

1. **Species [12.53 1]:** *Machaeranthera coloradoensis* (Gray) Osterhout (Colorado tansyaster; Colorado tansy-aster).
2. **Status:** Table 1 summarizes the current status of this plant by various ranking entity and defines the meaning of the status.

Table 1. Current status of <i>Machaeranthera coloradoensis</i>		
Entity	Status	Status Definition
NatureServe	G3	Vulnerable—At moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factors.
CNHP ^a	G3	Globally vulnerable; typically 21 to 100 occurrences.
CNHP	S3	State vulnerable; typically 21 to 100 occurrences.
USDA Forest Service	Sensitive	Species identified by a regional forester for which population viability is a concern, as evidenced by: a) significant current or predicted downward trends in population numbers or density, or b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.
USDI FWS ^b	Not Listed	Not federally recognized under the Endangered Species Act (ESA) as endangered, threatened, proposed, or candidate species.
^a Colorado Natural Heritage Program.		
^b US Department of Interior Fish and Wildlife Service.		

The 2012 U.S. Forest Service Planning Rule defines Species of Conservation Concern (SCC) as “a species, other than federally recognized threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area” (36 CFR 219.9). This overview was developed to summarize information relating to this species' consideration to be listed as a SCC on the Rio Grande National Forest, and to aid in the development of plan components and monitoring objectives.

3. **Distribution, abundance, and population trend on the planning unit [12.53.2,3,4]:**

Machaeranthera coloradoensis is known in Colorado from Chaffee, Dolores, Fremont, Gunnison, Hinsdale, La Plata, Lake, Park, Pitkin, Rio Grande, Saguache, and San Juan counties (CNHP 2015). NatureServe (2015) also reported this species from south-central Wyoming and considers it a regional endemic. There are 21-80 occurrences (31 principle occurrences in Colorado)¹ (NatureServe 2015).

There are also three herbarium specimens of this species collected from Dolores and Gunnison counties in 1998 and 1999, respectively, that are not included in the CNHP records. Colorado occurrences are on the Grand Mesa, Uncompahgre, and Gunnison National Forest, the San Juan National Forest, the Rio Grande National Forest (RGNF), the Pike-San Isabel National Forest, and the White River National Forest. Several Colorado occurrences are not on National Forest System Lands and may occur on private land,

¹ Any naturally occurring population that is separated by a sufficient distance or barrier from a neighboring population. As a guideline, Element Occurrences (EOs) are separated by either: 1 mile or more across unsuitable habitat or altered and unsuitable areas; or 2 miles or more across apparently suitable habitat not known to be occupied.

state lands, or Bureau of Land Management (BLM) lands. This assessment will focus on the Colorado occurrences and then, specifically, on the RGNF occurrences.

The estimated abundance of *Machaeranthera coloradoensis* in Colorado ranges from 20 individuals to several hundred individuals to more than 1,500 individuals at different locations. There are no data on population trends for *Machaeranthera coloradoensis*. Although several populations have been counted, multi-year population or quantitative demographic monitoring has not been initiated for any occurrences of this species. CNHP keeps occurrence records for this species, which often include repeated observations of individual populations but lack detailed demographic or abundance information.

Johnston (2002) has not observed any noticeable, drastic declines in this species based on his personal observations during repeat visits. Additional populations of *Machaeranthera coloradoensis* have been located in recent years, and several Forest Service botanists in Colorado believe that extensive surveys would discover more populations. Johnston (2002) estimated that potentially up to 90 populations of this species may be found, with up to 60,000 individuals. [primary source²: Beatty *et al.* 2004].

