Post-Blast Recovery of the Mount St. Helens Ecosystem

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Abstract

Forty-five years ago, Mount St. Helens, a long-dormant volcano, erupted. The aftermath of the tragedy presented scientists with a living laboratory to study the recovery of ecosystems affected by catastrophes. Ecosystem recovery has ramifications for the global Flood, which completely wiped away the existing Earth's ecosystems. Such a catastrophe has several overlaps with the Mount St. Helens eruption and thus gives creation scientists a window into ecosystem recovery from catastrophic conditions, such as those present during the Flood. In this paper, we examine the state of the Mount St. Helens ecosystem to determine whether it has recovered from the blast. Using species richness data from before the blast, and five subsequent time steps, we attempt to determine if Mount St. Helens is recovered, and, if so, what the implications are for the Global Flood Model as described in Genesis.

Key Words: diversity, ecosystem recovery, eruption, Global Flood Model, Mount St. Helens

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On May 18, 1980, Mount St. Helens in Washington state erupted. The eruption almost obliterated nearly 500 square kilometers around the mountain and caused ashfall miles from the blast zone, damaging standing forest that was not touched by the blast (Decker and Decker, 1981; Seymour et al, 1983). Tragically, many people were killed during the eruption. While a tragic result of our fallen world, the eruption allowed scientists to discover how an ecosystem recovers from a catastrophe. Such a recovery serves as a potential model system for recovery in the post-Flood world.

It is accepted among all young-Earth creationists that a global flood covered the surface of the whole Earth and completely reworked its topography. Some studies have been done in the aftermath of Mount St. Helens on the region's geology and with good reason (Austin, 1986; Morris and Austin, 2003; Austin, 2009; Walker, 2017). Mount St. Helens shows how the Flood might have changed the world. However, the attention of creationists has been largely focused on the geology of the region, not the biology, apart from three papers by Swenson (2018, 2020, 2021). No paper we could find has considered the question of the Mount St. Helen's ecosystem's recovery. Given that the creation model depends on rapid ecosystem recovery in the post-

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Flood world, including forming whole new plant ecosystems from seed, this question must be addressed. One study of volcanic recovery estimated roughly 2,000 years to reach full recovery (del Moral et al., 1996). The Flood was a far greater catastrophe than any volcanic eruption and, using the secularist methods, would doubtless take much longer.

Biological diversity cratered in the wake of the eruption. Even fifteen years after the eruption, satellite photos revealed many areas in the blast zone were under 20% maximum estimated cover (Lawrence and Ripple, 2000). Diversity took a corresponding dip (Crisafulli, Swanson, and Dale, 2005). Diversity was not, however, eliminated. Some species, particularly plants, survived in hollows and dips in the ground or behind ridgelines (del Moral, 2000). Areas with different exposure to mud and magma differed in how well existing organisms survived (del Moral, 1983). In one well-studied instance, a plant species, dependent on animals for dispersal, was genetically split in half, with about half the population being descended from blast survivors and the other half from outside immigrants (Yang et al., 2008). In most cases, new organisms arrived from outside the blast zone to recolonize the area (del Moral et al. 1995). However, by 2002, this had begun to change, as plants took root in the pumice plain and new communities emerged. Diversity began dropping as the ecosystem became stable (del Moral and Jones, 2002). The drop in diversity resulted from organisms well-suited to the post-volcanic landscape outcompeting earlier colonizers that may have been less-suited to the environment. Without competition, however, in the initial aftermath of the eruption, they could survive and propagate.

In the aftermath of the Mount St. Helens eruption, several regions emerged. The first of these regions was an area completely covered by volcanic pumice, aptly named the "pumice plain." Here, recovery was slow with one paper reporting a tiny number of plants living on the plain in 1988, mostly at lower elevations (del Moral and Wood, 1988). By 2010, five unique communities had been established in the pumice plain, and the plant community was becoming more homogenous (del Moral et al., 2012).

The second region was the tephra zone(s), where airborne volcanic particles settled thick enough to bury vegetation to varying depths. In these regions, recovery was also slow. Ten years after the blast, plant cover was substantially reduced in areas with extensive tephra, though some mosses thrived (Zobel and Antos, 1997). Zones with shallower tephra recovered more quickly than deeper areas, as might be expected, as it takes less time for plant roots to reach the underlying soil or for the tephra to erode to the soil level (Zobel and Antos, 1985). By 2005, areas that had been unforested had almost completely recovered, but forested areas had not (Crisafulli, Swanson, and Dale, 2005). Rates of recovery in these areas are somewhat site-specific (Fischer et al., 2019). Tephra zones also take the longest to reach 20% similarity to the original ecosystem (del Moral and Chang, 2015).

