Schoenocrambe argillacea (clay reed-mustard)

5-Year Review: Summary and Evaluation

Photo courtesy of Leila Shultz, Utah State University

U.S. Fish and Wildlife Service
Utah Field Office – Ecological Services
West Valley City, Utah 84119

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5-YEAR REVIEW
Schoenocrambe argillacea (clay reed-mustard)

1.0 GENERAL INFORMATION

1.1 Purpose of 5-Year Reviews

The U.S. Fish and Wildlife Service (Service) is required by Section 4(c)(2) of the Endangered Species Act (ESA) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in Section 4(a)(1) of the ESA. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process including public review and comment.

1.2 Reviewers

Lead Regional Office: Mountain-Prairie Regional Office (Region 6)
Bridget Fahey, Chief of Endangered Species, (303) 236-4258
Seth Willey, Recovery Coordinator, (303) 236-4257

Lead Field Office: Utah Ecological Services Field Office
Larry Crist, Field Supervisor, (801) 975-3330
Jessi Brunson, Botanist, (801) 975-3330, ext 133

1.3 Methodology Used to Complete the Review

We initiated a 5-year review of *Schoenocrambe argillacea* (clay reed-mustard) with a request for public comments on October 6, 2008 (73 FR 58261). We received no comments in response to the Federal Register (FR) notice. This review was completed by biologists from the Utah Ecological Services Field Office. It summarizes and evaluates information provided in the Utah Reed-Mustards Recovery Plan, current scientific research, and plant surveys. All pertinent literature and documents on file at the field office were used for this review. Interviews with individuals familiar with *S. argillacea* were conducted as needed to clarify or obtain specific information.

1.4 Background

1.4.1 FR Notice Citation Announcing Initiation of This Review

73 FR 58261, October 6, 2008

1.4.2 Listing History

<u>Original Listing</u>
FR notice: 57 FR 1398 1403, January 14, 1992
Entity listed: Species
Classification: Threatened range-wide

1.4.3 Review History

The status of *Schoenocrambe argillacea* was considered in the 1994 Recovery Plan (discussed further below) (Service 1994).

1.4.4 Species' Recovery Priority Number at Start of 5-year Review (as described in 48 FR 43098, September 21, 1983)

At the start of this 5-year review, the recovery priority number for *Schoenocrambe argillacea* was 11c. This ranking indicated:
1) populations face a moderate degree of threat; 2) recovery potential is low; 3) the species' taxonomic standing as a full species; and 4) the species is in conflict with construction or other development projects or other forms of economic activity.

TABLE 1. Recovery Priority Number

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict
High	High	Monotypic Genus	1	1C
		Species	2	2C
		Subspecies/DPS	3	3C
	Low	Monotypic Genus	4	4C
		Species	5	5C
		Subspecies/DPS	6	6C
Moderate	High	Monotypic Genus	7	7C
		Species	8	8C
		Subspecies/DPS	9	9C
	Low	Monotypic Genus	10	10C
		Species	11	11C
		Subspecies/DPS	12	12C
Low	High	Monotypic Genus	13	13C
		Species	14	14C
		Subspecies/DPS	15	15C
	Low	Monotypic Genus	16	16C
		Species	17	17C
		Subspecies/DPS	18	18C

The above ranking system for determining Recovery Priority Numbers was established in 1983 (48 FR 43098, September 21, 1983, as corrected in 48 FR 51985, November 15, 1983).

1.4.5 Recovery Plan

Name of plan: Utah Reed-Mustards: Clay Reed-Mustard (*Schoenocrambe argillacea*), Barneby Reed-Mustard (*Schoenocrambe barnebyi*), and Shrubby Reed-Mustard (*Schoenocrambe suffrutescens*) Recovery Plan (hereafter referred to as the "Recovery Plan").
Date approved: September 14, 1994

2. REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment Policy

This section of the 5-year review is not applicable to this species because the ESA precludes listing Distinct Population Segments (DPS) for plants. For more information, see our 1996 DPS policy (61 FR 4722, February 7, 1996).

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measureable criteria?

Yes.

2.2.2 Adequacy of Recovery Criteria

2.2.2.1 Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

Recovery criteria are no longer reflective of the best scientific information available. The Recovery Plan is 15 years old, and much of the information is now dated and inaccurate. For example, the criteria do not consider or address all of the known threats. In addition, we need to reevaluate the recovery criteria target for achieving populations of 2,000 plants because we do not know if that constitutes a minimum viable population size.

Nevertheless, the species' status relative to these criteria is discussed below so as to show the degree of progress toward recovery.

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.

First Recovery Criterion: Discover or establish 10 populations of 2,000 or more individuals for delisting. These populations must be demonstrated to be at or above minimum viable population levels.

Status: The first demographic-based recovery criterion is not fully met. No comprehensive surveys of *Schoenocrambe argillacea* have occurred since the Recovery Plan was written; total population estimates at the time were 6,000 plants across 3 populations (Service 1994). Based on our review of existing information, we now believe that one of the populations identified in the recovery plan is actually three separate populations. An additional population was erroneously omitted from the Recovery Plan. Therefore, we know of six populations of *S. argillacea* today (see section 2.3.1.2, **Distribution, abundance, and trends** for more discussion). Partial population surveys were conducted in 2004 and 2005 (Glisson 2004, 2005), but these were not sufficient to estimate the species total population size. In addition, we have not determined a minimum viable population size for *S. argillacea*.

