

Monitoring Report

MESA VERDE CACTUS
(Sclerocactus mesae-verdae)

1986 – 2014



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INTRODUCTION

Mesa Verde cactus (*Sclerocactus mesae-verdae*) was listed as a threatened species under the Federal Endangered Species Act in 1979 (44 FR 62471). The primary reasons for listing included illegal collection, highway construction, and off-road vehicle use.

Mesa Verde cactus is endemic to the Four-Corners Region of northwestern New Mexico and southwestern Colorado. The total range of this species is an area of approximately 75 x 30 miles, stretching from near Naschitti in southern San Juan County, New Mexico to about 10 miles north of the New Mexico border in Montezuma County, Colorado. Distribution within this range is sporadic and widely scattered. At least 95% of the total Mesa Verde cacti occur on tribal lands, primarily on Navajo Nation lands in New Mexico. North of Waterflow, New Mexico, Mesa Verde cactus occurs on small blocks of BLM and State Trust lands. Small numbers of cacti also occur on a Public Service Company of New Mexico (PNM) and private lands.

Mesa Verde cactus habitat occurs within the Colorado Plateau subdivision of the Great Basin Desert floristic region. The region is characterized by low variable annual rainfalls, averaging 7 inches in Shiprock, NM (WRCC 2015). The topography is eroded badlands of numerous small dry drainages between low hills and ridges at elevations between 4,800 and 6,560 ft. The majority of the occupied habitat consists of Mancos Shale which is a silty sediment of marine origin that is highly alkaline and saline. A relatively small portion of the total habitat occurs on the east side of the Farmington Hogback near Waterflow, New Mexico on Fruitland Shale which is fluvial in origin. This shale is highly sodic and also contains obvious quantities of selenite gypsum.

Vegetation cover in Mesa Verde cactus habitat is sparse and has the appearance of a nearly barren badland. It is most frequently associated with low-growing species of saltbush (*Atriplex cuneata*, *A. corrugata*, *A. confertifolia*). Other woody associates are *Artemisia spinescens* and *Frankenia jamesii*. Grass cover is typically sparse, but can include *Hilaria jamesii*, *Sporobolus cryptandrus* and *Oryzopsis hymenoides*. Herbaceous annuals can be common during wet years and entirely absent during periods of drought.

Mesa Verde cactus can reach an age of 20 years or more. Individual cacti reach reproductive maturity at 2 - 3 years of age, although some seedlings becoming established in difficult microhabitats may take longer. Flower buds begin to swell in early April and bloom during late April and early May. Fruits mature in late May and through June. Number of flowers and success in fruit-set are strongly correlated to size and condition of the individual plant.

Long term demographic monitoring has variously occurred on BLM lands, Navajo Nation and Ute tribal lands (Coles et al. 2012, Cully et al. 1993, Hazelton 2011, Kendall 2010, Roth 2004 & 2008, Sivinski 1999, 2003, 2007).

STUDY AREA AND METHODS

The Waterflow monitoring plot was established on BLM land north of Waterflow, New Mexico in 1986. This plot was monitored every spring for 10 years (1986-1995). Thereafter infrequent monitoring was accomplished in 1999, 2003, 2007, and 2014 by the New Mexico Forestry Division and BLM staff.

The monitoring plot is located on silty shale of the Fruitland Formation which is a sparsely

vegetated, almost barren badland of low ridges and dry drainages. The perennial vegetation provides only 6% ground cover and is mostly composed of low-growing species of saltbush (*Atriplex cuneata*, *Atriplex corrugata*, *Atriplex confertifolia*).

The plot is a 100x200 meter rectangle with a grid of steel rebar stakes along the margins. In 2014 the plot was monitored on May 15. In previous monitoring years individual cacti were located by triangulating surveyor tapes from two assigned stakes. Individual cacti were tagged with rectangular numbered aluminum tags. Since the last monitoring took place in 2007 the majority of these tags was either gone or no longer readable which made relocating previously documented cacti challenging. In 2014 surveyors walked evenly spaced transects throughout the plots and flagged each cactus found. Individual plants were then mapped with a GPS and tagged with a round individually numbered metal tags.

Data collected for each cactus included stem diameter, reproductive status (number of flowers and/or fruits), number of stems, and condition. Condition was evaluated by assigning a vigor rank (1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = dead).