USFS Corporate Database Habitat Type Associated with the Species, and Acreage of this Habitat on the Planning Unit: the habitat for this species would be considered predominately a grassland cover type but this species occurs over a very broad elevation range. A query was made of the RGNF's resource database to tally the acres of the following: grassland or talus/rock; slopes up to 35%; and elevation from 7,675-12,940 feet. This results in a very coarse, preliminary filter of potential habitat. Using this query, the Sangre de Cristo Mountain portion of the RGNF was found to contain roughly 158,000 potential acres. The San Juan Mountain portion of the RGNF was found to contain roughly 252,000 potential acres. This query could be further refined with additional criteria as more is learned about the habitat to create a better refined search image for *M. coloradoensis*. [primary source: USDA Forest Service 2015].

CNHP Ecological System of the Southern Rocky Mountains Ecoregion: This species' habitat is very broad, ranging from foothills (pinyon/juniper), montane (ponderosa pine/Douglas-fir), subalpine (Engelmann spruce) to alpine ecosystems. Consequently, *M. coloradoensis* occurs in numerous CNHP Ecological Systems and may not be meaningfully characterized this way.

[source: http://www.cnhp.colostate.edu/download/projects/eco_systems/eco_systems.asp].

4. **Brief description of natural history and key ecological functions [basis for other 12.53 components]:**

Machaeranthera coloradoensis is a perennial forb growing close to the ground in dry, sparsely-vegetated, erodible environments. It is generally found on rocky, exposed soils of sedimentary or volcanic origin. In Colorado, *M. coloradoensis* is found from foothills to alpine environments from 7,675 to 12,940 feet in elevation. *M. coloradoensis* macrohabitats range from plains/park grassland to dry grassland

² Primary source, as used here, means the reference cited was used verbatim at times. However, text was significantly abbreviated and citations were dropped for brevity. See the original reference for detailed analysis and complete literature citations.

communities within life zones of pinyon/juniper (*Pinus/Juniperus*) woodlands all the way up to alpine fellfields and meadows. Microhabitats include montane parks, bluffs, ridges, flats, rocky outcrops, talus slopes, fellfields, and roadsides, among others. This species grows on sedimentary and calcareous substrates (e.g., limestone, dolomite, shale), volcanic substrates (e.g., volcanic ash), or granitic substrates (Fertig 2000). This species is consistently found in areas with open exposure, but the slope, aspect, and moisture vary from site to site. *M. coloradoensis* is found from flat areas up to 35 percent slopes, on all aspects, and in both dry and mesic areas.

Based on qualitative estimates by botanists, many occurrences are in open settings with no or scattered trees, up to 5 percent cover by shrubs, 5 to 55 percent cover by grasses, 25 percent cover by forbs, 5 to 70 percent cover by bare ground, 0 to 1 percent cover by mosses/lichen, and 10 to 70 percent cover by gravel. Plant species associated with *M. coloradoensis* include scattered trees (e.g., *Pinus* spp.), shrubs (e.g., *Cercocarpus montanus*, *Chrysothamnus* spp.), forbs (e.g., *Astragalus* spp., *Erigeron* spp., *Potentilla* spp.), graminoids (e.g., *Festuca* spp., *Elymus* spp.), and lichens (e.g., *Xanthoparmelia* spp.). Some of these associated species are also rare plants (e.g., *Astragalus molybdenus*), and many are indicators of limestone-based soils.

Details concerning the reproductive biology and breeding system of *M. coloradoensis* are largely unknown. *M. coloradoensis* flowers from the beginning of July until the middle of August, and it sets seed from August through September. There is no information concerning the extent of sexual or vegetative reproduction in *M. coloradoensis*. Observations of *M. coloradoensis* populations in both Wyoming and Colorado indicate that most populations had a mix of vegetative, flowering, or fruiting individuals. The number of individuals in each reproductive stage depended on the date of the observation (the reported percentage of fruiting individuals ranged from 0 to 100 percent at different sites and dates).

There have also been no studies on vital aspects of *M. coloradoensis* reproduction, such as breeding system, germination requirements and success, demographic parameters, genetic aspects of reproduction, or which insect species are effective pollinators. The extent to which this species is self-compatible or requires outcrossing is not known. There have not been any studies on the life history, demography, fecundity (reproductive rate), or longevity of *M. coloradoensis*. In addition, *M. coloradoensis* is found from foothills to alpine environments, and life history and demographic patterns may vary among habitats.