Second Recovery Criterion: Establish formal land management designations which would provide for long-term protection on undisturbed habitat.

Status: The second criterion is not met. No formal land management designations are established to protect *Schoenocrambe argillacea* and its habitat.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history.

Schoenocrambe argillacea is a perennial herb with sparsely leafed stems 6 to 12 inches (15 to 30 centimeters) tall arising from a woody root crown. Flowering occurs in late April and early May, and fruiting occurs from May to June. Little information on the species' biology and life history was collected since the Recovery Plan was written. We do not know how long individuals live or how often new individuals establish. Glisson (2005) observed small mammal and insect herbivory of individual plants and fruits. We do not know what organisms pollinate this species.

2.3.1.2 Distribution, abundance, and trends.

Schoenocrambe argillacea grows on steep hillsides in a soil layer derived from the zone of contact between the Uinta and Green River geologic formations (57 FR 1396, January 14, 1992). This soil layer is gypsum-rich clay overlain with sandstone talus (57 FR 1396, January 14, 1992). The factors governing the long-term population dynamics of *S. argillacea* are not known (Service 1994).

Populations are defined as groups of occurrence records (or sites) located in the same geographic vicinity. *Schoenocrambe argillacea* occurs in six populations in Uintah County (see section 2.2.3, Status, above; Figure 1) including:

(1) Ray's Bottom

(2) King's Bottom

(3) Long Bottom

(4) Wild Horse Bench

(5) Big Pack Mountain

(6) Broome Canyon

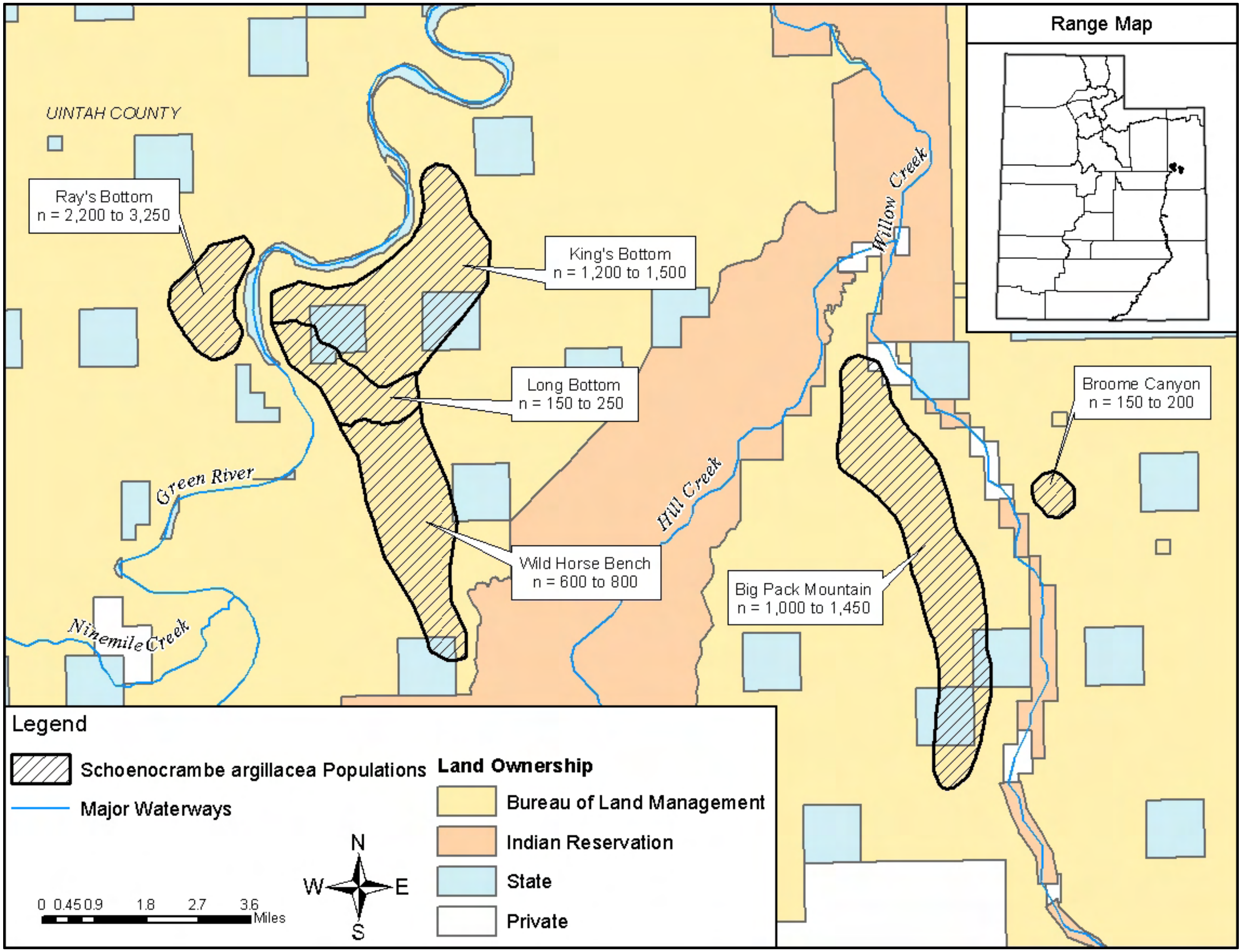

FIGURE 1. ***Schoenocrambe argillacea*** **populations.**

The species' known geographic distribution has not changed since development of the 1994 Recovery Plan. However, Figure 1, above, includes corrections to the Recovery Plan map. The Recovery Plan map showed a population to the west of Hill Creek, north of Big Pack Mountain. We determined that this location was erroneous. The Ray's Bottom population on the west side of the Green River was inadvertently omitted from the Recovery Plan map, but we have corrected this oversight in our map here.

