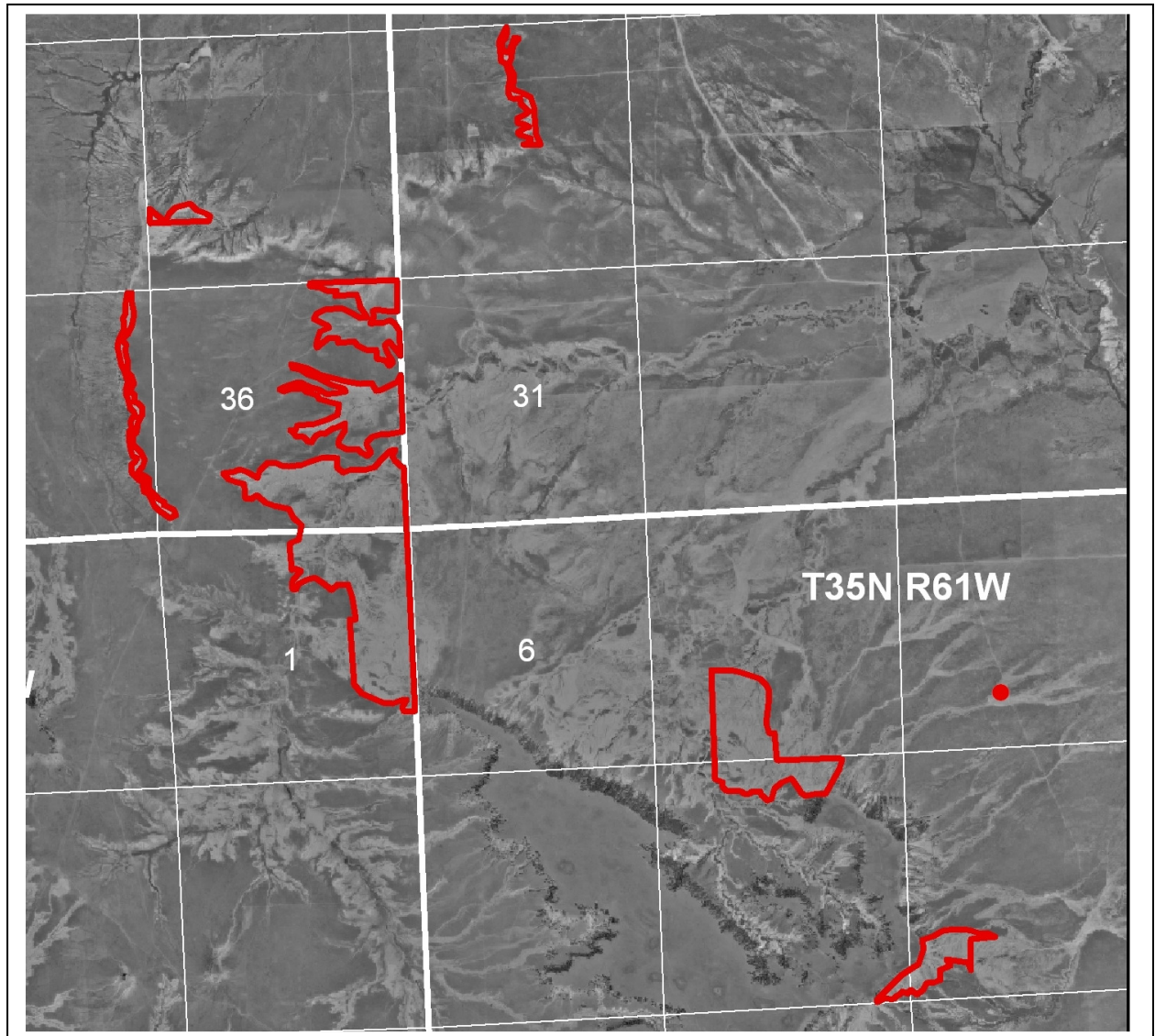
In the potential distribution model of *Lesquerella arenosa* var. *argillosa* (Fertig and Thurston 2003), distribution fell within a narrow range of elevation (1224-1385 m) but was associated with moderate relief (21-82 m) within this range.