Pollination biology, ecology, and specific pollination mechanisms for *M. coloradoensis* have not been studied. Members of the Asteraceae family are well equipped to attract pollinators and to disperse pollen. Bumblebees, butterflies, and other insects are common pollinators in montane ecosystems, but the most effective pollinators for *M. coloradoensis* are not known.

Details of seed dispersal mechanisms in *M. coloradoensis* are not known. This species has a bristly pappus on the fruits, which probably acts like a small parachute during wind dispersal. The seeds could also be dispersed downslope by soil or water movement (e.g., spring snowmelt or surface runoff). Minimal information is available concerning the fertility, seed viability, patterns of seed dormancy, and germination requirements of *M. coloradoensis*.

The existence of mycorrhizal relationships with *M. coloradoensis* or other *Machaeranthera* species was not discussed in the literature.

The interactions of *M. coloradoensis* within the plant community are not well known. This species is commonly found in sparsely vegetated areas, suggesting that it may be a poor competitor with meadow species and/or a superior competitor in somewhat stressful environments. Succession is a slow process in alpine environments, but historical evidence demonstrates that cushion plants of fellfields can be outcompeted by taller grasses and sedges over time to form alpine meadows. Erosion by wind, water, or gravity may play a role in maintaining suitable open habitat for *M. coloradoensis* and in reducing competition with shrub, forb, and grass species.

The presence of fire in foothills and montane environments is speculated to play a role in maintaining open habitat for *M. coloradoensis* and in reducing competition with shrub and grass species. However, the presence of *M. coloradoensis* in areas that have been prescribed burned and the effects of fire on this species are unknown.

There is no information concerning the role of parasites or diseases in the life cycle of *M. coloradoensis*. Several records in the CNHP database reported that there were no evidence of disease, predation, or injury. [primary source: Beatty *et al.* 2004].

5. Overview of ecological conditions for recovery, conservation, and viability [12.53 7, 9?, 10, 11, 12]:

There is a relatively large amount of potential habitat (see section 3) due to the wide elevation range of known occurrences and the corresponding diverse environments. Thus, this species does not appear to be a strict habitat specialist. However, as stated above, there are many uncertainties of what constitutes suitable habitat for this species.

Plant collecting is not known to be a threat to this species on the RGNF. The possible threats to the known occurrences on the RGNF are generally categorized as follows: recreation; permitted livestock; wildlife use; mining; exotic species; roads and trails; natural disturbance; and global climate change. Each of these potential threats is briefly discussed below.

Recreation. Foot traffic and recreation livestock (primarily horses; possibly pack goats and llamas at times) would be expected on designated trails with infrequent, if any, incidental cross-country foot/stock traffic possibly intersecting a population of *M. coloradoensis*. Dispersed camping (campsites, campfire rings, and trash) could potentially intersect a population. Sites close to designated roads and trails would be more vulnerable than those sites farther away.

Motorized use would be expected on designated routes, with only incidental impacts expected where occupied habitat and routes intersect. However, user-created routes (i.e., unauthorized routes) can create negative impacts and they should be immediately addressed when encountered. There are no documented effects from this activity.

The RGNF's afternoon big game ATV game retrieval policy creates the opportunity where an ATV could potentially intersect occupied habitat. The known occurrences of *M. coloradoensis* are in Management Area prescriptions that allow this activity. This species has a relatively prostrate growth form which

might make it somewhat less susceptible to lethal crushing damage, but this is unsubstantiated. There are no documented effects from this activity.

All of the known occurrences of *M. coloradoensis* are in Management Area prescriptions that allow winter snowmobile use off designated roads and trails. It is unknown whether this activity has any effect on this species when it is dormant and covered with snow. There are no documented effects from this activity.