The third zone, the blowdown zone, recovered more quickly, likely because of lower eruption damage. Groundcover species survived and quickly repopulated many areas (Halpern et al., 1990). Within 26 years, plant cover had reached as high as 70% in some sites (Halpern and Cook, 2018). Tree recovery, however, was below 6% cover in most cases in the same study. Other areas created by the eruption include the lahar mudflows, where early succession was not particularly influenced by nearby tracts of vegetation (del Moral, 1998). Environments tend to move toward homogeneity over time, as a form of stabilization (del Moral and Ellis, 2004).

In this study, we combined data from these and other areas within the blast zone to determine whether the diversity within the blast zone has reached levels similar to those existing before the blast. There are two main assumptions underlying in this research. The first assumption is that ecosystem recovery depends on the ecosystem's species richness and not the restoration of the specific species that existed before the blast. Thus, for this paper, ecosystem recovery depends on total species number and not species composition. Specific species-to-species interactions that defined the pre-1980 ecosystem may not be present in the modern ecosystem, yet they can still be considered recovered.

The second assumption is that if there is no significant difference between pre-blast and modern numbers of species within taxonomic groups, then the ecosystem is recovered. This is not necessarily the case. There could be, and likely are, areas within the blast zone where recovery is not complete. This is more likely the case in the pumice and heavy tephra regions, but there may be other places as well. The data we examined was from a top-down view of the whole ecosystem and thus may well miss the fine-grain details. Given the necessity of understanding post-catastrophe recovery and the paucity of work on the topic, it is crucial to understand the current state of the Mount St. Helens ecosystem.

Materials and Methods

For this study, we used species richness as a metric to determine if the Mount St. Helens ecosystem had recovered from the 1980 blast. Species richness is a common metric used in conservation to select areas to be conserved (Lelli et al., 2019). For our purposes, we wanted to compare the community before the blast with the community afterward. Species richness provided an excellent, easily accessible metric to compare the pre-blast environment with five separate post-blast time steps.

The dataset obtained from the citizen science website *iNaturalist* (2024) represents the observations of individuals in the Mount St. Helens region. Only data considered "Research Grade" (with three or more agreeing identifications) was used. Any observation with conflicting identifications was discarded to create the most accurate dataset. The *iNaturalist* data provided the bulk of the data for the modern portion of the dataset.

This data was combined with data from an extensive literature search for any organisms from the Mount St. Helens area. A full list of papers from which this data was obtained can be found in the reference section. The data was divided into six time steps, one representing a species presence before the blast, the others at the following post-blast dates: 1985, 1990, 2000, 2010, and the present.

Data was assigned to the time steps based on information in the papers. If the data was collected in 1986 or 2009, it was assigned to the 1985- or 2000-time step, respectively, as there was no guarantee that a species present in 2009 would survive into 2010. Thus, each time step represents a range of years. Any data from 2015 onward was assigned to the present. This represents a conservative approach, given that many species are present at a past time step, before missing a later time step and reappearing in the present. It is likely that those species mostly persisted in the Mount St. Helens ecosystem but were simply not documented. However, it is more conservative to assume their absence is real and not an artifact of incomplete data.

Once the data had been obtained, the number of species present in each group at each time step was tabulated. The genus, family, and order levels were examined to determine whether species richness in the environment had recovered after the blast. Paired t-tests were then performed for each level, comparing the number of species present in each group at time step one to the other five time steps. If the Mount St. Helens ecosystem has completely recovered its diversity, there should be no significant difference between the number of species present recently and the number present before the eruption. If, however, the difference is significant, it may mean recovery is not yet complete.

Fish were excluded from the analysis as they were absent from the *iNaturalist* data. Reptiles and mollusks were also excluded because *iNaturalist* did not contain enough data for analysis. Fungi, arthropods, amphibians, and birds lacked sufficient documentation prior to the blast populations to perform statistical analysis. Plants, however, make a good proxy for other organisms as species richness among plants has a beneficial effect on numerous animal groups in both disaster-affected and unaffected sites (Barton et al., 2014).