RESULTS

Mesa Verde cactus density in the Waterflow, New Mexico plot was relatively low in 1986 when the plot was established (Figure 1, Table 1). The plot population began to trend upward in (except 1990) and was fairly large during the early years of the 1990s until it reached another low point in 1995. The yearly total number of Mesa Verde cactus in the Waterflow plot has fluctuated since 1986, last 21 years, but reached its highest density of 235 cacti in 1999 (Figure 1, Table 1). This is probably due to the very favorable year of 1997, which received 11.45 inches of precipitation, followed by another above average rainfall year in 1998 (from weather station at adjacent San Juan Coal Mine). Most of the cacti in the 1999 plot population were juvenile, non-flowering individuals (Tables 1 and 2). A similar favorable precipitation year occurred in 1990 followed by several years of normal rainfall, which correlates positively with an increase in cactus density within the plot after 1990. The low density year of 1990 followed an especially dry period in 1989, which was a year receiving only 3.82 inches of precipitation. The very low density year of 1995 cannot be explained by the precipitation data. Many dead cacti were found in the plot that year and are assumed to have been killed by the longhorn cactus beetle (*Moneilema semipunctatum*), a frequent native predator of cacti.

The population crash observed in 2003 also followed an extremely dry period with only 2 inches of precipitation from September 1, 2001 to August 31, 2002. Only 26 of the 235 individual cacti found in May 1999 were still alive in April 2003 and the total population had decreased from 235 cacti in 1999 to 74 in 2003. The dead cacti were hollowed-out and most of the surviving cacti had damaged, chewed-up stems, presumably by longhorn cactus beetle or army cutworm (Lepidoptera) predation in 2002. The population appeared to be recovering in 2007, when 113 cacti were found in the monitoring plot. However, only 48 cacti were located in 2014.

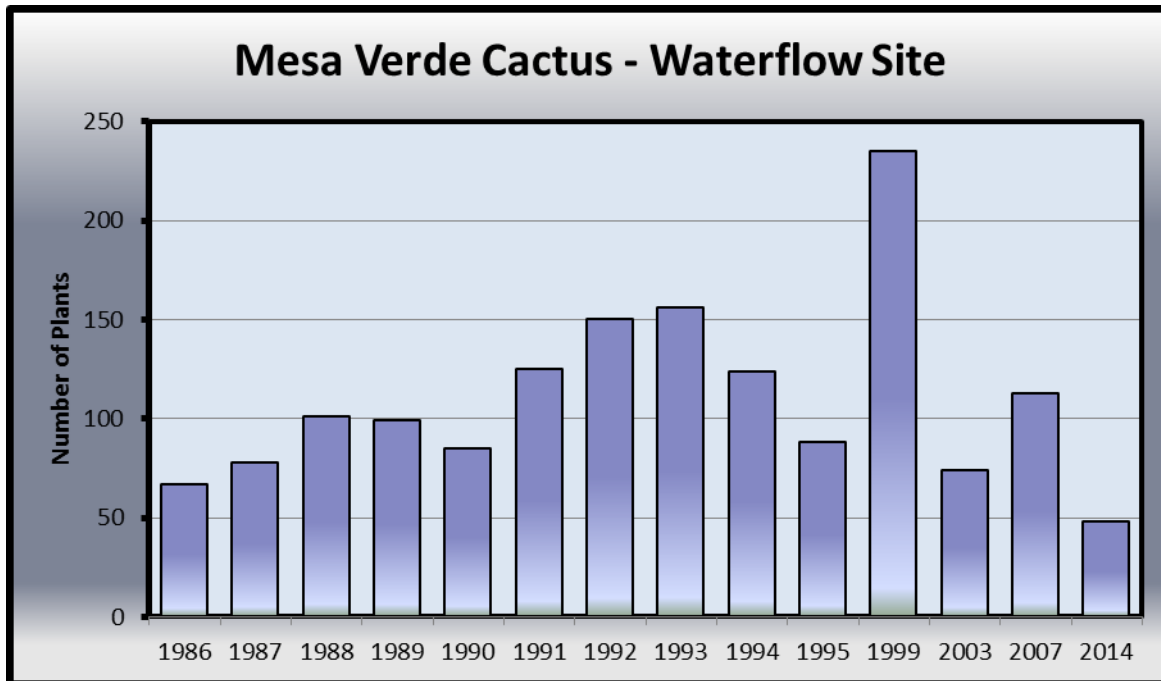


Figure 1. Number of Mesa Verde cacti located in the Waterflow monitoring plot between 1986 and 2014.