Finally, the Green River population polygon from the Recovery Plan map was expanded to more accurately incorporate known locations. We then split this polygon into three separate populations based on element occurrence data. Element occurrences are occurrence records that are grouped together based on geographic proximity and loosely represent a population. It is possible the three populations in this area are one continuous population or metapopulation. For now we will refer to these populations separately as they are recognized by the Utah Natural Heritage Program. Although not shown on our map, an erroneous element occurrence (number 2) exists north of the King's Bottom population. This element occurrence record is kept on file at the Utah Natural Heritage Program.

Figure 1 does not display suitable habitat. Mapping suitable habitat for this species is problematic because it grows on inaccessible slopes and the habitat is not well defined. In previous efforts to model and ground-truth suitable habitat, 1,177 acres (476 hectares) of suitable habitat for *Schoenocrambe argillacea* were identified near Big Pack Mountain (Buys & Associates 2007). However, this mapping effort failed to include 62 percent of previously known species' locations, indicating that more careful methods or a more accurate habitat description are needed.

Land ownership as a percent of the known population areas is presented in Table 2 below.

TABLE 2. Percent of the mapped *Schoenocrambe argillacea* populations by land owner.

LAND OWNER	TOTAL % OF KNOWN POPULATION AREAS
Bureau of Land Management	89%
State School & Institutional Trust Land Administration	11%
Private	<1%
TOTAL	100%

In 1992, the Utah Natural Heritage Program completed an extensive survey of potential habitat for *Schoenocrambe argillacea* and estimated the total number of *S. argillacea* was 6,000 plants (Franklin 1992; Service 1994). Partial population surveys were conducted in 2004 and 2005 (Glisson 2004, 2005), but these surveys were not comprehensive enough to estimate total number of plants within these populations. Therefore, 6,000 plants remains our best rangewide estimate for *S. argillacea*.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation:

There is no available information on the genetics of individuals or populations for *Schoenocrambe argillacea*. Genetic studies to better define the *Schoenocrambe* at the genus level were conducted and are covered below in section 2.3.1.4.

2.3.1.4 Taxonomic classification or changes in nomenclature:

Schoenocrambe argillacea was discovered by Duane Atwood in 1976. It was described as *Thelypodium argillacea* by Welsh and Atwood in 1977, then was moved to the genus *Schoenocrambe* by Rollins in 1982 (Service 1994). *S. argillacea* was listed as a threatened species under the authority of the ESA on January 14, 1992 (57 FR 1398 1403), under the name of clay reed-mustard.

Al-Shehbaz (2005) reestablished the genus *Hesperidanthus* and assigned five the of six *Schoenocrambe* species, including *S. argillacea*, to the genus *Hesperidanthus* on the basis of molecular, cellular, and morphological data. *Hesperidanthus argillaceus* is the name now accepted for this species by the Flora of North America (Al-Shehbaz 2010). However, *Schoenocrambe argillacea* is still listed as the scientifically accepted name for this species in the Integrated Taxonomic Information System (ITIS) and the U.S. Department of Agriculture (USDA) Plants Database (ITIS 2011; USDA 2011). Because *Hesperidanthus* is the most recently published name by the taxonomic authority for these genera, we propose changing the name in the Federal Register to reflect this best available scientific data (Al-Shehbaz 2005, Al-Shebaz 2010). We will also formally request the name be changed in ITIS and the USDA Plants Database. Until this time, we will continue to refer to this species as *S. argillacea*.

2.3.2 Five-Factor Analysis

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

When we listed *Schoenocrambe argillacea* and wrote the Recovery Plan, we believed oil and gas development was a significant threat to *S. argillacea* populations and habitat (57 FR 1398 1403, January 14, 1992; Service 1994). All Federal lands on which *S. argillacea* populations occur are leased for oil and gas development, and the entire range is underlain by oil-shale, which may be mined when economic conditions favor it (Service 1994). In the listing, we recognized that habitat disturbance from oil-shale development was not imminent (57 FR 1398 1403, January 14, 1992).

<u>Oil and Gas Development</u>
Oil and gas development remains a significant threat to *Schoenocrambe argillacea* populations and habitat (Service 1990; 1994). All Federal lands on which known populations of *S. argillacea* occur are leased for oil and gas development (Utah Division of Oil, Gas, and Mining (UDOGM) 2011). To date, oil and gas development within known *S. argillacea* areas has been moderate. We do not know the actual ground disturbance at this point from oil and gas development, but we estimate approximately 5 acres (2 hectares) of total disturbance per well, including roads and infrastructure. After excluding directional wells (which are usually drilled from existing well pads), we calculate that at least 130 acres are disturbed within *S. argillacea* populations as mapped, and an additional 85 acres could be disturbed as currently approved oil and gas wells are drilled within the next 2 years (UDOGM 2011).

Although 215 acres is less than 1 percent of the mapped area for clay reed-mustard, the potential for higher levels of development is nearly certain. Eighty-one percent of mapped populations (Figure 1) are within existing and proposed oil and gas field developments (Bureau of Land Management (BLM) 2011). These developments include the Kings Canyon, Little Canyon, River Bend infill, and Love Unit areas, for which environmental assessments analyzing expanded oil and gas development were completed. Environmental impact statements are being developed for two larger field developments, Greater Natural Buttes and Gasco (BLM 2011). The only population not entirely within an oil and gas field development is the Wild Horse Bench population, which represents approximately 20 percent of the species' total distribution area and 3 to 5 percent of the total known plants.