Results

Plants

Plants provided the most data with over 560 species documented in the blast area across the six time steps. Those species reside in roughly 300 genera, nearly 100 families, and almost 50 orders (Table I). Before the blast, nearly 200 genera of plants could be found in the blast zone, set in about 70 families, and over 30 orders. Currently, over 220 genera in 80 families across 45 orders can be found in the blast zone. The resetting of the Mount St. Helens ecosystem appears to have encouraged a diversity of plant life to flourish there.

Using paired t-tests, the number of species per genus, family, and order were compared to one another. In every instance, except time step six (the

Table I. This table shows the number of plant species, genera, families, and orders split by time steps. The time steps are pre-blast, 1985, 1990, 2000, 2010, and present. The final column shows the number of each group that has been gained in the present since the blast.

	Pre-Blast	1985	1990	2000	2010	Present	Total	Group Gains Since Blast*
Number of Species	328	113	141	74	159	356	569	28
Number of Genera	197	77	98	52	108	236	300	39
Number of Families	75	32	43	27	45	84	93	9
Number of Orders	35	21	25	19	25	44	47	9

* Calculated by the following equation: present - pre-blast = group gains since blast

Table II. This table shows the p-values for species richness at each time step and taxonomic level. All values are compared to their pre-blast counterparts.

	1985	1990	2000	2010	Present
Genus	7.164e-20*	2.011e-17*	1.219e-25*	2.241e-11*	0.355
Family	2.792e-9*	1.412e-8*	3.277e-9*	2.248e-7*	0.37
Order	1.14e-5*	8.57e-6*	1.01e-5*	7.36e-5*	0.512

* denotes significance

present), the p-values were significant. This was universally true across all taxonomic levels. Species richness in the present is not significantly different than it was pre-blast, but it is significantly different for all other time steps from the blast onward (Table II).

Mammals

Mammals were much less data-rich than plants with just 65 species in 22 families and seven orders (Table III). Genera-level analysis was not conducted as only one or two genera had good data. Using paired t-tests, both the family and order levels were compared to the pre-blast numbers of species at five separate time steps. Mammalian families were significantly different than the pre-blast numbers. Mammalian orders were not significantly different from the pre-blast (Table IV).

These results are likely less-robust than the plant results due to lower sample size, and the added complication of nocturnal animals like moles and bats, which are harder to observe and thus harder to obtain data for. However, the plant ecosystem is close to fully recovered while the mammals are not. Because most animals rely directly or indirectly on plant life, the plant ecosystem would need to be in place and stable for the mammalian ecosystem to stabilize.

Amphibians

The amphibians were even more data-poor than the mammals. We were able to document just 14 species in seven families across two orders living in the blast zone at any point (Table V). These numbers are similar to those documented by Swenson (2020). Before the blast, we documented a mere 12 species in five families across both orders. As with mammals, there simply needed to be more genera with more than one species to make a genera-level analysis relevant. So, only family and order-level analyses were performed.

Using paired t-tests, the time steps were compared to the first time step individually as done above. None of the results were significant (Table VI), indicating amphibian biodiversity was not affected by the Mount St. Helens eruption. Interestingly, that matches the findings of a survey of surviving vertebrates in the blast zone, which found 11 species in the blowdown zone survived the blast (Crisafulli, Swanson, and Dale, 2005). In Table V, it is interesting to note how little variance there is between pre-blast and modern species richness. This similarity may be due to incomplete data, or it may be due to amphibians surviving better in the blast zone. The improved survival could result from a water-dependent lifestyle, eggs surviving in water, or the tendency of amphibians to shelter

Table III. The table shows the number of mammal species, genera, families, and orders split by time step. The final column shows how many of each group have been lost since the blast compared to the present.

	Pre-Blast	1985	1990	2000	2010	Present	Total	Group Losses Since Blast*
Number of Species	47	26	26	8	2	19	64	-28
Number of Genera	34	21	22	8	2	17	43	-17
Number of Families	17	13	12	6	2	12	22	-5
Number of Orders	6	5	5	5	2	4	7	-2

*Calculated by the following equation: present - pre-blast = group losses since blast.

Table IV. This table shows the p-values for species richness in mammals at each time step split by taxonomic level. All are compared to the pre-blast numbers.

