

Moss Bed Study

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Prepared for
Resource Management

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Background Information

This cave monitoring project was started the summer of 1994, to study the effects of people disturbing moss beds at the entrances to caves in the Monument. The study sites are located at three caves in the El Malpais National Monument. This study is being conducted to find ways to protect the moss beds. It is also to find alternatives ways to continue use of caves by people and the continual growth of fragile moss beds.

Many lava tubes in El Malpais contain fragile moss beds. Normally, not found in such a dry climate, the combination of cool environment, with a moisture provide a suitable habitat for moss. The moss is found primarily in an area with a light source, usually the mouth of caves, a cave skylights or trenches.

The moss beds of each cave possess different types of life, such as, microorganisms, fungi, lichens, insects and of course different types of moss.

Reason for Study

Many people/visitors do not realize that by walking through the moss beds instead of around them, causes damage to the fragile life of this habitat. Previous studies show most damage is caused by **Humans/visitors** walking on the moss beds. So with the Monument receiving more visitors each year it is important to monitor and study the damage and find ways to lessen the impact on moss beds.

The purpose of this study is to obtain data regarding the impact on three different caves. The sites are set up in three different locations. The two control sites are in Frozen Mat Trench and the two research sites are in Four-Window and Navajo Ice Caves. The monitoring process is to be on going. These sites should be monitored at the end of July or during August each year.

Location of Study Sites

1. The control sites in Frozen Mat Trench, are located in the bottom of the trench in a spot appears to contain the same amount of debris as Four-Window Cave. The entrance to the area is marked by a dead log laying across the trench. Once in the trench, the first control site is on your right 30 yards down the trench. The second site is on your left 30 yards up the trench. The grid placement is marked with metal identification tags at two ends of the grid and each tag is marked with the site name and the numbers 7 and 49. The grid is placed over the markers with the number 7 and 49 lined up over the metal tags each marking the top right and

bottom right of the grid. This is done so that each year the same area is photographed for comparison.

2. Two study sites are found in Four-Window Cave. The first is found on the low point of the moss bed on the east side of the cave. The nails and metal tags are placed at the corner location as in the control cave. Both nails and tags, with site name and numbers 7 and 49 are on the right side. The second site is found further up on the rubble mound from the first moss bed, on the west side. The nails and metal tags, with the site name and numbers 7 and 49 are on the right side.
3. The fourth and last research site is in Navajo Ice Cave. It is at the mouth of the cave on top of a large "table boulder." The nails and metal tags with the numbers 7 and 49 are on the right side and correspond to the grid. One is placed on the rock at the top and is number 7 and the other nail and tag are below the rock and has the number 49 on it.

Tools Needed for Study

The grid used for the project is made of PVC pipe. It measures 49 inches by 49 inches (thus, it is a square). Written on the PVC pipe at each corner are the numbers 1, 7, 43, and 49 and on the cross pieces of pipe are marked "top" and "bottom". The grid is split by parachute cord and consists of 49 squares, measuring 7" x 7" each. The parachute cord and PVC pipe are marked (in red) at one inch increments to allow for the size comparison from previous years of study. 35mm camera with flash and 35mm lowlight high speed film.

Temperature and Relative humidity gauge.

You will need paper tabs indicating the grid locations and the sections of the grid are as follows: 37, 33, 17 and 12. Pictures are taken of the whole grid and each number section of grid as previously stated. This is done at each location to insure consistency and to avoid confusion. As the researcher may be different each year, and have no knowledge how and what was done in previous years of the study.

Project Study Results for July & August 1998.

Research for July 29 and August 10, 1998

As advised by the cave monitoring projects completed on July 31, 1994, August 6, 1995 and August 1, 1996, the procedures to photograph the moss beds and observe the cave conditions were followed on July 29 and August 10, 1998.

The first cave observed was Navajo Ice Cave. Observers were Robert Alexander and Mellisa Peterson, went to this location and set and lined up the grid with the

nails and metal tags. Once the grid was in place, photos were taken and observations were recorded.

Navajo Ice Cave:

Temperature = 50.6 °F Relative Humidity = 57%

Photo # 37 = Bare rock on 20% of the grid, 10% green lichen, 70% green moss, 50% moss increase from last year. New growth of about ½ to 1 inch high shows the moss it will recover, as shown, if people stay off.