Permitted livestock. The RGNF has been open to domestic livestock grazing since the late 1800s. There are occurrences of *M. coloradoensis* in open and active grazing allotments. However, this species is not known to be palatable and no herbivory has been observed and documented. Sheep grazing could potentially have more impact than cattle grazing, because sheep tend to graze closer to the ground and have a higher preference for forbs. However, sheep herbivory has not been observed. Impacts from grazing and/or trampling, if any, would be expected to be incidental due to low palatability.

Wildlife use. Palatability to wildlife and trampling effects to this species are largely unknown. Impacts from native herbivores has not been identified, although elk, bighorn sheep, mule deer, moose, and pronghorn antelope occur in habitats with *M. coloradoensis* on the RGNF. There is one observation (at North Clear Creek Falls on the RGNF) that noted some minor clipping of stems and was suggested to be attributed to either rodents or insects. But, the impacts of arthropods (an invertebrate animal having an exoskeleton, a segmented body, and jointed appendages) and rodents are unknown.

Mining. Mining considers leasable (oil and gas), saleable (sand and gravel), and locatable (hard-rock) minerals. Saleable mineral extraction has impacted a known occurrence in the past on the RGNF (i.e., the large gravel pit near North Clear Creek Falls). There are no known impacts from leasable minerals. Locatable minerals may have impacted occurrences in the past simply because there are so many exploratory sites and there is overlap with potential habitat for *M. coloradoensis*. However, there are no known active mining claims directly threatening known occurrences on the RGNF. It is also important to note, paradoxically, that substrate exposed during mine road construction activities has been documented to possibly create favorable habitat for *M. coloradoensis* to establish. For example, at least four occurrences of *M. coloradoensis* on USFS lands occur in areas with historic mining activity, and one population was growing on prospect piles created during historical mining activities.

Exotic species. There are no reports of non-native invasive plant species specifically affecting *M. coloradoensis*. The potential threat by invasive plant species is present since *M. coloradoensis* occurs over a broad range of habitats. However, none of the RGNF occurrences are reported to be threatened at this time. The possible ecosystem effects of exotic species on pollinators and whether that ultimately impacts *M. coloradoensis* is unknown.

Roads and trails. There is an infrastructure network of roads and trails in the RGNF and it will continue to receive periodic maintenance. Effects of this maintenance to *M. coloradoensis* are unknown. This infrastructure can potentially facilitate new invasive species spread. However, the infrastructure is not known at this time to be causing specific invasive species spread into occupied habitat or threatening known occurrences of *M. coloradoensis*.

Natural disturbance. This include events such as avalanches; water erosion; land/rock movement; fire; blowdown; frost-heaving; wind-scouring; and insects and disease. Little is known about these events and their specific relationship with this species. *M. coloradoensis* populations in alpine areas with scattered tree cover and minimal fuels are less likely to be affected by blowdowns or fire than populations at lower elevation sites within forested areas. The type, size, frequency, and intensity of disturbances that define the natural disturbance regime are unknown. At lower elevations, *M. coloradoensis* is typically found in open areas outside of tree stands, and fire may play a role in maintaining these open areas by reducing competition from tree seedlings and tall grasses.

Global climate change. Global climate change is likely to have wide-ranging effects in the future. Projections based on current atmospheric CO₂ trends suggest that average temperatures will increase while precipitation will decrease in Colorado. Temperature increase could cause vegetation zones to climb 350 feet in elevation for every degree Fahrenheit of warming.

It is unclear how *M. coloradoensis* would respond to warmer temperatures. Climate change effects to arthropod populations, both beneficial and detrimental to *M. coloradoensis*, cannot be predicted. The importance of either specific or general pollinators to *M. coloradoensis* sustainability is unknown.

Atmospheric nitrogen deposition (of both organic and inorganic forms) is increasing worldwide. Relatively low levels of nitrogen enrichment are advantageous to some species but deleterious to others, making it difficult to predict species- and community-level responses. [primary source: Beatty *et al.* 2004].

Overall, based on current information, threats to *M. coloradoensis* are considered relatively low. However, this should be tempered with the high number of unknowns about this species.