	1985	1990	2000	2010	Present
Genus	N/A	N/A	N/A	N/A	N/A
Family	0.056753	0.052585	0.001532	0.001086	0.020053
Order	0.079706	0.07121	0.040903	0.036595	0.07979

during the warmer parts of the day. There is also a spatial element in that, since the data was not separated by eruption zone (e.g. tephra fall, pumice, blowdown, etc.), it is possible the trend we observe is reflective of only one area of the blast zone.

Discussion

There are obvious parallels and differences between the Mount St. Helens eruption and the Flood. The Flood completely reshaped the Earth's landscape, creating new hills, valleys, rivers, canyons, and so on. Mount St. Helens did something similar, cutting the drainage of a river system and spawning a new fork of a river (Major et al., 2000). New gullies, canyons, and valleys were formed either by runoff or by direct volcanic action (Swanson and Major, 2005). In the Flood, all air-breathing, land-dwelling organisms were wiped from the face of the Earth (Genesis 7:21–22), save those in the Ark (Genesis 7:23). Mount St. Helens, while thorough, was not quite a Flood-level disaster, as organisms did survive in the blast zone (del Moral, 1981). Further, unlike the Flood, there was a surviving bank of organisms that could migrate into the blast zone to fill the void. Thus, it is likely that the Mount St. Helens ecosystem would recover more rapidly than the post-Flood world.

Drawbacks of *iNaturalist*

Due to the nature of the sampling process, some species were likely missed. The *iNaturalist* dataset in particular suffers from two significant drawbacks. First, because not all of the identifiers are trained taxonomists, there are likely false identifications mixed into the data. This issue could be mitigated if two species in the dataset are falsely identified as each other, when both are found in the study area, for example. False identifications like these may make up a sizable percentage of false identifications. Seventy-five of the 236 genera present in plants for the modern time step are represented by more than one species. The problem is likely less severe for mammals, as the lay public tends to be more familiar with them than with plants or amphibians. False identifications could skew the dataset towards a higher number of species in the present, leading to an insignificant statistical result when the true result is significant.

The second major issue with the *iNaturalist* dataset is the natural bias people have toward things they find beautiful. People are far less likely to take a picture of a grass plant than a plant with abnormal growth (cacti), pretty flowers, or trees. As an example, in the United States, there are over 24

Table V. This table shows the number of amphibian species, genera, families, and orders split by time step. The final column shows how many of each group have been gained or lost since the blast compared to the present.

	Pre-Blast	1985	1990	2000	2010	Present	Total	Group Net Since Blast*
Number of Species	12	1	1	5	7	11	14	-1
Number of Genera	8	1	1	5	6	17	9	1
Number of Families	5	1	1	4	6	7	7	2
Number of Orders	2	1	1	2	2	2	2	0

* Calculated by the following equation: present - pre-blast = group net since blast.

Table VI. This table shows the p-values for species richness in amphibians at each time-step split by taxonomic level. All are compared to the pre-blast numbers.

	1985	1990	2000	2010	Present
Genus	N/A	N/A	N/A	N/A	N/A
Family	0.071519	0.071519	0.110552	0.375818	0.735765
Order	0.361	0.361	0.258	0.677	0.874

million observations of wild plants on *iNaturalist* that are "Research Grade." Just 604,170 or roughly 1% of those observations are of grasses, despite there being roughly 11,500 species of grass, more than most other plant families (Peterson et al., 2017; *iNaturalist*, 2024). The legumes (Fabaceae), with roughly 19,500 species (Ma et al., 2021), have more than double the number of observations despite not having double the species (*iNaturalist*, 2024). This, combined with the similarity of many grasses to the layman's eye, likely created issues with the Poaceae data. The confusion between species could have inflated the number of species present in the dataset. Meanwhile, the under-observation of Poaceae species would likely deflate the number of species, leading to a roughly balanced impact.

In the mammalian dataset, the bias is evident in a different way. Nocturnal mammals, like Chiroptera, or burrowing mammals like moles, are mostly absent from the *iNaturalist* dataset as they are harder for normal people to observe. Seven members of Chiroptera are listed in the blast area before the eruption, yet none are included in the *iNaturalist* data. Chiroptera is one of the most abundant mammalian orders, yet there are just under 36,000 *iNaturalist* observations in the U.S. (Kasso and Balakrishnan, 2013; *iNaturalist*, 2024). Given that there are nearby bat populations, it seems highly unlikely that bats have not recolonized the Mount St. Helens region. It is far more likely they have simply not been recorded in the dataset due to most observers not being out at night to photograph them. The absence of Chiroptera from the *iNaturalist* dataset likely creates a more significant result than is present, making the ecosystem appear less recovered than it truly is.