Photo #33 = Bare rock on 40% of the grid, 5% green lichen, 5% debris, 50% green moss with new growth. The moss shows signs of disturbance as shown in photograph, but did not cause severe damage to moss. There is a noticeable increase in moss growth since last year, due to fewer people stepping on moss bed area. If people are kept off the moss bed, this area will fully recover, as evident from years 1995, 96 and 97 where there has been an increase of moss growth.

Photo #17 = 30% bare rock, 5% green lichen, 5% debris, 60% green moss and it shows new growth. The green moss has stayed the same since last years and is approximately ½ to 1 inch tall and is recovering.

Photo #12 = 15% bare rock, 5% green lichen, 5%debris, 75% green moss, there is an increase of moss from last year and the green moss is ½ to 1 inch long and is recovering.

Whole Grid = Moss is in good shape with signs of new growth on the upper half of grid and between side 7 and 49 with one bare spot showing. There is a bare spot between 43 and 49. This grid showed signs of new growth in the middle over some bare rock areas from last year. But there are still some signs of people walking on the moss beds.

Overall = If visitors stay on a marked trail these moss beds will thrive and show new growth. (Also if people left the flagging alone to show the trail past the moss bed to NIC, the moss beds will remain protected. The flagged trail marked by Schulz and Alexander, summer 1997, was removed. New flagging was put up by Alexander and Peterson, summer 1998.)

Four-Windows Cave: Lower Garden

Temperature = 45.0 °F Relative Humidity = 70%

Photo #37 = 4% bare rock, 5% debris, 1% lichen, 90% green moss about ½ to 1 inch tall and its growin. There is an increase of about 30% new moss compared to last year. This shows that if people stay on

the marked trail the moss will recover.

Photo #33 = 40% bare rock, 10% bare ground, 5% debris and 45% green moss, there is a slight decrease of moss in this grid. But of the moss there its in real good shape and is about ½ to 1 inch high. I believe over time this area will recover.

Photo #17 = 95% moss, 5% debris, there is a large increase of moss from last year of about 65% and is in good shape and is about ½ to 1 inch thick. This is due to the fact of people staying on the marked trail. If people stay on the trail this show that the moss will recover

Photo #12 = 95% moss, 5% debris, there is an increase of about 55% moss from last year, and its in real nice shape and is about ½ to 1 inch tall. This shows that if people stay on the marked trail that the moss bed will recover.

Whole Grid = Because of the roped off area being more stable, people are staying off the moss beds and following the marked trail, we have increase in moss over the whole grid. This shows that if people stay on the trail and off the moss beds that they will recover.

Overall = The roped off area is preventing visitors from walking on the lower moss bed. The moss garden is showing no signs of disturbance and moss growth continues to increase on an annual. At the present rate of growth, moss bed area will completely recover.

Four-Windows Cave: Upper Garden

Temperature 49.7 °F Relative Humidity = 74%

Photo #37 = 100% bare rock. There was a decrease of 10% moss compared to last year. This grid did show signs of recovery last year (1997), but no signs of new growth are visible this year (1998). There is no evidence of people walking on it.

Photo #33 = 15% bare rock, 5% lichen and debris, 80% moss. This grid shows an increase of 5% new moss over the grid and is in good shape with new growth ½ inch thick and thriving.

Photo #17 = 25% rock, 15% lichen, 60% brown and green moss. The new moss is in good shape and is ½ inch thick. There is an 20% decrease of moss in this grid from last year.

Photo #12 = 20% bare rock, 5% debris, 40% dog lichen, 35% moss green and brown. This grid contains one type of moss and one type of lichen, this is a correction from last year(1997). The lichen is dog lichen and is growing over half of this grid. The moss is in good shape and shows signs of new growth and is about ½ thick.

Whole Grid = The pictures show that by visitors staying behind the ropes there are signs of new growth and the moss is in good condition. But there is an increase of dog lichen over the whole grid this could become a concern in the future

Overall = This moss bed is growing well due to good moisture and sunlight as well as the posting of interpretive signs and roping off the area to keep visitors off.

Frozen Mat Trench Control Site #1

Temperature = 44.0°F

Relative Humidity = 63%

Photo #37 = 55% green moss, 20 % rock with brown moss, 10% bare rock, 10% debris, 5% lichen. There is an increase of about 5% new moss and in good shape and the moss is about ½ to 1 inch thick.