The entire range of the *Schoenocrambe argillacea* is underlain by oil-shale, which may be mined when economically favorable (Service 1994). Because of economic constraints, significant commercial oil-shale production is unlikely within the next 20 years (BLM 2008b).

Schoenocrambe argillacea may be afforded some protection from the impacts of energy development because most of the known populations grow on precipitous and loose terrain, too steep for some oil- and gas-related surface disturbance (57 FR 1398 1403, January 14, 1992). However, this does not necessarily protect populations from the direct impacts of infrastructure (for example, pipelines or roads) or indirect impacts, including habitat fragmentation, dust, pollinator disturbance, invasive plants, sedimentation and erosion (57 FR 1400, January 14, 1992).

Given the location of economically developable resources and a lack of protective land management designations, unchecked oil and gas development would, in the absence of the ESA, lead to endangerment of *Schoenocrambe argillacea*. The ESA's protections allow coordination between the Federal resource agencies to avoid or minimize impacts to plants and their habitat through the development and implementation of species-specific conservation measures (BLM 2008a). However, even with the ESA's protections, habitat fragmentation, erosion, sedimentation, and fugitive dust impacts are likely to result from continuing oil and gas development projects, as discussed below.

Habitat Fragmentation: *Schoenocrambe argillacea* exists in small, low-density populations that are likely prone to negative effects from habitat fragmentation. For example, small plant populations fluctuate more widely over time and the smaller the remnant, the more susceptible the population is to extinction (Soulé et al. 1992; Forman and Alexander 1998; Menges 2002; Lienert 2004). Small plant populations can lose genetic variation and their population viability decreases (Ellstrand and Elam 1993; Lienert 2004; Kolb 2008). Fruit set, germination rate, offspring survival, and total numbers of flowers per plant are higher in large populations than in small populations (Paschke et al. 2002). Similarly, the number of capsules per plant and the number of seedlings per plant are positively correlated with population size (Schmidt and Jensen 2000).

Roads associated with energy exploration and development cause a high level of habitat fragmentation. Increased oil and gas developments result in more roads developed near and potentially in *Schoenocrambe argillacea* habitat. Ecological effects of roads to plants can extend more than 328 feet (100 meters) from the road (Angold 1997; Forman 2000; Forman and Deblinger 2000). Disturbance can occur directly from construction or indirectly from road dust, discussed further below (Eller 1977; Spatt and Miller 1981; Thompson et al. 1984; Farmer 1993; Angold 1997; Sharifi et al. 1997; Trombulak and Frissell 2000; Hobbs 2001; Myers-Smith et al. 2006). There is a strong correlation between vegetation composition and health with distance from a road, although it may take decades for the full effects of road development to be realized (Auerbach et al. 1997; Myers-Smith et al. 2006).

Road Dust: *Schoenocrambe argillacea* may be impacted by the indirect effects of road dust associated with oil and gas development. Road traffic mobilizes and spreads dust (Farmer 1993; Trombulak and Frissell 2000), and for every vehicle traveling 1 mile (1.6 kilometers) of unpaved roadway once a day, every day for a year, approximately 2.5 tons of dust are deposited along a 1,000-foot (~300-meter) corridor centered on the road (Sanders pers. comm. 2008). Dust deposition tends to be highest near the road and decreases with increasing distance from the road (Everett 1980; Spatt and Miller 1981; Walker and Everett 1987; Santelmann and Gorham 1988; Myers-Smith et al. 2006). For example, in one study, 97 percent of dust was deposited within 410 feet (125 meters) of the road (Walker and Everett 1987). The distance from a road at which dust can affect vegetation varies (see McCrea 1984; Myers-Smith et al. 2006), but negative impacts can occur up to 984 feet (300 meters) away from the road (Everett 1980). Using information from these studies, the BLM now implements a buffer of 300 feet (91 meters) for surface disturbance activities near *S. argillacea* occupied habitat and a requirement for monitoring plants where surface disturbance occurs within the 300-foot (91-meter) buffer.

Dust negatively affects photosynthesis, respiration, transpiration, water use efficiency, leaf conductance, growth rate, plant vigor, gas exchange, and allows the penetration of phytotoxic gaseous pollutants (Eller 1977; Spatt and Miller 1981; Thompson et al. 1984; Farmer 1993; Sharifi et al. 1997; Trombulak and Frissell 2000; Hobbs 2001). Dust comprised of finer particulates caused more improper functioning of the stomata than larger particles (Ricks and Williams 1974; Eller and Brunner 1975; Eveling and Bataille 1984; Rawson and Clarke 1988; Hirano et al. 1995). Improperly functioning stomata result in increased water loss in two ways: due to an increased transpiration rate because of increased leaf temperatures and due to clogged stomata that are unable to close at night (Hirano et al. 1995). Dust also can inhibit sunlight from reaching plant surfaces (Sharifi et al. 1997). Additionally, dusted leaves were 4 to 5°F (2 to 3°C) warmer (Sharifi et al. 1997) than undusted, control leaves (Hirano et al. 1995).