Lack of Published Papers

Data paucity cannot be entirely blamed on citizen scientists, however. Despite the golden opportunity for studying ecosystem recovery that the Mount St. Helens eruption presented, surprisingly few papers were published, and they became fewer as the eruption faded further into the past. As shown in Tables I and III, species records dropped off during the 2000- and 2010-time steps, mostly due to a lack of papers on the topic. A few long-term studies were done, but only a handful of authors participated. This lack of data, particularly at the fourth- and fifth-time steps, likely influenced recovery expectations. It is possible that, were there more data from these earlier time steps, the Mount St. Helens ecosystem might have shown full recovery in an earlier time step.

Recovery

Even with the limited data availability, the Mount St. Helens ecosystem has shown a remarkable ability to recover from a devastating local catastrophe. Within 45 years, the plant ecosystem has recovered its previous richness entirely. The mammalian and amphibian ecosystems are inconclusive, due either to the lack of data or small sample size, but show promising signs. Nevertheless, Mount St. Helens cannot be considered fully recovered as a whole ecosystem. The data needed to analyze that claim is lacking, though future surveys will allow us to assess that question. However, parts of the ecosystem are fully recovered, or close to being so. This recovery shows how resilient Earth ecosystems are in the face of catastrophe. However, more research is needed on recovering areas, particularly after floods, volcanic eruptions, and earthquakes, to see if the results from Mount St. Helens hold across all such ecosystems.

Post-Flood and Mount St. Helens Blast Comparison

While post-Flood recovery is not directly comparable to Mount St. Helens, due to the survival of some organisms in the blast zone and the presence of nearby unaffected populations, some overlap still exists. It has been 45 years since the Mount St. Helens blast and the plant population is fully recovered. It would likely have taken slightly longer on the post-flood Earth, but a one-hundred-year timeline seems reasonable. The extra time allowance is conservative, assuming viable seeds did not land in certain areas and that the post-Flood climate was unstable enough to prevent habitat stabilization. It would also allow for the growth of fully mature trees from seed and the settling of plant diversity in the region. However, there would likely have been regional variations depending on climate and organism-to-organism interactions. We lack data in this study to make firm claims about fungi, but it is possible, given the abundance of dead material after the Flood, that they would have thrived. This is an excellent area of future research as more data becomes available.

Mammals, amphibians, and other land-dwelling for which we lack data in this study would likely have taken longer to reach a recovered state in the post-Flood world. This would have been partly due to smaller initial population sizes than plants and fungi. We do not know how many seeds or fungal spores survived for each fungal and plant kind, but it likely was more than the two or seven/fourteen individuals carried on the Ark. The Ark organisms also have generally lower reproductive rates than plants and fungi, which often produce thousands of seeds/spores at a time. It is reasonable to assume that the Earth's Ark organisms would have stabilized globally within a few hundred years, though with local variations depending on climate as the world entered the post-Flood Ice Age. Extinctions undoubtedly occurred during this time, but overall, the ecosystem structures likely were back to resembling pre-Flood ecosystems, at least in terms of species richness. Since we know from Scripture that Noah lived 350 years after the Flood (Genesis 9:28), by the time of his death, the Earth may have fully recovered from the catastrophic Flood. Of course, this is speculative, but it is a reasonable assumption.

Conclusion

Mount St. Helens, while a horrific catastrophe, has proven very beneficial for creationist research. Creation geology has greatly benefitted from this demonstration of how geological formations can form rapidly and not over millions of years. Recovery of the Mount St. Helens ecosystem now provides another benefit. The bleak post-Flood landscape is no obstacle to ecological recovery. Indeed, such recovery could be very rapid, within the lifetime of Noah and his family after they got off the Ark. Plants were likely close to recovering by the time Noah's grandchildren began having children. By the time of his death, Noah likely witnessed an Earth that, though topographically different, was very similar in ecosystem structure to the one God destroyed in the Flood. Plants were likely fully recovered. While we lack data for the Ark kinds, there are indications of movement toward recovery, and thus it is conceivable they were recovered, or close to recovered, by the time of Noah's death. While there are some differences, the Mount St. Helens ecosystem represents a window, however cloudy, into the recovery after the Flood.

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