

The Effect of Salt Marsh Restoration on Ant Biodiversity

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Abstract

This experiment investigates the effect of salt marsh restoration on ant biodiversity. Salt marshes are essential to the existence of coastlines and nurseries. However, many are being destroyed by urbanization and human contact. The introduction of invasive species has led to a decline in the population of native species, which disrupts the stability of the ecosystem. We collected and analyzed ant DNA from salt marshes at three different stages of restoration. At Marine Park in Brooklyn, there was one completely restored site as well as a non-restored location. In Flushing Meadows Corona Park, the site is currently in the late stages of restoration. All three sampling sites had different compositions of ant species. The salt marsh in the process of restoration had the most biodiversity, with six species in all. All locations contained invasive ant species. However, our data is not conclusive as a result of our small sample size.

Introduction

• Salt marshes are ecosystems where freshwater and ocean water mix. They are essential to the existence of coastlines and nurseries.

• Many salt marshes are being destroyed because of urbanization, human contact and invasive species.

• Salt marshes are restored to make improvements in the health of the ecosystem. The restoration of salt marshes diminishes the effects of human impact and invasive species and returns the ecosystem back to its healthy and non-degraded state.

• One of the most common species to be found in most ecosystems are ants. Ants are essential to the maintenance and existence of an ecosystem.

• New methods are needed to determine the efficacy of salt marsh restoration. Ant biodiversity could be used as an indicator of the ecosystem's health (Danoff-Burg et. al., 2010).

• This experiment investigates whether ant biodiversity is greater in restored, developing or non-restored salt marsh.

• We hypothesize that the restored location of Marine Park will have higher biodiversity than the developing salt marsh and the non-restored locations will have the least biodiversity.

Methods and Materials

• Ants were collected using Pecan Sandies cookie baits from different three different locations.

• They were frozen, sorted, photographed and entered into the DNALC database where they received a code.

• DNA was extracted following the barcoding protocol (<http://www.dnabarcoding101.org>).

• The DNA was amplified and stained. Gel-electrophoresis was then used to make sure the samples contained DNA.

• Samples were sent for sequencing, trimmed, and matched with sequences that were already located in the GenBank database.

• DNA from seventeen samples were successfully extracted and linked to known species of ants.

• Data was analyzed to determine which ants were invasive and which ones were native to the ecosystem.

Results

- There were 17 species of ants that were successfully sequenced and identified.
- *Cardiocondyla elegans* was the most common ant found at the non-restored side. This species of ant is an invasive ant which is mostly found in areas of disturbance or human altered areas, thus it provides reasoning as to why we found many *Cardiocondyla elegans* on the non restored side of the marsh. They are usually located in soil near lakes and dry sand.
- The developing salt marsh, Flushing Meadow Corona Park, was the most biodiverse and had the least percent of invasive species (50%) compared to the other two stages of restoration, 75% of the species on the restored side of Marine Park were invasive, while 71% were invasive on the non-restored side.
- Four new DNA sequences for the species *Cataglyphis bicolor* and *Cardiocondyla elegans* were identified.

Figure 1: Native and Invasive Species from the Restored, Developing, and Non-Restored locations

Sampling site	Location	Date collected	Species Name	Invasive or native
1	Restored Marine Park	8/03/15	<i>Linepithema humile</i>	Invasive
2	Restored Marine Park	8/03/15	<i>Solenopsis invicta</i>	Native
3	Restored Marine Park	8/10/15	<i>Tetramorium cf.</i>	Invasive
4	Restored marine Park	8/03/15	<i>Tetramorium sp.</i>	Invasive
5	Non-restored Marine Park	8/04/15	<i>Aphaenogaster rudis</i>	Native
6	Non-restored Marine Park	8/04/15	<i>Cardiocondyla elegans</i>	Invasive
7	Non-restored Marine Park	8/04/15	<i>Cardiocondyla elegans</i>	Invasive
8	Non-restored Marine Park	8/04/15	<i>Cardiocondyla elegans</i>	Invasive
9	Non-restored Marine Park	8/04/15	<i>Cardiocondyla elegans</i>	Invasive
10	Non-restored Marine Park	8/04/15	<i>Odontomachus opaciventris</i>	Invasive
11	Non-restored Marine Park	8/10/15	<i>Cataglyphis osium</i>	Native
12	Process of restoration Flushing Corona park	5/12/16	<i>Crematogaster auberti</i>	Invasive
13	Process of restoration Flushing Corona park	5/12/16	<i>Tennothorax affinis</i>	Invasive
14	Process of restoration Flushing Corona park	5/12/16	<i>Tetramorium cf.</i>	Invasive
15	Process of restoration Flushing Corona park	5/12/16	<i>Prenolepis imparis</i>	Native
16	Process of restoration Flushing Corona park	5/12/16	<i>Camponotus nearticus</i>	Native
17	Process of restoration Flushing Corona park	5/12/16	<i>Camponotus pennsylvanicus</i>	Native