Dust from roads also impacts soil quality and vegetation type. Soils near roads can have significantly lower nutrient levels, altered organic horizon depth, higher bulk density, and lower moisture (Auerbach et al. 1997). Furthermore, soil characteristics and plant community composition can remain significantly different up to 28 years after road development (Myers-Smith et al. 2006).

One way to minimize road dust is to spray either calcium chloride or magnesium chloride on the road surface in addition to water, but these substances tend to increase salt accumulation in the soils adjacent to roads (Sanders and Addo 1993; Myers-Smith et al. 2006). Calcium chloride and magnesium chloride also directly negatively impact plant health (Furniss pers. comm. 2009). Lignin-based dust suppressants may perform better than salts, but still negatively impact water quality from runoff (Sanders and Addo 1993). Because of these impacts to plants, water-only dust abatement is encouraged for construction activities within occupied habitat (Service 2008).

Slower vehicles reduce airborne dust, and the relationship between speed and dust emissions is linear (Sanders and Addo 1993; Hobbs 2001). For instance, reducing vehicle speeds from 30 miles (48 kilometers) per hour to 15 miles (24 kilometers) per hour reduces dust emissions by 50 percent (Hobbs 2001).

Plant-Pollinator Interactions: Many of the negative effects of habitat fragmentation to plants are due to effects on plant-pollinator interactions (Debinski and Holt 2000; Moody-Weis and Heywood 2001; Aizen et al. 2002; Gathmann and Tscharntke 2002; Lennartsson 2002; Kolb 2008). Fragmented plant populations appear to be less attractive to insect pollinators, which spend more time in larger, unfragmented plant habitats (Aizen et al. 2002; Goverde et al. 2002; Lennartsson 2002; Kolb 2008). Furthermore, insect pollinator diversity increases in larger populations (Mustajarvi et al. 2001) and decreases in isolated habitats with smaller plant population size (Steffan-Dewenter and Tscharntke 1999). Lower pollinator visitation rates were associated with lower seed sets and reproductive success in fragmented sites compared to intact sites (Jennersten 1988).

Bumblebees visit more flowers on fewer flower stalks in sparser plant populations (Mustajarvi et al. 2001; Goverde et al. 2002). This leads to increased self-pollination or near-neighbor pollination and contributes to inbreeding (Goverde et al. 2002; Lennartsson 2002). Inbred plants produce fewer flowers and seeds, have smaller plant height and smaller leaf-size, and reduced reproductive success (Steffan-Dewenter and Tscharntke 1999; Lienert 2004; Kolb 2008).

We do not know which insect species pollinate *Schoenocrambe argillacea*. However, ground nesting, solitary bees pollinate the closely related *S. suffrutescens* (shrubby reed-mustard), that grows in nearby habitats (Service 1994; Tepedino 2000; Bartlett et al. 2008; DiTerlizzi et al. 2008; Tepedino pers. comm. 2008), and it is likely *S. argillacea* pollinators are similar.

Ground nesting bee species have specific nest site requirements. Thus, habitat alterations and fragmentation caused by human land use activities can change native bee populations and species composition (Cane 2001). Nest sites are more often a limiting factor than pollen or nectar (Gathmann and Tscharntke 2002), and increased oil and gas development is likely to disturb nest sites for ground nesting bee species. This disturbance could potentially limit cross-pollination and genetic diversity of *S. argillacea* populations.

Erosion and Sedimentation: Although oil and gas development may not occur directly on the steep habitat *Schoenocrambe argillacea* occupies, erosion or sedimentation could still impact this species, particularly if the plants are downslope of development activities. In fact, development-related erosion and sedimentation may be a particular concern to this species because it grows on precipitous hillsides. Because of this unique vulnerability, the BLM Vernal Field Office requires energy companies to get site-specific approval from both the BLM and the Service when disturbance will occur upslope of habitat (BLM 2008a). This conservation measure is in effect because the species is listed as threatened by the ESA.

Summary

Oil and gas development is the most significant threat to *Schoenocrambe argillacea*. In the absence of protection from the ESA, ongoing oil and gas development could endanger this species and its habitat (52 FR 37416, October 6, 1987).

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

In our listing rule and the Recovery Plan for *Schoenocrambe argillacea*, we did not consider overutilization a threat to this species. No new information suggests overutilization for commercial, recreational, scientific, or educational purposes is a threat today.

2.3.2.3 Disease or predation:

When we listed *Schoenocrambe argillacea*, we believed sheep and cattle grazing may have had an historical impact on this species. However, by 1994 grazing was no longer expected to impact *S. argillacea* due to changes in grazing management, namely reduced numbers of sheep and cattle on the land (Service 1994). Grazing levels have not increased appreciably since then, and thus we still conclude that grazing is not impacting *S. argillacea*. Elk were reported in *S. argillacea* habitat, but we have not determined whether they browse on this species (Glisson 2005). Insect and small mammal herbivory occurs on *S. argillacea* fruits (Glisson 2005), but we do not have any information that this is occurring at a level that negatively impacts the species.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

No Federal, State, or local laws or regulations were adequate to protect *Schoenocrambe argillacea* from the threats present at the time of listing. When the Recovery Plan was written, only the protections of the ESA applied to this species. Below we analyze the current situation (i.e., the situation with ESA protections in place) and, in order to gauge the adequacy of the existing regulatory mechanism, what would happen in the absence of ESA protections.

<u>Federal Laws and Regulations</u>
Land ownership within the mapped *Schoenocrambe argillacea* populations is predominantly BLM (Table 2). The remaining land owners include State School and Institutional Trust Land Administration (SITLA) and private landowners.