4. Soil relationships: Soils in *Lesquerella arenosa* var. *argillosa* are silty, loamy or gravelly mollisols grading into entisols, with high gravel content and high calcium bicarbonate concentration. They are aridic, and directly overlying or adjoining whitish yellow or gray limestone and shale, derived from the Niobrara Formation. The soil profile is often shallow, corresponding with the thin soil range site. The soils are also reported as possibly seleniferous (Marriott 1992) based on presence of *Astragalus bisulcatus*, a plant species with selenium-accumulating capacity.

In the potential distribution model (Fertig and Thurston 2003), the soils were Typic and Ustic Haplargids and Haplocalcids. Bedrock geology was Cretaceous mixed shale or sandstone (Kmix, Ksh), corresponding with the Niobrara Formation.

5. Regional climate: In the potential distribution model of *Lesquerella arenosa* var. *argillosa* (Fertig and Thurston 2003), distribution fell within an area of low mean January precipitation (0.65-0.77 cm; 0.3 in), moderate mean April precipitation (4.23-4.75 cm; 1.7-1.9 in), moderate July precipitation (4.83-5.46 cm; 1.9-2.1 in), and moderate fall precipitation (3.10-3.54 cm). Shortwave radiation is relatively high in both January (6.45-7.17 MJ/m²/day) and in July (21.96-24.32 MJ/m²/day). Mean monthly temperatures reflect a continental plains climate, with low mean January temperature (-5.85° - 3.84 °C; 21.5°-25.1° F), mild mean April temperature (5.86°-7.99 °C; 42.5°-46.4° F), hot mean July temperature (20.71°-22.86° C; 69.3°-73.1° F), and mild mean October temperature (7.05°-9.14° C; 44.7°-48.4° F). Note that the model used data averages for a large area that differ from the nearest meteorological station.

Figure 7. Aerial photo of *Lesquerella arenosa* var. *argillosa* local distribution pattern