Figure 1: This chart depicts several aspects of the results.

Primarily, it shows in which location the samples were found in. It also shows the species which were the best match for the ants that we had collected. Knowing this helped us conclude whether the species identified were invasive species or native species.

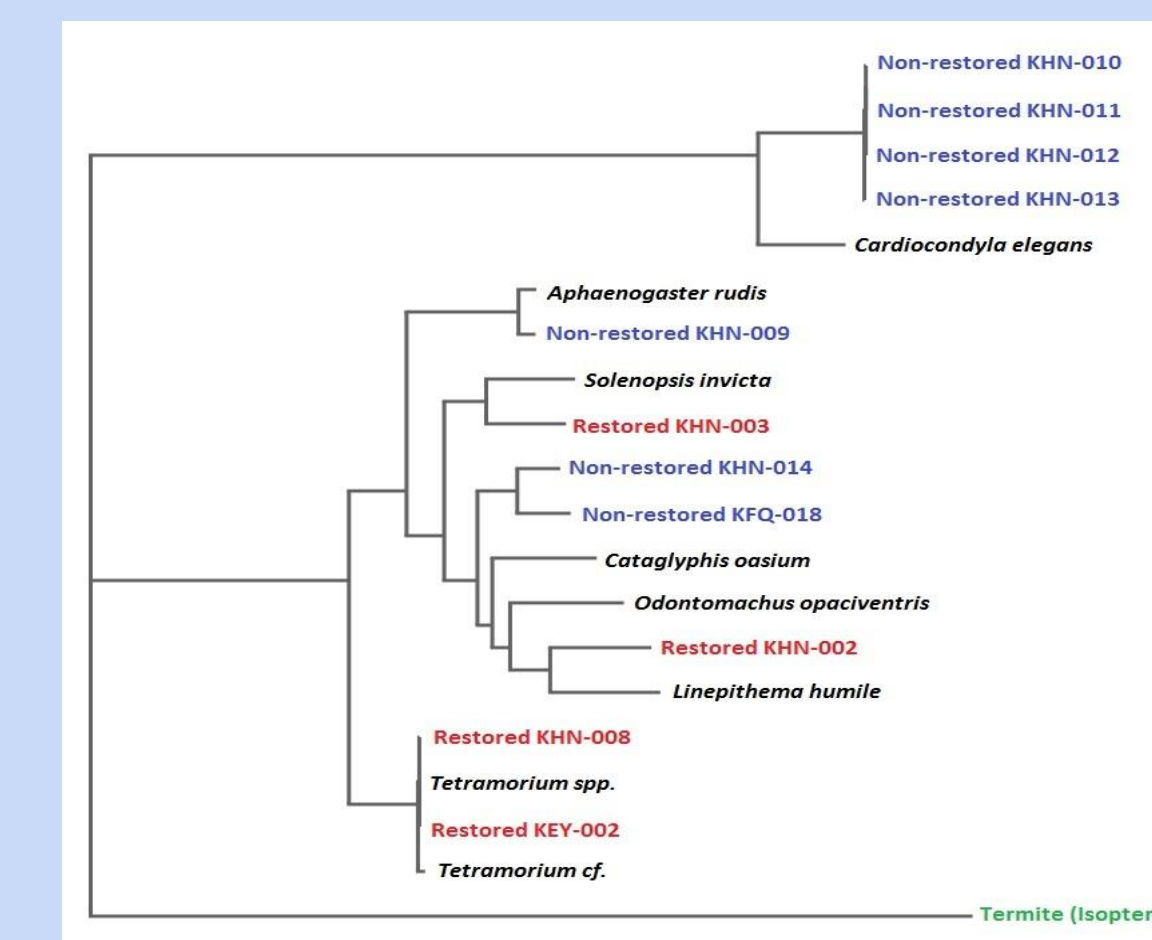
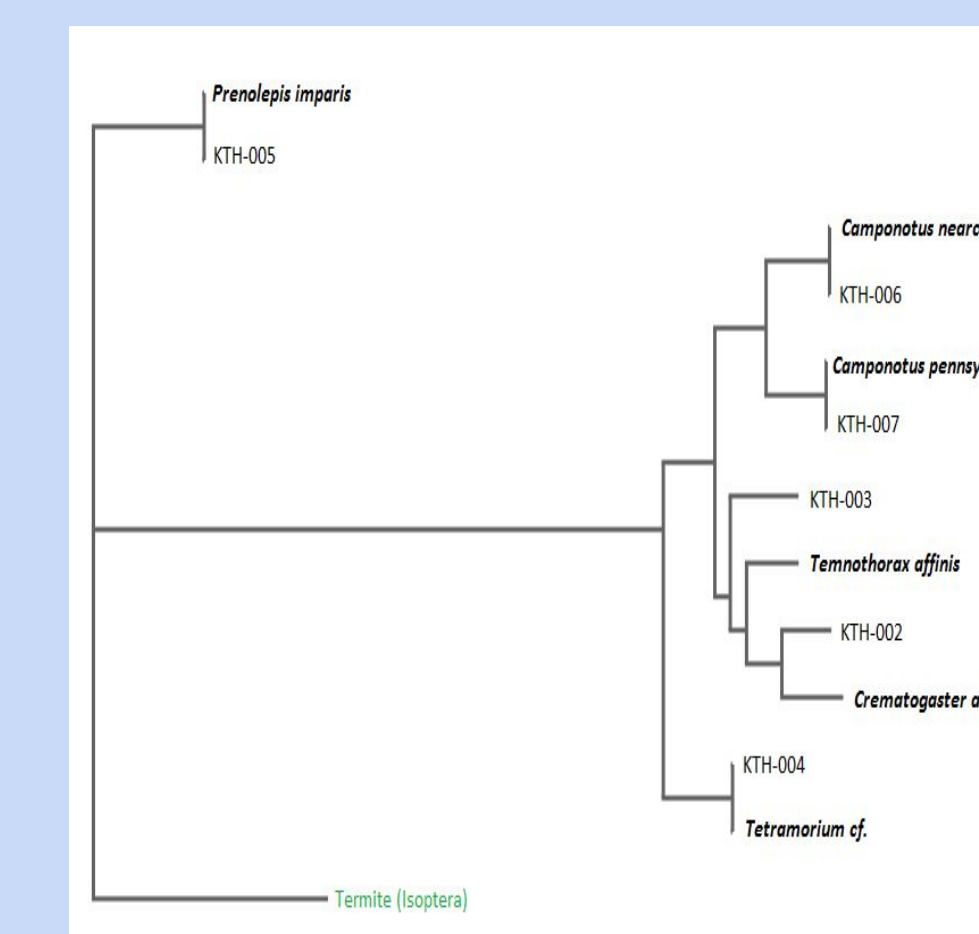