The National Environmental Policy Act (NEPA) (42 U.S.C. 4371 et seq.) provides some protections for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, NEPA requires an agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where the analysis reveals significant environmental effects, the Federal agency must discuss mitigation that could offset those effects (40 CFR 1502.16). These mitigations usually provide some protections for listed species. However, NEPA does not require that adverse impacts be mitigated, only that impacts be assessed and the analysis disclosed to the public. In the absence of the ESA's protections, it is unclear what level of consideration and protection Federal agencies would provide through the NEPA process and whether protection of *Schoenocrame argillacea* from the threats would be adequate.

The ESA is the primary Federal law that protects *Schoenocrambe argillacea* since its listing in 1992. Section 7(a)(1) states that Federal agencies, in consultation with the Service, shall carry out programs for the conservation of endangered species. Section 7(a)(2) requires Federal agencies to consult with the Service to ensure any project they fund, authorize, or carry out is not likely to jeopardize the continued existence of listed species or modify their critical habitat. Section 9(a)(2) of the ESA prohibits the following activities: 1) the removal and reduction to possession (i.e., collection) of endangered plants from lands under Federal jurisdiction, and 2) the malicious damage or destruction on lands under Federal jurisdiction, and 3) the removal, cutting digging, damaging, or destruction of endangered plants on any other area in knowing violation of a State law or regulation, or in the course of any violation of a State criminal trespass law. Section 9 also makes illegal the international and interstate transport, import, export, and sale or offer for sale of endangered plants and animals.

The BLM included conservation measures specifically addressing the protection of *Schoenocrambe argillacea* in the Vernal Field Office Resource Management Plan, which provides protection for the species for the next 20 years, or the life of the plan (Service 2008). An example of implementation of the conservation measures is the Kerr-McGee Greater Natural Buttes project, which proposed drilling up to 3,496 wells in the Greater Natural Buttes management area. The applicant-committed conservation measures included avoidance or minimization of impacts, dust abatement, monitoring plans, and erosion-control measures (Service 2007). Without the ESA, this development might have continued without affording any protection for *S. argillacea*, which may have threatened the species with becoming endangered.

In the absence of the protection of the ESA, *Schoenocrambe argillacea* would remain a special status species on BLM lands for at least 5 more years. On BLM lands, limited policy-level protection is afforded to special status species through the Special Status Species Management Policy Manual #6840 (BLM 2008c). The BLM is committed to maintain current inventories for sensitive species, monitor populations to determine whether land management objectives are being met, and to ensure that land use and implementation plans fully address appropriate conservation of BLM special status species (BLM 2008c).

Although the currently known distribution of *Schoenocrambe argillacea* does not include any Tribal lands, this species is likely to occur on Tribal lands in yet undiscovered populations. Oil and gas development on the Uintah and Ouray Reservation is regulated by the Bureau of Indian Affairs (BIA) and the BLM. There are no Tribal laws or regulations that provide protection to the species, but through the Federal nexus (in this case, the involvement of the BIA and BLM) protection, if the species is found to be present, is provided under the ESA. Without the ESA, we are aware of no regulatory mechanisms that would adequately protect the species on Tribal lands.

State Laws and Regulations
Utah has no State laws or regulations that protect *Schoenocrambe argillacea*.

Local or Other Laws and Regulations
There are no county or local laws or regulations protecting *Schoenocrambe argillacea*.

Summary
In the absence of the ESA's protection, we believe that the existing regulatory mechanisms would not provide *Schoenocrambe argillacea* with adequate protection from the threats. Over the next 20 years, the BLM's Resource Management Plan would provide some protection from direct and indirect impacts through implementation of the conservation measures. In addition, there would be some limited policy-level protection afforded to the species through BLM's Special Status Species Management Policy. However, the continued protections of the ESA are necessary given the level of oil and gas leasing and proposed development in this species' populations (see section 2.3.2.1).

2.3.2.5 Other natural or manmade factors affecting its continued existence:

At the time of listing, we determined that small population sizes affected *Schoenocrambe argillacea*; most populations contained less than 200 individuals. Small populations may still remain a problem for this species, in addition to current impacts from habitat fragmentation, road dust, invasive species, and climate change. Most habitat fragmentation and road dust can be attributed to oil and gas development, and both are discussed in section 2.3.2.1 above and will not be discussed further here. There are no data regarding the effects of invasive species and climate change specifically for *S. argillacea*. We include information from other species to illustrate the most likely impacts to *S. argillacea*.

Small Populations

When *Schoenocrambe argillacea* was listed, it was known to occur in 2 general areas—around the Green River and Willow Creek—in 6 populations with fewer than 6,000 individuals, and most sites contained fewer than 200 individuals. Estimates for the Recovery Plan did not indicate significant changes, and we do not have more recent comprehensive data indicating changes in population size.

Small populations and species with limited distributions are vulnerable to relatively minor environmental disturbances (Given 1994). Small populations also are at an increased risk of extinction due to the potential for inbreeding depression, loss of genetic diversity, and lower sexual reproduction rates (Ellstrand and Elam 1993; Wilcock and Neiland 2002). Lower genetic diversity may, in turn, lead to even smaller populations by decreasing the species' ability to adapt, thereby increasing the probability of population extinction (Barrett and Kohn 1991; Newman and Pilson 1997). On the other hand, many naturally rare species have persisted for long periods within small geographic areas, and many naturally rare species exhibit traits that allow them to persist, despite their small population sizes.