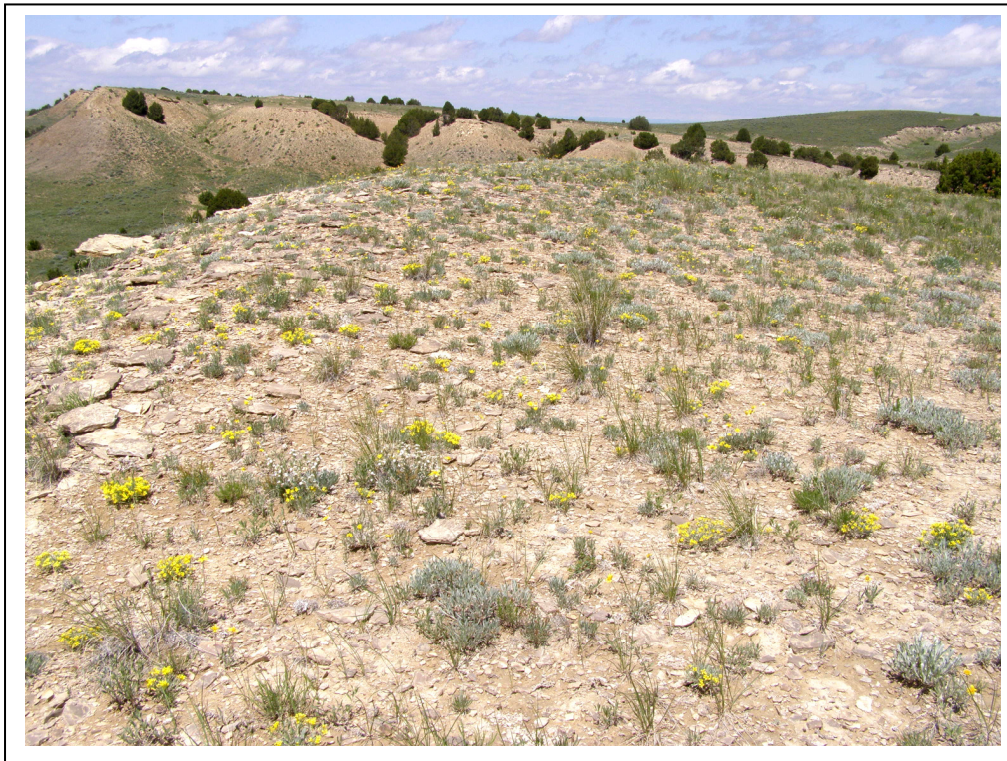


Note: The local distribution patterns of *Lesquerella arenosa* var. *argillosa* (example above) correspond with suitable environmental conditions within the boundaries of isolated parcels of public land. Several of the habitat photos that are printed on the following pages were taken among the colonies represented above. Figures 8 and 11 were taken in Section 8 (above). Figure 10 was taken in the NE ¼ of Section 36 (above).

Figure 8. Habitat of *Lesquerella arenosa* var. *argillosa* – silty butte slopes. By B. Heidel.



Figure 9. Habitat of *Lesquerella arenosa* var. *argillosa* – gravelly escarpment rim. By B. Heidel.



Figures 10 and 11. Relatively well-vegetated habitats of *Lesquerella arenosa* var. *argillosa*.
By B. Heidel.



6. Local microclimate: The nearest meteorological monitoring station is Redbird 1NW (USDI NOAA 2006), documenting a continental climate. The mean annual precipitation is reported at 39.5 cm (15.53 in; 1948-2005) and 36.2 cm (14.25 in; 1971-2000) with the highest precipitation coming in May and June (6.2 cm and 6.4 cm; 2.45 in and 2.53 in, respectively; 1971-2000). The mean annual temperature is 8.2° C (46.8° F), with mean monthly temperature in January of -5.7° C (21.8° F) and mean monthly temperature in July of 22.9° C (73.3° F; all based on 1971-2000 data). These local microclimate conditions might be exaggerated by wind, aspect, slope steepness, and other environmental characteristics.

F. Population biology and demography

1. Phenology: Originally, the flowering phenology of *Lesquerella arenosa* var. *argillosa* was characterized as running from April to June, with fruits present in late May-June, and dried fruits possibly persisting longer (Marriott 1992). Mature fruits have been photographed in early June (Figure 5, photographed on 2 June 2007). However, the 2009 growing season had a moist, late start in which *L. a.* var. *argillosa* flowering probably did not start until mid May and fruits did not mature until mid- or late June.

2. Population size and condition: *Lesquerella arenosa* var. *argillosa* is estimated as having from 50,000-100,000 plants in one giant population complex covering about ca 750 acres but spread out over about 50 mi². This estimate combines the tallies of eighteen separate colonies but does not include two areas surveyed by Marriott (1992) on private land, and both of which estimated as having at least 1000 plants. It also does not include any attempts to survey bladed roadside habitat. Many of the 18 colonies comprising the Old Woman Hills Creek occurrence are far enough apart from one another that they would be interpreted as separate occurrences, were it not for photointerpretation that suggests the presence of suitable habitat between isolated public tracts (Figure 7).