6. Key ecosystem characteristics and ecological conditions for recovery, conservation, and viability:

NatureServe (2015) indicates that some (13-40) of the known occurrences of this species across its range are rated good³ for viability. It remains important to maintain the current populations that exist on the RGNF. Fortunately, at the present time, all threats appear to be at a relatively low level.

The RGNF should strive to maintain habitat conditions for *M. coloradoensis* by applying suggested management practices as follows:

- 1) Manage habitat. Manage and adjust/reduce, where needed to protect populations, pressures from any management influences (see section 5) found to be creating unacceptable impacts.
- 2) Manage environmental stressors. Continue assessing the RGNF's contribution to global climate change and adaptively adjust actions where permissible within the Forest Service's legal and

³ Good Viability: Size: 200 or more individuals (based on available EOR data). Condition: the occurrence should have a good likelihood of long-term viability as evidenced by the presence of multiple age classes and evidence of flowering and fruiting, indicating that the reproductive mechanisms are intact. Anthropogenic disturbance within the occurrence is minimal. If exotic species are present, they comprise less than 10% of the total ground cover.

regulatory authority. Use tools such as the Forest's Climate Change Scorecard to assess impacts and make positive changes where needed. Reductions in the RGNF's contribution to global climate change should benefit *M. coloradoensis*.

7. Key uncertainties and information needs/gaps:

To begin a discussion of uncertainty, it is relevant to assess the overall risk to the habitat at a very broad scale. The CNHP characterizes *M. coloradoensis* as occurring primarily in alpine habitat. Alpine habitats account for about 3% of Colorado's landscape. At a very coarse landscape scale, alpine habitats are considered to be effectively conserved in Colorado (Rondeau *et al.* (2011)). The likely dominate potential threat to alpine plants at this broad scale is predicted to be global climate change (Neely *et al.* 2009; Rondeau *et al.* 2011). However, *M. coloradoensis* occurs over a broader range of habitat than just alpine. Threats across the habitat range of this species on the RGNF were judged to be relatively low. Neely *et al.* (2009) and Rondeau *et al.* (2011) evaluated the overall conservation status of *M. coloradoensis* and rated it as "effectively conserved." As a whole, habitats of *Machaeranthera coloradoensis* do not appear to be at immediate risk or severely threatened by consequences of current land management.

The viability of *M. coloradoensis* is difficult to ascertain because the full distribution and abundance is unknown, demographic parameters have not been studied, and the effects of management activities have not been studied. Many populations have not been observed for over 20 years.

Based on the few available data, it appears that population numbers are not declining, and new populations have been discovered in recent years. Johnston (2002) noted that habitats of this species appear to be stable in size and quality and to be fairly resilient to grazing and some trampling. While this species appears to be persisting under current natural disturbance regimes and with current levels of recreation and management activities, it is difficult to predict its ability to tolerate environmental stochasticity in the future (e.g., global environmental changes, drought, or invasive species) and any significant future management changes (e.g., livestock grazing, natural resource development, or prescribed burning).

Based on data collected, it would be difficult to conclude that the distribution or abundance of *Machaeranthera coloradoensis* is declining or expanding throughout its range. The rate at which this species disperses and colonizes new locations is unknown, and little is known of its dispersal and establishment capabilities.

The lack of information regarding the basic biology, colonizing ability, vegetative and sexual reproductive potential, or genetic variability of *M. coloradoensis* makes it difficult to pinpoint the biological or ecological characteristics important for long-term persistence of this species.