Species with limited climatic ranges and restricted habitat requirements are typically the most vulnerable to extinction (Intergovernmental Panel on Climate Change (IPCC) 2002; Machinski et al. 2006). The risk of extinction is expected to increase for species with low population numbers (IPCC 2002; Jump and Penuelas 2005). We discuss the effects of climate change further in our "Climate Change" section below.

We lack information on the population genetics of *Schoenocrambe argillacea*, so we do not know what constitutes the minimum viable population size for this species. Regardless, because population numbers are low for *S. argillacea*, we consider small population size to increase the species' vulnerability to the threats discussed under sections 2.3.2.1, 2.3.2.4, and 2.3.2.5.

Invasive Species

Invasive, exotic plant species can contribute to the extinction of native plants (Soulé et al. 1992). Exotic invasive species are common along highways because seeds are carried and deposited along roads by vehicles, and spread via vehicle-caused air turbulence (Forman and Alexander 1998).

Roads often promote the spread of invasive species by altering soil characteristics, stressing native plant species, and providing easier movement by wild or human vectors (Trombulak and Frissell 2000). Spread of invasive species via roads coupled with increased road dust can exacerbate the impact on native species; an increase in fine dust particles can increase nonnative, exotic plant species (Reynolds et al. 2001). We discuss the effects of roads on plants and surrounding habitat in our "Road Dust" section above (section 2.3.2.1).

Cheatgrass (*Bromus tectorum*) occurs in *S. argillacea* habitat (Glisson 2005). Cheatgrass can out-compete native species for soil nutrients and water (Melgoza et al. 1990; Aguirre and Johnson 1991; Pyke and Novak 1994). If it establishes in sufficient density in native plant communities, cheatgrass increases flammability, leading to shortened fire return intervals that make it difficult for native plants to re-establish (D'antonio and Vitousek 1992). Halogeton (*Halogeton glomeratus*) is another invasive species that is found in the vicinity of *S. argillacea* habitat, but is not documented within occupied habitat (Brunson 2009; Buys & Associates 2009). Halogeton quickly infests areas that are either left barren from fire or are exposed to some type of soil disturbance (Pavek 1992). Halogeton tends to be a poor competitor, but it can accumulate sodium in the soil and alter soil microbiota to the disadvantage of native plants (Kitchen and Jorgensen 2001; Kitchen and Carlson 2008).

Although invasive species are present in *Schoenocrambe argillacea* habitat, they have not been identified in high numbers or densities. Atmospheric levels of carbon dioxide are expected to double before the end of the 21st century (IPCC 2002), which is likely to increase biomass and seed production of invasive annuals (Mayeux et al. 1994; Smith et al. 2000; Ziska et al. 2005). This effect, if manifested, could facilitate the expansion of cheatgrass and other invasive plants that could compete with and further threaten *S. argillacea*. Regardless, we do not currently consider invasive species a threat to *S. argillacea*.

<u>Climate Change</u>

Climate change is likely to affect long-term survival or distribution of native species. In the southwestern United States, including Utah and *Schoenocrambe argillacea* habitat, average temperatures have increased ~1.5°F (0.8°C) compared to a 1960-1979 baseline (Karl et al. 2009). By the end of this century, temperatures are expected to warm a total of 4 to 10°F (2 to 5°C) in the Southwest (Karl et al. 2009). Hot extremes, heat waves, and heavy precipitation will increase in frequency, with the Southwest experiencing the greatest temperature increase in the continental United States (IPCC 2007).

Throughout *Schoenocrambe argillacea*'s range, precipitation is predicted to increase 10 to 15 percent in the winter and decrease 5 to 15 percent in spring and summer under the highest emissions scenario (Karl et al. 2009). Fall precipitation is expected to stay the same (Karl et al. 2009). The levels of aridity of recent drought conditions and perhaps those of the 1950s drought years will become the new climatology for the southwestern United States. In fact, much of the Southwest remains in a 10-year drought, "the most severe western drought of the last 110 years" (Karl et al. 2009, p. 130).

We do not know how changes in precipitation will affect *Schoenocrambe argillacea*. However, we do know that increased drought can be detrimental to many drought-tolerant species. Drought conditions led to a noticeable decline in survival, vigor, and reproductive output of rare plants in the Southwest during the drought years of 2001-2004 (Anderton 2002; Van Buren and Harper 2002, 2003; Hughes 2005; Clark and Clark 2007; Roth 2008a, 2008b). Effects related to climate change, such as persistent or prolonged drought conditions, may affect the long-term persistence of *S. argillacea*, but without further research or information, it is difficult to predict how.

<u>Summary</u>
The effects of small population size could be a detriment to the survival of *Schoenocrambe argillacea*, particularly if coupled with anthropogenic threats such as oil and gas development. The effects of invasive species and climate change are uncertain, and we cannot predict their effects on this species' survival without more information.

2.4 Synthesis

At the time of listing, we concluded that *Schoenocrambe argillacea* was threatened (i.e., likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range) due to small population size, limited distribution, oil and gas development, and inadequacy of regulatory mechanisms (57 FR 1401, January 14, 1992).

