Draft Recovery Plan for the

Dudley Bluffs Bladderpod (*Physaria (Lesquerella) congesta*)

and

Dudley Bluffs Twinpod (*Physaria obcordata*)

Photos courtesy of: Steve L. O'Kane Jr.

Prepared by:
U.S. Fish and Wildlife Service
Western Colorado Ecological Services Field Office
Grand Junction, Colorado

April 2019

ACKNOWLEDGEMENTS

The Service would like to thank the following individuals and their respective organizations for their dedicated efforts to the protection and recovery bladderpod and twinpod. Without their assistance, the development of the recovery plan and implementation strategy for the species would not have been possible: Larry Bennett (Hayden-Wing Associates, LLC), Alex Correa (ExxonMobil), Matthew Dupire (Bureau of Land Management), Keith Etzel (Shell Frontier Oil and Gas, Inc.), Lisa Foy (Hayden-Wing Associates, LLC), Jill Handwerk (Colorado Natural Heritage Program), Ken Holsinger (Bureau of Land Management), Tom Knowles (Colorado Division of Wildlife), Brian Kurzel (Colorado Natural Areas Program), Peggy Lyon (Colorado Natural Heritage Program), Jeff Madison (Rio Blanco County), Maggie Marston (Bureau of Land Management), Terry Miller (Wyatt Ranch), Zoe Miller (Bureau of Land Management), James Roberts (Bureau of Land Management), Rusty Roberts (Bureau of Land Management), Raquel Werstbaugh (Colorado Natural Areas Program), and Chuck Whiteman (Shell Frontier Oil and Gas, Inc.)

DISCLAIMER

Recovery plans delineate reasonable actions that are believed necessary to recovery and/or protect the species. Plans are prepared by the U.S. Fish and Wildlife Service (Service), sometimes with the assistance of recovery teams, contractors, State agencies, and others. Plans are reviewed by the public and subject to additional peer review before they are adopted by the Service. Objectives will only be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints. Recovery plans do not obligate other parties to undertake specific tasks. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the Service. They represent the official position of the Service only after they have been signed by the Regional Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks. By approving this document, the Regional Director certifies that the information used in its development represents the best scientific and commercial data available at the time it was written. Copies of all documents reviewed in development of the plan are available in the administrative record, located at the Service's Western Colorado Ecological Services Field Office, Grand Junction, Colorado.

Suggested citation:
U.S. Fish and Wildlife Service. 2018. Draft Recovery Plan for the Dudley Bluffs Bladderpod (*Physaria (Lesquerella) congesta*) and Dudley Bluffs Twinpod (*Physaria obcordata*). Western Colorado Ecological Services Field Office, Grand Junction, Colorado.

Approved: ______________________________
Deputy Regional Director, Region 6

Date: 3.18.19

Draft Recovery Plan for

Dudley Bluffs Bladderpod (*Physaria (Lesquerella) congesta*)

and Dudley Bluffs Twinpod (*Physaria obcordata*)

This recovery plan describes criteria for determining when the Dudley Bluffs bladderpod (bladderpod) (*Physaria congesta*) and Dudley Bluffs twinpod (twinpod) (*Physaria obcordata*) should be considered for delisting; lists site-specific actions that will be necessary to meet those criteria; and provides estimates of the time required and costs associated with implementing the actions needed for recovery of the species. Additionally, cursory information on the species' biology and status are included, along with a brief discussion of factors limiting their populations. A Species Biological Report, which provides a more detailed accounting of species status, biology, and threats, and a Recovery Implementation Strategy, which describes the activities to implement the recovery actions, is available at https://www.fws.gov/mountain-prairie/es/dudleybluffs.php. The Recovery Implementation Strategy and Species Biological Report will be updated on a routine basis.

LEGAL STATUS OF THE SPECIES

Bladderpod and twinpod were federally listed as threatened species under the Endangered Species Act on February 6, 1990 (55 FR 4152). Critical habitat was determined to be not prudent and therefore was not designated for either species due to concerns for the plants' vulnerability to vandalism or collection if detailed maps were to be published. Both species have a recovery priority number of 8C, which indicates a moderate degree of threat, high recovery potential, and conflict with construction, development projects, or other forms of economic activity, especially oil and gas development.