Figure 2: This is a phylogenetic tree that shows the proximity of our DNA sequences compared to the original DNA of each species from the two locations of Marine Park. This chart further portrays the relationship between the species found in the marsh to ant species that were known.

Figure 3: This phylogenetic tree shows the proximity of our DNA sequences compared to the original DNA of each species from Flushing Meadows Corona Park. This chart further portrays the relationship between the species found in the marsh to ant species that were known.



Restored side of Marine Park



Developing location of Flushing Meadows Corona Park



Non-restored side of Marine Park

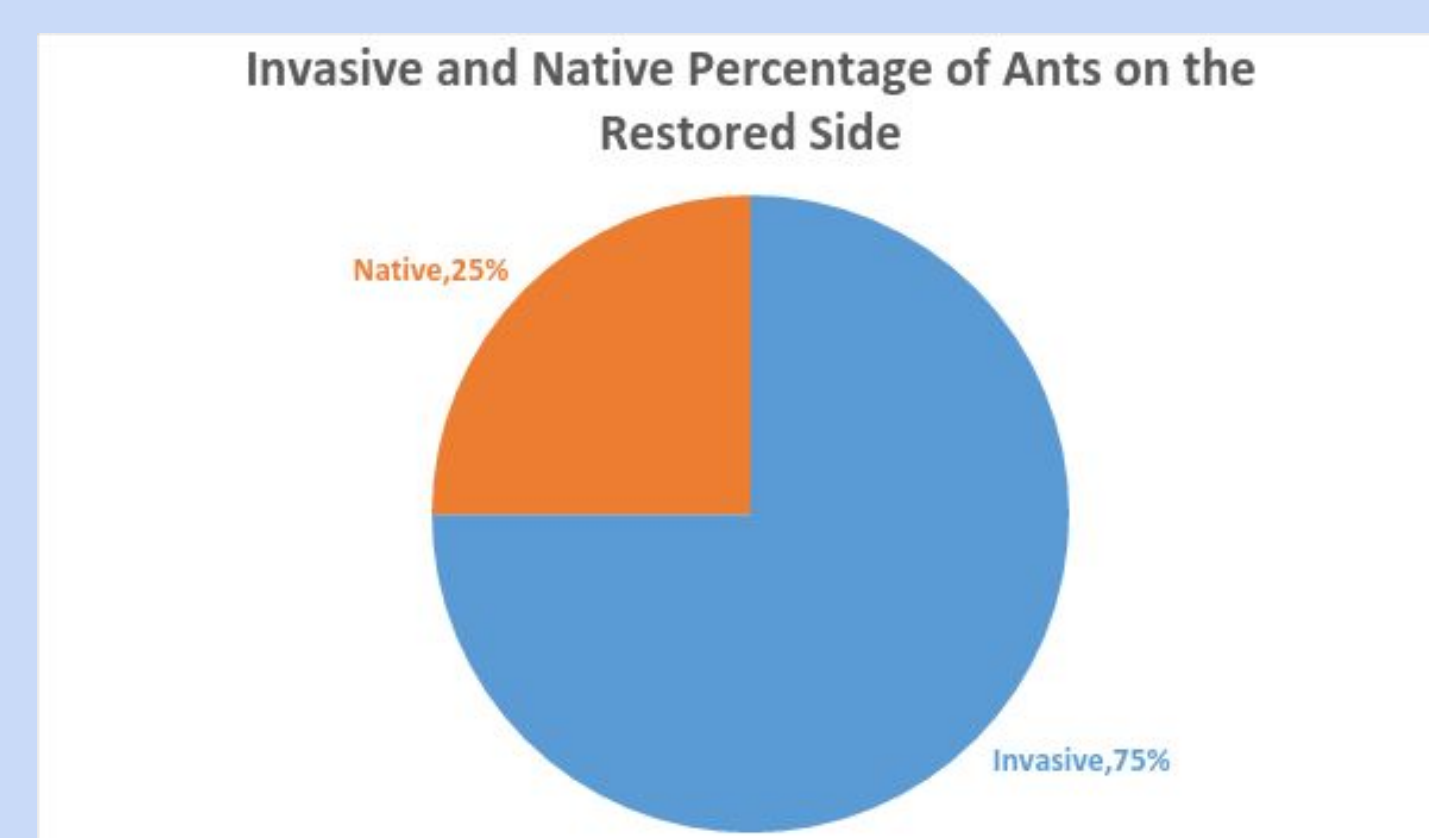


Figure 3: Of all the ants collected and identified in the restored part of the Salt Marsh, 75 percent of the ants are invasive species.