Density within size classes also varied greatly over the study period (Figure 2). Mesa Verde cactus size is often indicative of relative age. Cacti that are 2 cm or less in diameter are juvenile seedlings. They can (but seldom do) begin to produce flowers at a young age when the stems are about 2.0 cm in diameter. They begin to regularly produce 1- few flowers at the 4-6 cm stage, but the large cacti (>6 cm or multistemmed) produce the greatest per-plant number of flowers (up to 27/plant). Reproductive effort varies greatly from year to year and is associated with rainfall. The lowest reproductive effort was recorded in 2003, when only 9 % of the plants inside the monitoring plot were flowering or fruiting (Table 1). The largest reproductive effort was recorded in 2014 when 94% of the population was flowering or fruiting.

Table 1. Reproduction efforts of *Sclerocactus mesae-verdae* at the Waterflow, New Mexico monitoring plot.

Year	Number of Cacti Reproductive	Percent of Population Reproductive
1986	42	64%
1987	54	73%
1988	51	67%
1989	66	67%
1990	48	58%
1991	102	82%
1992	116	83%
1993	108	76%
1994	92	76%
1995	81	88%
1999	51	22%
2003	7	9%
2007	54	48%
2014	45	94%

The numbers of seedlings detected in this plot can vary greatly depending on precipitation or the keenness of the observers, or both (Figure 2). Unfortunately the monitoring plot is very large, making it difficult to detect the small cryptic cacti, especially seedlings, juveniles, and small non-flowering plants. Adult cactus density was generally more stable until 2003 when nearly all large cacti were killed by insects. The majority of the plot population is usually medium-sized plants (2.1-6.0 cm)(Figure 2). Only the years 1993 and 1999 had the seedling class at greater densities than the next larger size class. Only one seedling/juvenile plant was documented in 2014 (0.2 – 2.0 cm in diameter).