Bladderpod is ranked S1 in the state of Colorado by the Colorado Natural Heritage Program, meaning the species is critically imperiled due to rarity or biological factors that make it vulnerable to extirpation from the state. Twinpod is ranked S1S2, meaning the species is critically imperiled to imperiled in the state (CNHP 2014). Since the entire range for both species is located within the state of Colorado, extirpation from the state would also mean extinction of the species.

HABITAT REQUIREMENTS AND LIMITING FACTORS

Bladderpod and twinpod are rare endemic mustards that occur along drainages and tributaries in the Piceance Basin in Rio Blanco County of northwest Colorado. They occur on barren white shale outcrops associated predominantly with the Thirteenmile Creek Tongue of the Green River Formation. Both species are edaphic (soil) endemic species, inhabiting slopes of various aspects of white shale barrens and outcrops, deltaic and fluvial calcareous sandstones and siltstones, and derived fragile soils.

Bladderpod and twinpod are affected by a variety of factors including mineral extraction and related development, off-highway vehicle use, invasive species, livestock and wild horse grazing, and wildfire. In addition, the naturally limited range of their suitable habitat makes the species more vulnerable to these stressors, and existing regulatory mechanisms are not sufficient to protect the species from these stressors.

RECOVERY STRATEGY

The primary strategy for recovery of bladderpod and twinpod is to reduce or remove threats to the species; protect key conservation areas; protect existing populations; enhance and maintain suitable and potential habitat, including pollinator habitat; and monitor the progress of recovery. Conservation and recovery of these species will require human intervention and participation. To fully recover these species, we intend to build and strengthen partnerships to facilitate recovery.

RECOVERY STRATEGY RATIONAL

Population size and distribution are critical considerations for conservation prioritization, in order to maintain resiliency and representation. The fragmentation of bladderpod and twinpod habitat by human-related activities threatens to reduce the species to mosaics of small populations occurring in isolated habitat remnants. Small, fragmented populations with limited gene flow are susceptible to inbreeding and face a greater risk of extinction (Frankham 2003). Populations with few individuals and low effective population size are likely to suffer from low genetic diversity (Ellstrand 1992; Ellstrand and Elam 1993; Loveless and Hamrick 1984). As population size diminishes, the chance that genetic diversity is lost increases, and the likelihood that gene flow from distant populations will replenish genetic variability decreases (Loveless and Hamrick 1984).

Representative populations from across the range of bladderpod and twinpod are a key element of the recovery strategy. Reciprocal transplant studies have shown that there is often a high degree of local adaptive differentiation in plant populations (Ellstrand and Elam 1993). Effective genetic management of fragmented populations of threatened species is often needed but rarely occurs (Frankham 2003). The preservation of genetic diversity across populations is important not only for short-term persistence but also provides the material for future adaptation and evolutionary potential (i.e. representation), thereby increasing the species' probability of persistence over the long-term (Neel and Cummings 2003; Newman and Pilson 1997).

Specific genetic data on the populations selected for conservation is needed to determine how many populations are necessary for long-term persistence. However, in the absence of these data, an evaluation of four rare plant species demonstrated that anywhere from 53 to 100 percent of the remaining populations must be preserved to meet the genetic diversity conservation standard of the Center for Plant Conservation (Neel and Cummings 2003). It is important to consider that even the number of existing populations may not necessarily be sufficient, as it is possible these populations have not yet reached steady state equilibrium (Hanski et al. 1996). Given these considerations and based on the recommendations of species experts, this recovery plan requires the conservation of a minimum of seven bladderpod (100 percent of occurrences) and seven twinpod (64 percent of occurrences) key conservation areas, and protection of all other populations of the species. These criteria are intended to preserve the available genetic variability (i.e. representation) within the species and provide for their long-term persistence. It is the opinion of species experts and resource managers that fewer than seven occurrences of either species puts the species at risk of loss of genetic variability, thereby reducing the representation of the species.