Photo #33 = 60% green moss, 20% bare rock, 10% lichen, 10% debris. There is an increase of about 10% new moss since last year. The moss in this grid is in good shape and is ½ inch thick

Photo #17 = 40% bare ground, 10% bare rock, 5% debris, 45% green moss. There is an decrease of moss from last year of about 35%. The moss present it is in good condition and shows signs of growth and is ½ to 1 inch thick.

Photo #12 = 65% rock with small amount of moss growing over the rock, 35% green moss. Counting the new moss growing over the rock there is an increase of moss in this grid and its in good shape and is about ½ to 1 inch thick.

Whole Grid = There appears to be an increase of moss within the whole grid. But there is also an increase of debris that has fallen into the trench and over the study area.

Overall = The moss bed appears to be in better shape than last year and there are different shades of green. This could be caused by the open top above the trench. Which gives it more sunlight and heat than the other moss beds in the study. However, there is also an increase of debris from the opening and in the future this

may cause some effects on the moss bed.

Frozen Mat Trench Control Site #2

Temperature = 55.7 °F Relative Humidity = 80%

Photo #37 = 40% green moss, 50% bare rock with some areas of moss growing on the rock, 5% dog lichen, 5% debris. The moss is in good shape and is about ½ to 1 inch high. The lichen shows new growth and is about ½ inch high. There is an increase of new moss from last year.

Photo #33 = 60% green moss, 25% dog lichen, 14% bare rock, 1% debris. The moss in this grid is in good shape and about ½ to 1 inch high. There is a slight increase of moss from last year and shows new growth. The dog lichen has increased about 20% and is growing good and is about ¾ to 1 inch high.

Photo #17 = 50% green moss, 40% bare rock, 5% debris, 5% lichen. There is a decrease of 10% moss from last year. However, moss that is present is growing and is about ½ to 1 inch high.

Photo #12 = 75% green moss, 15% debris, 10% lichen. There is an 5% decrease of moss from last year. But the moss present is growing and in good condition and is about ½ to 1 inch tall.

Whole Grid = This grid is in good shape and there is moss present through out the grid and shows signs of increase. Most of the new growth is about ½ to 1 inch high and in real good shape.

Overall = This is the second year of this control site and it shows signs of new moss growth throughout the site. But there is an increase of dog lichen and debris. There is also an increase erosion changes, such as fallen rock from within the trench and fallen tree debris.

Conclusions

Over the past five years, the pictures of Navajo Ice Cave moss bed show that if people are kept off the moss beds they will recover from damage caused by walking and scuffing the moss. This year's study show that only one area was scuffed up and if people stay on the marked trail the recovery process at Navajo Ice Cave will continue.

The pictures of the upper and lower moss bed gardens at Four-Windows Cave over the past four years show a very good example of what happens when people are kept off the moss beds. The northeast corner of the lower garden moss bed has recovered visibly from last year. This is due, in part, to visitors staying on the trail and behind the enclosures and following the interpretive signs. The reenforcing of the roped off areas around the moss bed gardens, has lowered the area of disturbed moss more this year and should continue if people stay behind the roped off areas. I believe it will continue to grow back if we keep the public off these areas. Educating the public on the fragile life cycle of moss, will enable the Monument to protect the moss beds for future generations.

The Frozen Mat Trench moss gardens appear to be doing fine, one problem observed is a type of lichen called dog lichen, (*Peltigera canina*) In some places within the trench and inside one of the grid this lichen is growing and it may eventual take over the whole trench. This needs to be researched to determine if this will happen or not. At present the dog lichen is confined to mostly outside the study area, but needs to be monitored, so it does not effect the overall study.

Recommendations to Be Considered

There is a type of lichen growing in Frozen Mat Trench. This invader species might take over the whole area. It needs to researched to see what type of affects this will cause if any.

A new type of barrier needs to be designed for the Navajo Ice Cave, at present there is only orange flagging marking the trail for the public to use. The trail that is marked leads the public around and through the fragile moss garden at Navajo Ice Cave. A more permanent type barrier like the one used in the Four-Windows Cave and interpretive signs warning the public as to why they should stay on the marked trail only needs to be installed at Navajo Ice Cave. After the rope enclosures at Four-Windows Cave was fixed properly and the posting of interpretive signs that has increased peoples awareness of fragile moss gardens and they are staying on the trail and off the moss beds.