The primary keys to further understanding *M. coloradoensis* are as follows: identifying high-quality populations and populations that may be immediately threatened; surveying for new populations; understanding the effects of management activities; and studying basic biological traits. The following types of studies would supplement basic knowledge regarding this species:

- Re-location and detailed mapping and inventory of existing populations,
- Identification of high-quality populations and habitats,
- Surveys for new populations,

- Identification of any imminent threats to known populations,
- Identification of disturbance types, frequencies, and intensities; especially as related to management activities,
- Microhabitat characterizations and measurements,
- Studies related to reproductive biology, including pollinator surveys, germination trials, vegetative reproduction, mycorrhizal associations, and seedbank analyses,
- Identification of possible causes of individual plant mortality (e.g., herbivory, parasites, diseases), and,
- Genetic analyses to assess gene flow, variability, and possible hybridization throughout range.

[primary source: Beatty *et al.* 2004].

The following is an outline of a monitoring approach that could be used to inform the development of the RGNF Forest Plan revision's monitoring plan. Additionally, areas of research opportunity (beyond the scope of the Forest Plan revision) are suggested below based on key uncertainties about this species.

- 1) Monitoring: monitoring priority is a judgment determination based on number of occurrences, potential threats, and conservation status. The priority for this species is thought to be low. This is primarily due to the status being G3/S3 (see Table 1) and the threats to this species on the RGNF being judged low. Existing management practices are not known to be causing detrimental impact. However, only limited search effort and monitoring have been conducted so individual occurrences may be vulnerable to unforeseen impacts. Therefore, monitoring is suggested as follows:
 - a. Search for and document new species occurrences found on the Forest. Ensure that additional occurrences are recorded in the appropriate electronic database. Also record negative search results in an appropriate electronic database to track habitat that has been searched. Additional occurrences increase the odds in the confidence of assessing population viability, especially with greater geographic separation (e.g., finding occurrences within and outside its known range). Finding additional occurrences helps inform whether additional monitoring is needed and at what intensity.
 - b. Monitor known element occurrences to document presence/absence. Evaluate each occurrence, subject to available funding. Visually document the same populations every 5-7 years (twice in a planning cycle). Consider enlisting an organization such as CNHP to help develop a rapid monitoring technique that is meaningful for trend analysis but is easy to establish and simple to evaluate.
 - c. Make visual observations to assess if any impacts (threats) are occurring to known occurrences. Assess the type, source, frequency, and magnitude of the impact. Develop a strategy at the appropriate time for mitigating impacts (eliminate, move, delay, or reduce the impact).
- 2) Research:
 - a. Reproductive biology, autecology, and demography. There are many unknowns about this species' life cycle suggesting numerous areas of potential research. Relationships

with pollinators and arthropods are largely unknown (see Beatty *et al.* 2004 for a detailed discussion).

- b. Genetics. Genetic stochasticities are unknown. An accurate estimate of this species' genetic vulnerability is unknown.
- c. Disturbance. There are unknowns about the role and types of disturbance and their possible affect on *M. coloradoensis*.
- d. Environmental uncertainty:
 - i. Continue and/or expand studies on the effects of air pollution on alpine and lower elevation grassland and talus/rock environments; effects to their associated plant communities; and effects specifically on *M. coloradoensis*.
 - ii. Continue and/or expand studies on the effects of global climate change on alpine and lower elevation grassland and talus/rock environments; effects to their associated plant communities; and effects specifically on *M. coloradoensis*.

8. Key literature:

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USDA Forest Service. 2013. Threatened, endangered and sensitive plants and animals. Supplement No. 2600-2013-1, Forest Service Manual 2600, Chapter 2670. Rocky Mountain Region (Region 2), Denver, Colo. Effective August 24, 2013. 21 pp.

USDA Forest Service. 2015. RGNF GIS data. Unpublished data available from the Supervisor's Office, Rio Grande National Forest, Monte Vista, CO. Date of access: May 2015.

USDI Fish and Wildlife Service (USDI FWS). 2015. *Machaeranthera coloradoensis*. Online access to determine status/rank. Available: <http://www.fws.gov/endangered/> Date of Access: May 2, 2015.

9. Envirogram:

An envirogram is not available for this species.

10. Map of Known Occurrences:

Figure 1 shows the known occurrences of *Machaeranthera coloradoensis* on the RGNF.