Estimating the minimum population sizes needed to ensure long-term viability is a challenge. Population viability analyses use computer modeling to estimate a population's viability into the future under various threats and management scenarios. However, a population viability analysis that incorporates genetic data, pollinator success, threats, and demographic data has not been completed for bladderpod or twinpod. Completing a population viability analysis would help identify those occurrences that should be the focus of conservation efforts and to determine which management scenarios will best conserve such occurrences (Menges 2000; Oostermeijer et al. 2003). Detailed information on parameters such as recruitment, growth, mortality, and age structure of an occurrence are required to model population persistence (Menges 1990); consequently, many years of monitoring are needed to acquire the data necessary to conduct a population viability analysis. Without a population viability analysis, minimum viable population numbers for plants must be estimated using data from similar species and available scientific literature.

Minimum viable population size for plants in general is estimated at a median 4,824 individuals (Traill et al. 2007). However, caution is needed when applying a standard minimum viable population number, especially to plants, since different life strategies may make them more or less susceptible to extinction (Menges 1991). For example, in one study, researchers determined that populations with fewer than 100 breeding individuals were highly vulnerable to extinction through mutations, although this extinction may take 100 generations (Lynch et al. 1995). Another study found that outcrossing plant species, such as bladderpod and twinpod, that require pollination between individuals were more prone to extinction than self-pollinating species (Lennartsson 2002). Depending on factors such as population growth rates and the degree of environmental variation, some estimates of minimum viable populations range into the thousands or tens of thousands (Nunney and Campbell 1993; Soule 1986). Achieving and maintaining at least the minimum viable population size is an indicator of a resilient population. A population viability analysis is preferable to best estimate the minimum viable population numbers specific to bladderpod and twinpod. However, until these data become available, we will use the median minimum population size of 4,824 individuals. Range-wide, both bladderpod and twinpod greatly exceed this number. We currently estimate that there are 219,300-731,300 bladderpod individuals range-wide and 42,600-52,100 twinpod, yet threats to both species remain. As we have seen with the Piceance Creek twinpod occurrence, a single event such as a wildfire is capable of extirpating an entire occurrence of the species. Because of this and the lack of data to delineate populations rather than occurrences, we will apply the standard minimum population size to each of the key conservation areas for the species. Therefore, we consider the minimum range-wide population sizes to be 33,768 bladderpod and 33,768 twinpod. This approach is consistent with the conservation strategy that focuses on the preservation of several populations, each supporting a density of at least the minimum viable population size, across heterogeneous habitats (Nunney and Campbell 1993). If population viability analyses are conducted for bladderpod and twinpod in the future, that study should be used as guidance for this criterion instead.

This recovery plan emphasizes the conservation of larger, more resilient occurrences of bladderpod and twinpod. However, preservation of smaller occurrences is also important for preserving the genetic diversity, or representation, of the species. Through the criteria outlined in this recovery plan, we attempt to conserve representation, resiliency, and redundancy of the species, based on the theory that we must "save some of everything, save enough to last" in order to conserve an imperiled species (Stein et al. 2000). In particular, emphasis should be placed on occurrences that have the potential of supporting at least 4,824 individuals. We have defined such occurrences as key conservation areas. The protection and management of these key conservation areas, or areas that have the potential to serve as key conservation areas, forms the foundation of the recovery strategy for bladderpod and twinpod.

Disturbance due to mineral extraction and related actions is the primary threat to bladderpod and twinpod. By encouraging avoidance of bladderpod and twinpod populations, restricting disturbance in occupied habitats, and minimizing disturbance in adjacent pollinator habitats, the majority of known threats to the species, including their direct, indirect, and cumulative impacts, could be effectively removed or greatly reduced. Vegetation reclamation in the vicinity of bladderpod and twinpod has been largely unsuccessful. The BLM has recorded instances of disturbances that are 60 to 70 years old that have not been successfully reclaimed. In contrast, disturbed pollinator habitat may be able to be reclaimed to a state in which it will function again as pollinator habitat. Therefore, it is possible that limited disturbance in pollinator habitat is acceptable provided that it will be reclaimed to a functional status. Additional research into specific habitat needs for pollinators is necessary to quantify reclamation requirements. We consider all habitats within 1,970 feet (600 m) of occupied habitat as pollinator habitat for bladderpod and twinpod, based on flight distances of pollinators known to visit the species (Tepedino et al. 2012).