Table 4. Size and extent of *Lesquerella arenosa* var. *argillosa* occurrences in Wyoming

Site name	Population size	Extent	Trend
Old Woman Hills Creek	50,000-100,000	ca 750 acres spanning ca. 50 mi ²	Stable or increasing
Coyote Gap	< 50	Much less than 1 acre (ca 20 meters on both sides of road)	NA
Cow Gulch	9	Much less than 1 acre (widely-scattered over nearly a mile of road)	NA

Population numbers might be expected to vary from year-to-year for this short-lived perennial. The early 2009 growing season conditions appeared to represent a highly favorable year. These climate considerations mean that the 2009 estimate of numbers is apt to be high relative to other years. The exclusion of surveys on bladed roadside settings or on private lands mean that the 2009 estimate of numbers is apt to be incomplete.

There are no replicable trend data available for *Lesquerella arenosa* var. *argillosa* in Wyoming, but 2009 growing season conditions are inferred to signify at least a short-term upswing. It is hypothesized but not proven that accidental colonies established in the course of quarrying its habitat and dispersing seeds with gravel are likely to decline if not disappear over the long-term. There have been no major needs for monitoring identified. It may be worthwhile to revisit the two accidental roadside occurrences to determine whether they persisted. This is basic presence/absence monitoring that would help evaluate the net impact of quarrying occupied habitat. Census monitoring has limited merit without further context because colony or sub-colony counts are apt to oscillate for this short-lived perennial. Demographic monitoring is labor-intensive and may not be warranted unless there were population declines or there were otherwise a high value placed on collecting baseline life history data. However, monitoring should be considered if there were any reason to expect that *L. a.* var. *argillosa* is affected by land management practices, evaluating trends in treated and control conditions.

G. Reproductive biology

1. Type of reproduction: Members of the *Lesquerella* genus produce fruits called siliques that dry and burst open to release seeds. They are generally semelparous (monocarpic), flowering once and dying. There is no known vegetative reproduction.
2. Pollination biology: Cross-pollination is the norm in the *Lesquerella* genus, with bees and flies being the most commonly observed pollinators (Rollins and Shaw 1973). Self-compatibility has also been reported among a limited number of species in the genus by the same authors. The pollination of *Lesquerella arenosa* var. *argillosa* has not been investigated. A small, solitary bee and a black, metallic beetle were noted visiting flowers during 2009 surveys.
3. Seed dispersal and biology: There are no known dispersal mechanisms for seeds of *Lesquerella arenosa* var. *argillosa* other than short-distance dispersal by aid of gravity and wind, possibly aided by water and the erosive nature of its habitat. Other species in the genus have

been reported as having long-lived seed banks in which viable seeds persist over more than one year awaiting suitable climate conditions (Baskin and Baskin 2000). There were very few locales where seedlings of *L. a. var. argillosa* were observed during 2009 surveys, and only one where locally common in the bottom of a gully where mature plant numbers were low (Figure 12; which has ca 36 seedlings in view). There, plants may have washed in from adjoining slopes and the local pattern of recruitment may not necessarily represent typical seed biology and phenology.

The absence of seedlings among most *L. a. var. argillosa* colonies may not be possible to interpret in one year of surveys. The region has been through prolonged drought conditions up until a wet spring in 2007, followed by near-average conditions in the next two years. It is possible that the vigorous plants observed in 2009, all over a year old, and the apparent absence of plants in other age/stage classes, mean that they all germinated together as recently as 2007.

Figure 12. *Lesquerella arenosa* var. *argillosa* seedlings around mature plant. By B. Heidel.



H. Population ecology

1. General summary: The 2009 survey results refine earlier status information documenting that it is much more widespread and numerous on the Old Woman Hills Creek landscape than previously known. It is restricted to low-competition settings.
2. Competition: *Lesquerella arenosa* var. *argillosa* is often in zones or microhabitats with sparse vegetation. It is absent from the prairie and steppe vegetation that adjoins occupied habitat, whether because it is a poor competitor or because it cannot disperse into or become established in high vegetation cover. The fact that it is locally abundant along roadsides where the corridor has been scraped or shallowly bladed could be explained either because it

is a poor competitor or because well-vegetated habitat is not environmentally suitable in other ways.