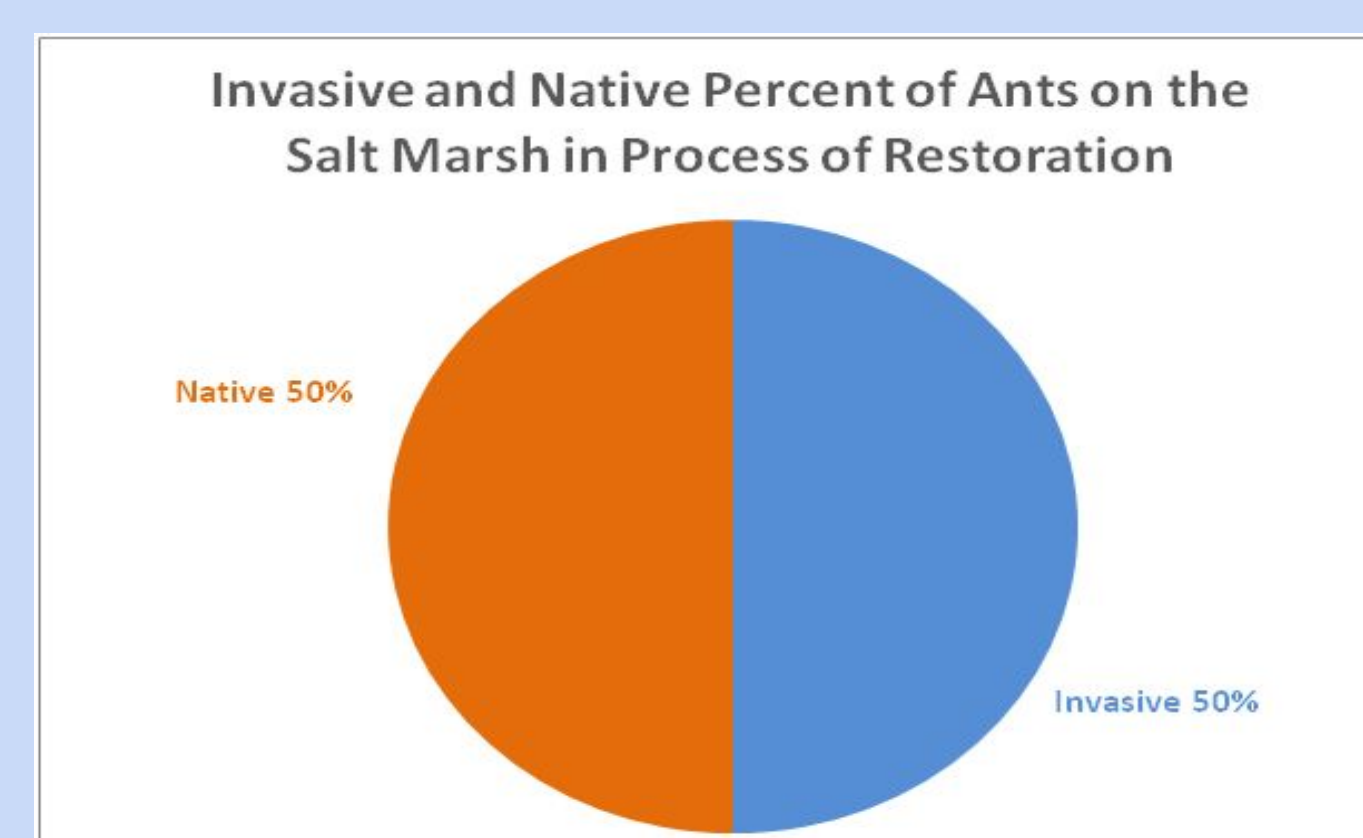


Figure 6: Of all the ants collected and identified in the Salt Marsh in process of restoration, 50 percent of the ants are invasive species.