RECOVERY OBJECTIVES

The goal of this Recovery Plan is to ensure the long-term viability of bladderpod and twinpod in the wild to the point that the species can be delisted from the Federal list of Endangered and Threatened species.

RECOVERY CRITERIA

Criteria for delisting:

Delisting of bladderpod and twinpod may be considered when all of the following conditions have been met to address the threats to the species:

1. At least seven key conservation areas for bladderpod and seven key conservation areas for twinpod are protected (owned or managed by an individual, agency, or organization that identifies conservation of bladderpod or twinpod as a management objective of the site) (Factors A, C, D, and E). A key conservation area includes all occupied habitat within an occurrence and the surrounding area of potential impact. The area of potential impact is the area where indirect effects may impact plants. For bladderpod and twinpod, we consider this to be the area within 1,970 ft (600 m) of occupied habitat. Key conservation areas are protected from disturbance, meaning:
    a. Occupied habitat within key conservation areas should encounter no additional surface disturbance.
    b. Pollinator habitat should remain intact, meaning there should be no more than 12 percent cumulative disturbance within 1,970 feet (600 m) of occupied habitat.
    c. Suitable habitat within key conservation areas should contain no more than 10 percent cumulative disturbance.

   d. Habitat within key conservation areas possesses the following qualities (Factors A, C, and E):
      i. Habitat is of the quality and quantity necessary to support a stable and self-supporting occurrence of bladderpod or twinpod. In key conservation areas where both species are present, the area may be considered a key conservation area for both species, given that the habitat of the area is of the quality and quantity necessary to support stable and self-supporting occurrences of both bladderpod and twinpod.
      ii. Adjacent habitat is available with conditions sufficient to support pollinating insects.
      iii. Habitat conditions at each key conservation area are stable or improving after 10 years of monitoring.
2. At least seven occurrences of bladderpod and seven occurrences of twinpod within key conservation areas are stable and self-sustaining. To be deemed stable and self-sustaining, an occurrence must demonstrate a stable or increasing growth rate (lambda equal to or greater than 1) over a consecutive 10-year period. Plant abundance may fluctuate within individual sites, but the defined occurrences should have a stable or increasing growth rate over a ten-year time period. The then-year period may start retroactively (Factors A, C, D, and E).
3. Range-wide total population sizes at or greater than 33,768 bladderpod and 33,768 twinpod are maintained for a minimum of five years (Factors A, C, D, and E).
4. All populations of bladderpod and twinpod are represented in an *ex-situ* seed collection that is managed according to the Center for Plant Conservation guidelines (Guerrant et al. 2004). The *ex-situ* seed collection should contain existing levels of genetic diversity (representation) of bladderpod and twinpod across the ranges of the species and should take place over a 10-year period (Factor E).
5. Criteria 1 through 4 have been realized and demonstrated effective via monitoring efforts (Factors A, C, D, and E).
6. Long-term habitat protections are in place to protect key conservation areas from identified threats to the species and manage for surface disturbing activities. Habitat protection can be achieved via long-term management agreements, conservation agreements, or memoranda of understanding in accordance with landowner and agency authorities (Factor D).

Factor B (overutilization for commercial, scientific, or educational purposes) was not identified as a threat to bladderpod or twinpod and is, therefore, not addressed in the recovery criteria.

<u>ACTIONS NEEDED</u>

The actions identified below represent, based on the best available science, our assessment of the conditions necessary to achieve recovery of the bladderpod and twinpod. Recovery actions are assigned numerical priorities to highlight the relative contribution they may make toward species recovery (48 FR 43098):

> **Priority 1** – An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 – An action that must be taken to prevent a significant decline in species population or habitat quality or some other significant negative impact short of extinction.
Priority 3 – All other actions necessary to provide for full recovery of the species.

Recovery Action	Estimated Cost	Priority
1. Protect, enhance, and maintain existing bladderpod and twinpod populations and habitat.	$320,000	1
2. Maintain propagule bank, including long-term seed storage for bladderpod and twinpod.	$25,000	2
3. Conduct research to aid in the recovery of bladderpod and twinpod.	$770,000	3
4. Develop and implement a post-delisting monitoring plan.	$40,000	3
Total Estimated Cost	**$1,155,000**	

ESTIMATED COSTS OF DELISTING
The estimated costs associated with implementing recovery activities total $1,155,000 over a 15-year period. This is projected to be the minimum time needed to implement recovery activities and monitor results.