3. Herbivory: No signs of herbivory were observed in 2009 surveys despite livestock present in some of the areas, even on a rim where sheep use is very concentrated. There were slight amounts of trampling at the latter site. Most occurrences had some plants with galls in the flowers, previously reported as “aberrant, enlarged flowers” (Marriott unpublished survey 1991), though usually in a fraction of the plants and with few galls on any individual plant (see Figure 3).
4. Hybridization: There are no reports of hybridization in the wild, and there were no intermediate character states observed during 2009 surveys.
- I. Land ownership: BLM-administered lands encompass the majority of occupied habitat for *Lesquerella arenosa* var. *argillosa*, but the BLM lands are isolated, 40-400+ acre parcels where *L a.* var. *argillosa* occupies only a fraction of the area. Two sections of state land also provide habitat, some of it contiguous with habitat on BLM lands.

IV. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

A. Potential threats to currently known populations:

1. Mining and extractive energy development:

There are three classes of mining and energy resource extraction activities on BLM-administered lands. Two of the three are in present in or near *Lesquerella arenosa* var. *argillosa* habitat, including both salable and leasable minerals. There are no known locatable minerals.

- a. Salable minerals include materials such as sand, gravel, dirt and rock, used for many construction purposes. They are bulky and needed in large volumes, so their sheer weight makes transportation costs high. BLM's policy is to make these materials available to the public and local governmental agencies whenever possible and wherever environmentally acceptable. There is not an application or permitting process involved. BLM sells mineral materials to the public at fair market value, but gives them free to states, counties, or other government entities for public projects (USDI Bureau of Land Management 2009).

The gravelly limestone that is often found in some *Lesquerella arenosa* var. *argillosa* habitat is suitable for road surfacing material. There is one, small active quarry on private lands as surveyed by Marriott (1992), and it has the same geology as a directly-adjointing BLM tract that is not quarried.

- b. Leasable minerals are subject to lease by the Federal Government and include energy resources (oil, gas, coal) as well as potash, sodium and phosphate. In the course of survey, a few oil well developments were noted in proximity to *Lesquerella arenosa* var. *argillosa* habitat around the Seaman Hills.

Marriott (1992) noted that quarrying would be a threat if done extensively. She went on to state that the limited quarrying that took place at the time of 1991 surveys may aid in dispersal via road shoulders chipped with quarried material. Her inference about potential dispersal has been borne out in the two recently documented places where it was found on road shoulders amid unsuitable habitat. However, the road shoulder colonies have low numbers and may be accidentally wiped out in routine road maintenance. Furthermore, it appeared as though the original quarry site has lost most available habitat; an observation of private land made from public land. By this interpretation, quarrying signifies a major, net impact.

The number of new *Lesquerella arenosa* var. *argillosa* colonies documented in 2009 documents that it is more locally widespread than previously known and thus more secure from quarrying if the BLM sensitive species policy covers leasable minerals. There are no such provisions on state lands. Highway work was in progress on U.S. Hwy. 18/85 several miles to the west at the time of survey, but there was not associated quarrying activity in *L. a.* var. *argillosa* habitat. Perhaps the most serious threat would be wind farm construction in the same townships occupied by *L. a.* var. *argillosa*, in which case large quantities of local surfacing material would be needed. In addition, there are also active oil wells in the Seaman Hills area at the southern end of the study area. Large-scale road and well-pad construction for expanded oil extraction would have the same affect. The rocky, well-drained setting occupied by *Lesquerella arenosa* var. *argillosa* follows level bands in places, so that any new road developments could be potential impacts.

Lesquerella arenosa var. *argillosa* habitat is notably weed-free. Perhaps the most serious potential for exotic species invasion among species present in the same townships would be encroachment of Yellow sweetclover (*Melilotus officinalis*). Yellow sweetclover is a robust, biennial, nitrogen-fixing legume that readily establishes in sparsely vegetated settings, competing with the native flora, and sometimes facilitating a successional shift away from sparse vegetation. It is also present in the same sections as *L. a.* var. *argillosa*, and can expand its distribution with new disturbance and favorable climate episodes.