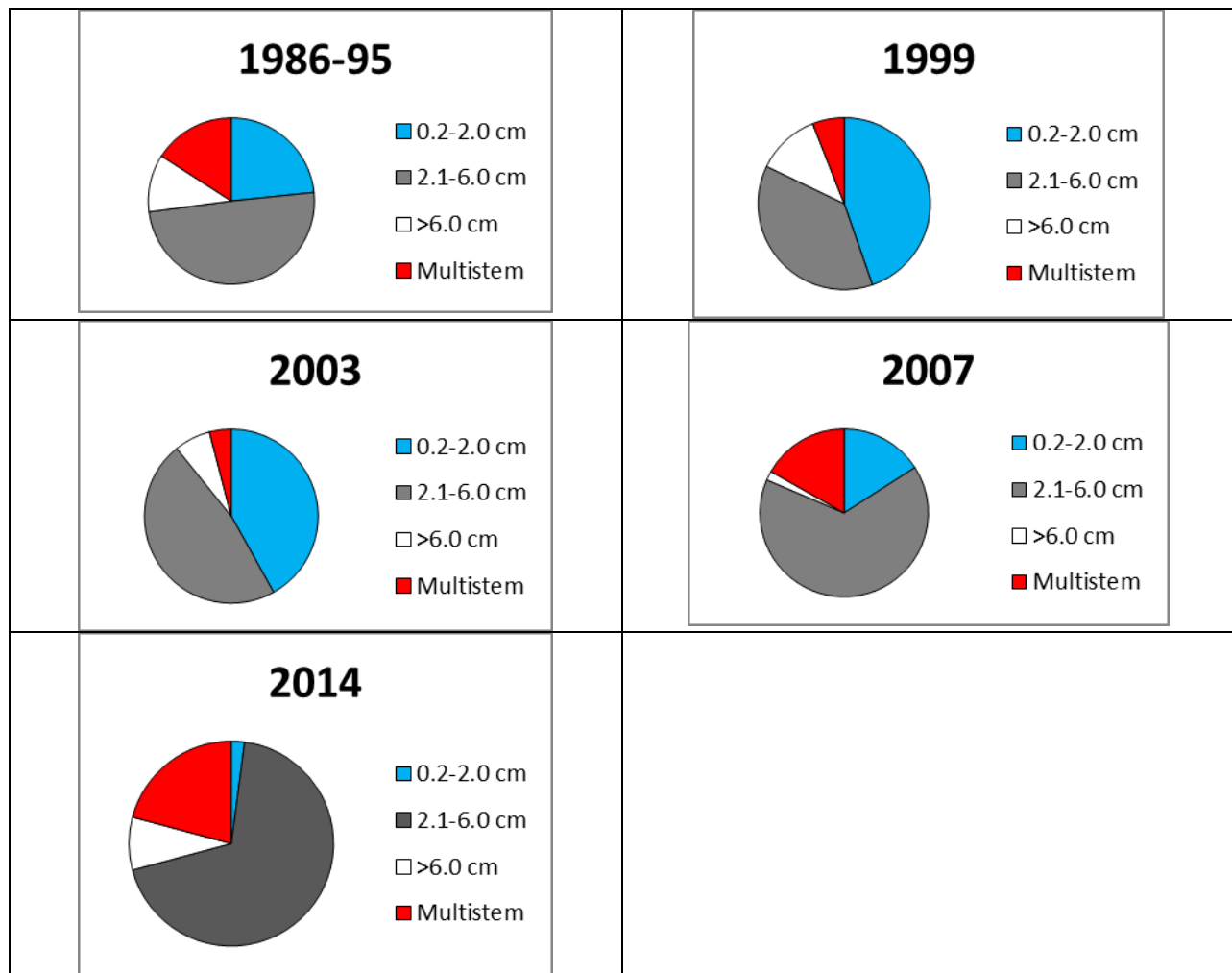


Figure 2. Size class distribution of Mesa Verde cactus between 1986 and 2014 at one monitoring site near Waterflow, NM.

In 2003 all data sheets were reexamined for causes of mortality in this population (Sivinski 2003). Usually the cause could not be determined. From 1986 to 1999, the dead remains of the monitored cacti could only be found 35% of the time. Usually no remains were located. Only three instances (1987, 1994 and 1995) when holes in the ground or crumpled tags were found suggested that one or a few cacti had been removed by cactus poachers. The 2003 monitoring year was different. The dead remains of 76% of the cacti that had died since 1999 were still visible and assumed to be victims of insect predation during the summer of 2002. In 2014 vigor of individual plants was recorded. The majority of plants were found in good to excellent condition (Figure 3). No plants were found in poor condition or dead.

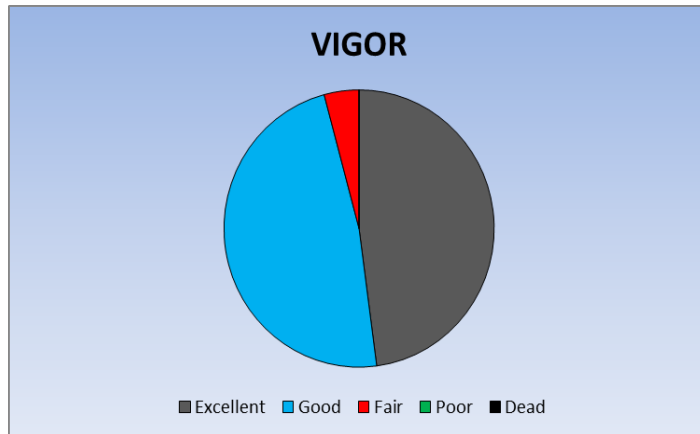


Figure 3. 2014 vigor of Mesa Verde Cactus at the Waterflow monitoring plot in San Juan County, NM.

The longhorn cactus beetle (*Moneilema semipunctatum*) is a native predator of cacti, typically on species of *Cylindropuntia* and *Opuntia*. However, more recently this beetle has been observed to use various species of *Sclerocactus* as an alternate host (Woodruff 2010). The larvae of these beetles burrow into the stem of the cactus and pupate in the cactus and emerge as adults in the summer. The caudex of a beetle-damaged Mesa Verde cactus can survive for period of months and even initiate new stems, but the majority eventually dies from desiccation or secondary infections. Army worms (moth larvae) were also found in the dead stems of Mesa Verde cactus in 2003 (Barney Wagener, BLM-Farmington District, pers. comm. 2003).

The 2002-2003 insect kill of Mesa Verde cactus has been the most extreme during the 28 years this plant's populations have been monitored. Monitoring plots on BLM lands near Waterflow, New Mexico had mortality rates of 68.5% (this study) and 97.1% on another BLM plot (Barney Wegener and John Kendall, BLM-Farmington District, 2003). Similar declines were noted in 2003 on the Navajo Nation in New Mexico and the Ute Mountain Ute Reservation in Colorado (Daniela Roth, Navajo Natural Heritage Program, pers. comm., 2003).