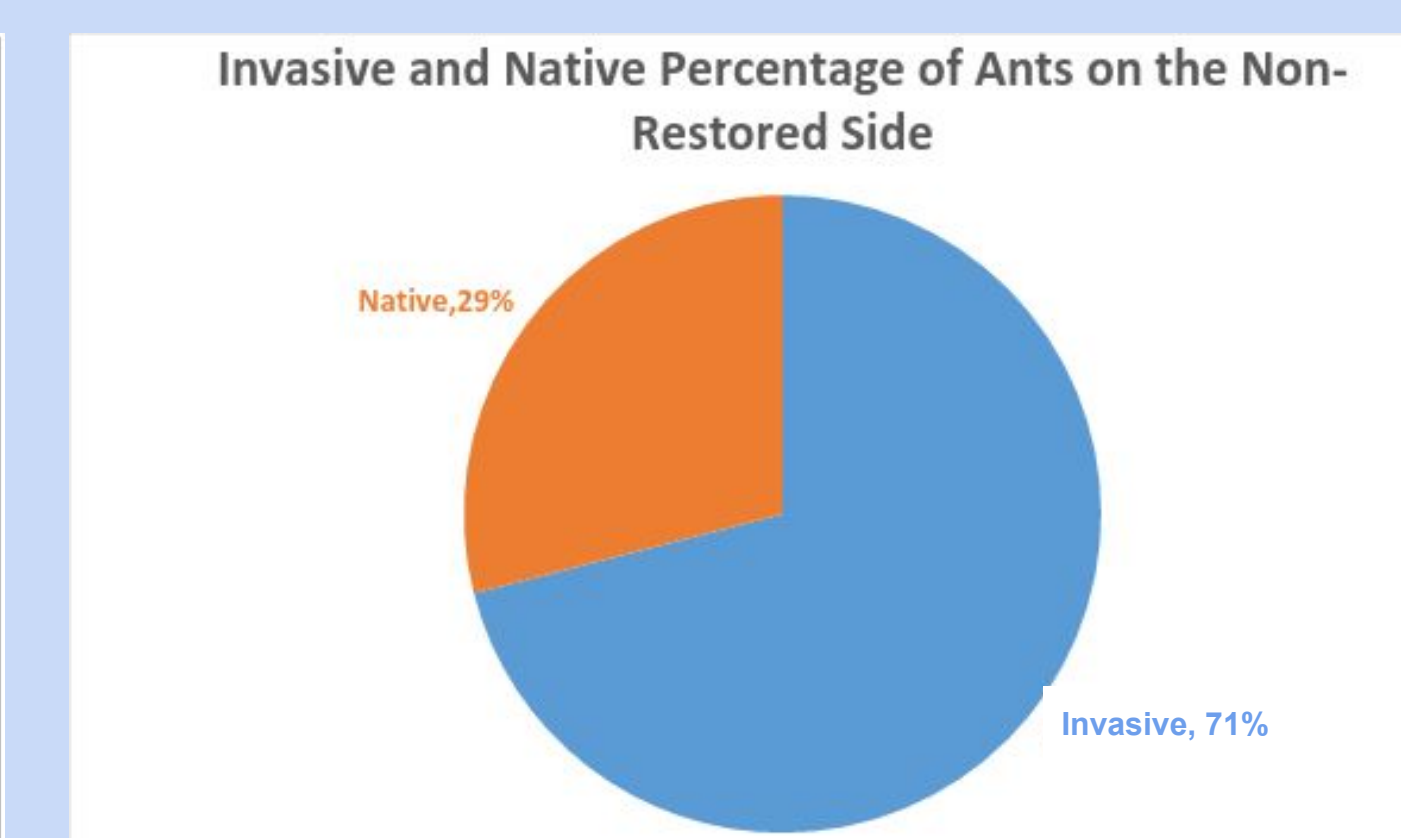
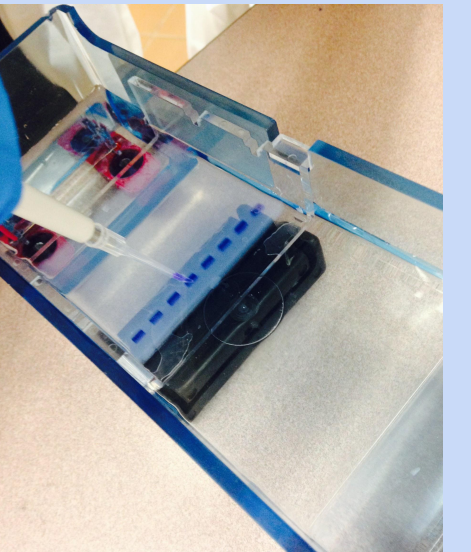


Figure 4: Of all the ants collected and identified in the non-restored part of the Salt Marsh, 71 percent of the ants are invasive species.

Conclusions

- The species found in the restored, developing and the non-restored salt marsh had little to no correlation between them.
- The correlating species was *Tetramorium cf.* which was found in the restored and developing salt marsh. It is an invasive species and demonstrates the negative effects of invasive species in an ecosystem.
- *Cardiocondyla elegans* appeared in more than one site on the non-restored side, thus showing the impact of invasive species on the non-restored salt marsh.
- There were many mismatches between the DNA obtained from our project and the known sequences published on GenBank. As a result, we were able to publish 4 new sequences for these species.
- The percentages shown could mean that native species are being replaced by invasives species that are disrupting the ecosystem.
- The conclusion drawn from the data is that it may not be the quantity of species that are identified in each area to tell the impact of restoration but rather, the species identified itself. Each species has a different job and impact to the community.



Selected References

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