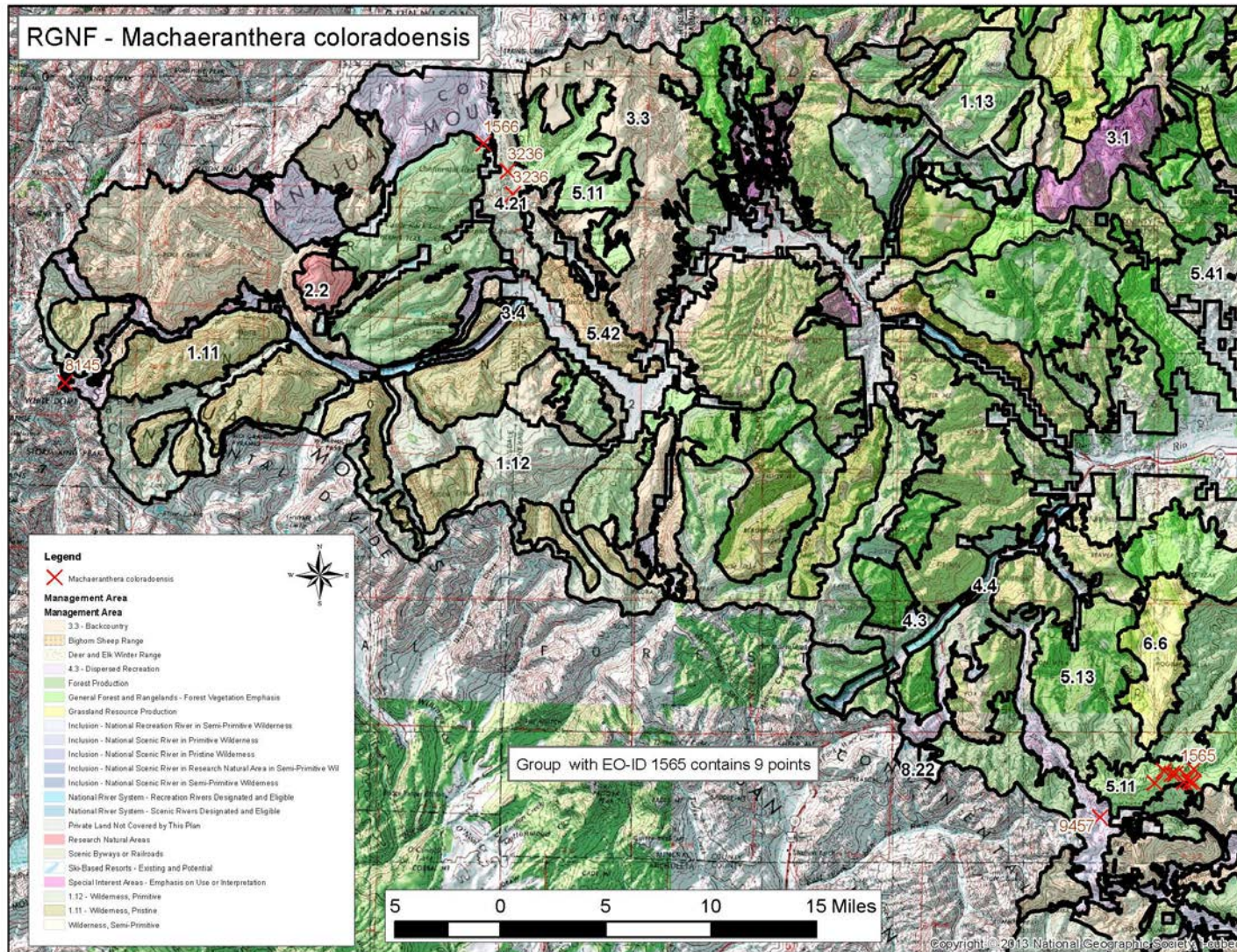


Figure 1. *Machaeranthera coloradoensis* occurrences on the RGNF. [source: USDA Forest Service 2015].