CONCLUSIONS AND RECOMMENDATIONS

Although the Mesa Verde cactus population at the Waterflow plot has been shown to fluctuate, the population has not recovered since the 2002 extreme die-off was documented in this and other monitoring sites. Recruitment is episodic and related to periods of favorable precipitation. The greatest mortality event at the Waterflow population and other monitoring sites was documented in 2003 and was the result of insect predation during 2002. No dead plants were found in 2014, indicating that plants died several years prior, possibly during the drought years of 2009 and or 2012. It is possible that some smaller, non-flowering plants were missed in 2014 because the majority of tags were missing or no longer associated with plants (pulled out of the ground). However, it is also possible that the population is in decline as a result of prolonged drought conditions and a diminishing seed bank as reproductive adults have declined over the past 15 – 20 years. Population fluctuations maybe be natural for Mesa Verde cactus but may also

indicate a slow decline in response to unprecedented and prolonged droughts associated with global climate change.

To better understand the decline of this population and gain a better understanding of overall population trends on BLM lands, monitoring of this plot needs to be more frequent and take place at a minimum of every 1-2 years. Once a better understanding of the cause of decline is gained, management actions and conservation measures can be developed to address and hopefully halt a continued decline. Management actions may include additional protection measures, population augmentation, reintroductions, ex-situ conservation through seed storage, additional studies to research causes of decline (pollinator availability, pollination success, seed banking, inbreeding depression, predation), and rangewide surveys to document the current abundance and distribution of the species.

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REFERENCES

- Coles J. J., K.L. Decker, and T.S. Naumann. 2012. Ecology and population dynamics of *Sclerocactus mesae-verdae* (Boissev. & C. Davidson) L.D. Benson. *Western North American Naturalist* 72(3): 311-322.
- Cully, A., P. Knight, R. Sivinski, M. Olwell, D. E. House, and K. Lightfoot. 1993. Preliminary results from a long-term study of Mesa Verde cactus (*S. mesae-verdae*). In: Proceedings of the Southwestern Rare and Endangered Plants Conference – 1992. R. Sivinski and K. Lightfoot (eds.), pp. 108-120, Misc. Publ. No. 2, New Mexico Forestry and Resources Conservation Division, Santa Fe.
- Hazelton A. F. 2011. Mesa Verde Cactus (*Sclerocactus mesae-verdae*)10 Year Transplant Monitoring Report -Shiprock Fairgrounds 2001-2011. Unpublished report prepared for the Navajo Natural Heritage Program, Department of Fish & Wildlife, Window Rock AZ, 86515
- Kendall, J. 2010. Bureau of Land Management Hogback ACEC Mesa Verde cactus plot data and status updates. Excel database received by the USFWS, May 3, 2010. Bureau of Land Management, Farmington, New Mexico.
- Ladyman, J. 2004. Status Assessment Report for *Sclerocactus mesae-verdae* (Mesa Verde Cactus). Prepared for: The Navajo Natural Heritage Program, Window Rock, AZ.
- Roth, D. 2004. Monitoring Report: Mesa Verde cactus transplantation for BIA Route N57 – Cudei Rd, San Juan County, NM. Navajo Natural Heritage Program.
- Roth, D. 2008. Monitoring Report: *Sclerocactus mesae-verdae* transplant project - Northern Navajo Fairgrounds, Shiprock, San Juan County, NM. Navajo Natural Heritage Program.
- Sivinski, R. 1999. Mesa Verde cactus: A fourteen-year demographic summary of the Waterflow, New Mexico study plot. New Mexico Forestry Division - Energy, Minerals and Natural Resources Department, Santa Fe.
- Sivinski, R. 2003. Mesa Verde cactus: An eighteen-year demographic summary of the Waterflow, New Mexico study plot. New Mexico Forestry Division - Energy, Minerals and Natural Resources Department, Santa Fe. Unpublished report prepared for the U.S. Fish and Wildlife Service.
- Sivinski, R. 2007. Mesa Verde cactus: a twenty-one year demographic summary of a Waterflow, New Mexico study plot. New Mexico Energy, Minerals, and Natural Resources Department, Santa Fe, New Mexico. Unpublished report prepared for the U.S. Fish and Wildlife Service.
- USDI-Fish & Wildlife Service 1984. Mesa Verde cactus (*Sclerocactus mesae-verdae*) Recovery Plan. Region 2, Albuquerque, NM.

USDI-Fish & Wildlife Service. 2010. Mesa Verde Cactus *Sclerocactus mesae-verdae* (Bossevain & C. Davidson) L. Benson.5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Albuquerque, New Mexico

Western Regional Climate Center. 2015. Accessed via <http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm8284> on January 14, 2015.

Woodruff, D. 2010. The cactus and the beetle. *Sego Lily* Vol. 33: 3.