Since listing, the threats of oil and gas development, small population sizes, and limited distribution remain. Oil and gas development throughout major portions of the species' habitat is occurring, and additional developments are planned. Absent protection from the ESA, the species would likely be impacted from direct destruction or indirectly from the effects of road dust and habitat fragmentation to the point that it may become endangered. Because of Section 7 consultation processes under authority of the ESA, we are able to work with BLM and energy development companies to survey for the species, delineate conservation areas, and approach oil and gas exploration and production in a phased approach. Small population sizes remain a concern with only 6,000 total individuals. New potential threats from invasive species or climate change may exacerbate negative effects, but we need research that directly tests these questions.

Most of what we know of the species' distribution is from a survey completed over 10 years ago and a few partial surveys conducted on a case-by-case basis. Regular monitoring of the species across its entire range is needed to track the species' response to ongoing threats and population changes over time.

We conclude that *Schoenocrambe argillacea* should retain its classification as a threatened species throughout its range. The threats from potential oil and gas development are too great to warrant delisting of this species.

3. RESULTS

3.1 Recommended Classification

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change is needed

4. RECOMMENDATIONS FOR FUTURE ACTIONS[1]

Surveys and Monitoring

- We recommend creating a better distribution map for *Schoenocrambe argillacea*. Because of the difficult terrain it inhabits and previous inaccuracies in habitat mapping (see section 2.3.1.2 above), we also recommend developing alternative mapping techniques, such as using satellite imagery to map and ground-truth suitable habitat.

- We recommend developing a reliable comprehensive population estimate every 5 years. Populations that are accessible by foot should be resurveyed routinely. General estimates may be used for inaccessible areas. Should additional populations and higher numbers be identified, this may address the small population size and limited distributional concerns cited in section 2.3.2.5 and 2.4 above. Improved habitat mapping and better population counts should also be considered in land use decisions to minimize impacts to the species. Finally, improved habitat maps and population estimates should be used to help revise the Recovery Plan (as recommended below).

- We will work with the BLM to establish long-term demographic monitoring plots for *Schoenocrambe argillacea*. We will review available information (Glisson 2005) and coordinate with experts to identify appropriate monitoring plots. Data we collect on survival, reproduction, and habitat condition for the species will help us identify trends, threats, and whether conservation measures incorporated thus far are effective.

- We will work with the BIA and the Ute Tribe to map potential habitat and survey for new populations of *Schoenocrambe argillacea*, if discovered on Uintah and Ouray Indian Reservation lands.

- Approximately 11 percent of mapped *Schoenocrambe argillacea* populations occur on State and private lands (see Table 2). We should work with SITLA and private landowners to survey and conserve *S. argillacea* habitat and increase outreach efforts.

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[1] The Uinta Basin Rare Plant Forum—a group of private, government, and non-profit biologists—ranked *Schoenocrambe argillacea* as a high priority for future studies (Uinta Basin Rare Plant Forum 2009). Most of the priorities identified by this group are captured here.

Research

- Basic biological and ecological information should be obtained for this species, including determining pollination mechanisms and pollinators. The habitat also needs to be better defined by accurately characterizing parent material, soil, and landscape characteristics of occupied habitat.

- We should collect seeds to include this species in the Center for Plant Conservation collection. Seeds also should be tested for viability and longevity.

- Once habitat requirements are better understood and reliable suitable habitat maps are developed (see above actions), we recommend studying the feasibility of introducing *Schoenocrambe argillacea* into new areas of unoccupied suitable habitat near existing populations.

Threats Abatement

- On Federal lands, we should continue to avoid development in *Schoenocrambe argillacea* populations and suitable, unoccupied habitat to the extent possible, until we can complete research showing what level of development in *S. argillacea* habitat is tolerable. We should ensure that developers follow established conservation measures when disturbance occurs and that habitat fragmentation is reduced to the extent possible.

- Using better distribution maps and updated survey information, we should identify and establish core conservation areas in minimally-disturbed habitat (both occupied and unoccupied) for long-term protection of *Schoenocrambe argillacea*. We should work with the BLM to adopt these conservation areas under a long-term conservation agreement.

- Use conservation area information to identify and establish an Area of Critical Environmental Concern (ACEC) on BLM land to protect *Schoenocrambe argillacea* and its habitat. The ACEC should include no surface occupancy stipulations for those areas where mineral rights are not yet leased. The ACEC can be formally recommended to the BLM and incorporated during their resource management planning process.

- Develop a habitat management plan, which the BLM incorporates into the RMP and implements. Ensure that all *Schoenocrambe argillacea* occurrences on public lands are within management areas where maintenance of the species is a primary management goal.

- Develop conservation agreements with those federal mineral leaseholders whose leases are not subject to the terms of BLM management plans protecting the plants (leases that predate the RMP/habitat management plan). Through implementation of these conservation agreements, companies would implement conservation measures necessary to protect the species from mineral extraction activities.

Administrative Actions

- Once we have new survey data and research data available, we recommend revising the Recovery Plan to explicitly address the relevant listing factors. Time and cost required to meet the criteria and recover the species should be included in the Recovery Plan.

- We will publish in the Federal Register a formal name change from *Schoenocrambe argillacea* to *Hesperidanthus argillacea* to reflect the best available science.

- We will formally request the name be changed from *Schoenocrambe argillacea* to *Hesperidanthus argillacea* in the ITIS and USDA plants databases.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW
of *Schoenocrambe argillacea* (clay reed-mustard)

Current Classification: Threatened rangewide

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change is needed

Review Conducted By: Jessi Brunson, Botanist, Utah Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve ______________________ Date 7/11/11

REGIONAL OFFICE APPROVAL:

Lead Assistant Regional Director, Fish and Wildlife Service

Approve ______________________ Date 7/11/11