DATE OF RECOVERY
If all recovery activities are fully funded and implemented as outlined, achieving recovery criteria is expected to take 15 years. Therefore, the earliest projected recovery date for bladderpod and twinpod is 2033. Species recovery will depend largely on the commitment and ability of partners to implement conservation actions necessary to achieve recovery criteria.

LITERATURE CITED

Colorado Natural Heritage Program (CNHP). 2014. Colorado Rare Plant Guide: *Penstemon debilis*, www.cnhp.colostate.edu.

Ellstrand, N.C. 1992. Gene flow by pollen: implications for plant conservation genetics. Oikos :77-86.

Ellstrand, N.C., and D.R. Elam. 1993. Population genetic consequences of small population size: implications for plant conservation. Annual Review of Ecology and Systematics 24(1):217-242.

Federal Register notice. 1990. Endangered and Threatened Wildlife and Plants; Final Rule to Determine Lesquerella Congesta (Dudley Bluffs Bladderpod) and Physaria Obcordata (Dudley Bluffs Twinpod) to be Threatened Species. 55 Federal Register 4152.

Frankham, R. 2003. Genetics and conservation biology. Comptes Rendus Biologies 326:22-29.

Guerrant, E., P. Fiedler, K. Havens, and M. Maunder. 2004. Revised genetic sampling guidelines for conservation collections of rare and endangered plants: Supporting Species Survival in the Wild. *In* Ex situ plant conservation: supporting species survival in the wild, Island Press.

Hanski, I., A. Moilanen, and M. Gyllenberg. 1996. Minimum viable metapopulation size. The American Naturalist 147(4):527-541.

Lennartsson, T. 2002. Extinction thresholds and disrupted plant–pollinator interactions in fragmented plant populations. Ecology 83(11):3060-3072.

Loveless, M.D., and J.L. Hamrick. 1984. Ecological determinants of genetic structure in plant populations. Annual Review of Ecology and Systematics 15(1):65-95.

Lynch, M., J. Conery, and R. Burger. 1995. Mutation accumulation and the extinction of small populations. The American Naturalist 146(4):489-518.

Menges, E.S. 1990. Population viability analysis for an endangered plant. Conservation Biology 4(1):52-62.

Menges, E.S. 1991. Seed germination percentage increases with population size in a fragmented prairie species. Conservation Biology 5(2):158-164.

Menges, E.S. 2000. Population viability analyses in plants: challenges and opportunities. Trends in Ecology & Evolution 15(2):51-56.

Neel, M.C., and M.P. Cummings. 2003. Effectiveness of conservation targets in capturing genetic diversity. Conservation Biology 17(1):219-229.

Newman, D., and D. Pilson. 1997. Increased probability of extinction due to decreased genetic effective population size: experimental populations of Clarkia pulchella. Evolution 51(2):354-362.

Nunney, L., and K.A. Campbell. 1993. Assessing minimum viable population size: demography meets population genetics. Trends in Ecology & Evolution 8(7):234-239.

Oostermeijer, J., S. Luijten, and J. Den Nijs. 2003. Integrating demographic and genetic approaches in plant conservation. Biological Conservation 113(3):389-398.

Soule, M.E. 1986. Conservation biology: the science of scarcity and diversity. Sinauer, Sunderland, MA .

Stein, B.A., L.S. Kutner, and J.S. Adams. 2000. Precious heritage: the status of biodiversity in the United States. Oxford University Press on Demand.

Tepedino, V.J., W.R. Bowlin, and T.L. Griswold. 2012. Pollinators complicate conservation of an endemic plant: Physaria obcordata (Cruciferae) in the Piceance Basin, Colorado. Natural Areas Journal 32(2):140-148.

Traill, L.W., C.J. Bradshaw, and B.W. Brook. 2007. Minimum viable population size: a meta-analysis of 30 years of published estimates. Biological Conservation 139(1-2):159-166.