B. Management practices and response: Grazing does not appear to affect *Lesquerella arenosa* var. *argillosa* in Wyoming. This appeared to apply even in the pasture that was under sheep grazing, and where sheep use was concentrated in occupied habitat. The only exception to this may be where there were attempts to construct a stock dam in the middle of occupied habitat. The surrounding slopes slumped and filled the impoundment, eliminating portions of suitable habitat. In other words, it was the construction work in the middle of occupied habitat rather than the grazing practice that had the impact.

There have been no studies of fire management practices and associated responses involving *Lesquerella arenosa* var. *argillosa*. There were no signs of wildfire or evidence of prescribed

burns in its habitat. The sparseness of the vegetation in general would not be likely to conduct a wildfire. However, such disturbances are possible in the surrounding grasslands, where fire could be directly or indirectly be accompanied by spread of non-native species.

County road management directly affects the species where the Boner Road Road passes through about two miles (3.2 km) of occupied *Lesquerella arenosa* var. *argillosa* habitat. The taxon persists or thrives under existing mechanical practices, but would be seriously impacted if the right-of-way were ditched or if herbicides were used in the right-of-way.

C. Conservation recommendations

1. Recommendations regarding present or anticipated activities: *Lesquerella arenosa* var. *argillosa* habitat is highly restricted within Wyoming but locally extensive in a portion of Niobrara County. Aerial photointerpretation is the recommended method for screening potential habitat and determining the need for field survey elsewhere in the townships where it is known to occur. Private landowners are critical partners in general land management as well as any activities or developments as they affect this taxon.

It is not known from BLM lands in other states, but at least two occurrences in South Dakota are on Badlands National Park, at least four occurrences in Nebraska are on Oglala National Grassland, and one occurrence in Colorado is on Pawnee National Grassland (Beatty et al. 2003).

2. Notification of BLM personnel of locations on BLM lands: To prevent inadvertent impacts to known population segments, all appropriate BLM personnel involved in planning, and on-the-ground land management activities, including oversight of mineral material quarrying, roads and wind energy developments, should be provided with location data for *Lesquerella arenosa* var. *argillosa*. Toward this end, the updated state species abstract and GIS files of all currently known occurrences are provided with this report.

Status recommendations: The new survey results document that BLM lands are key to maintaining *Lesquerella arenosa* var. *argillosa* on public lands in the state. Since the time that *L. a.* var. *argillosa* was first designated as Sensitive by Wyoming BLM, it has been documented as more numerous in Nebraska and South Dakota than previously known (reviewed by Beatty et al. 2003). Its presence on seven other federal sites in other states may diminish the relative significance of Wyoming's single natural population as contributing to overall viability. However, the new survey results document a much greater extent and numbers than previously known. Few other *L. a.* var. *argillosa* populations have estimated numbers, and none of them are known to have numbers that approach Wyoming population estimates. It is possible that the Wyoming population is among the largest. While existing threats are limited, conservation status of *L. a.* var. *argillosa* could be changed by major

changes in management, changes in public or private land ownership, or new development on the landscape.

- D. Summary: *Lesquerella arenosa* var. *argillosa* is known from a single area in Niobrara County, Wyoming, at the western limits of its known distribution. It has been documented on about 750 acres of occupied habitat on isolated public parcels that spans roughly 50 mi², with population numbers estimated at 50,000-100,000 plants in 2009 surveys. Quarrying seems to signify a net impact to *L. a.* var. *argillosa* even though it has become established in a couple roadside settings where introduced with quarried gravel. It is resilient to common management practices and some forms of disturbance including grazing and shallow blading of its habitat bordering roads, while vulnerable to any large-scale quarrying or spread of non-native species competitors.

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