ELACHISTA TRIFASCIATA MONITORING REPORT

ST HELENA CLOUD FOREST PROJECT

Year 2, June 2022 to June 2023 report

ST HELENA NATIONAL TRUST

THE PEAKS NATIONAL PARK
ST HELENA ISLAND, 1502

Contents

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Photo credit: Liza Fowler

Introduction

The endemic moth St Helena silver grass miner *Elachista trifasciata* is globally IUCN red listed as Critically Endangered and as a priority endemic, it was selected to have its ecology and distribution studied as there are knowledge gaps and it is a species that has a clear association with an endemic plant, the sedge *Carex dianae* (**Fowler & Karisch, 2020**). It was also selected to be one of the 32 priority endemic invertebrates to be used to represent the entire cloud forest endemic invertebrate fauna when carrying out surveys. *Elachista trifasciata* was first discovered on Mount Actaeon at Diana's Peak in abundance in the 1870's (Wollaston, 1879), and rediscovered in 2017 after it was believed to have become extinct. However, nothing was known about its ecology, until the link between the sedge *C. dianae* and the moth *E. trifasciata* was discovered in 2018 (**Fowler & Karisch, 2020**).

In 2018 attempts to rear larvae of *E. trifasciata* on *C. dianae* in the St Helena National Trust's laboratory were undertaken. They showed that *C. dianae* is very sensitive to changes of humidity in the soil and air. The plant reacted with a different turgor in the cells, which lead to a longitudinal distortion of the leaf and as a consequence led to the sudden death of the larvae, which feed in mines in the leaves. There were also some existing assumptions that the populations of *C. dianae* from the Peaks, High Peak and The Barn might be different and possibly different subspecies. This assumption was confirmed by Bradshaw et al. 2024. They found that the populations were significantly genetically from those individuals found at The Barn, and a very slight morphological or physiological differences between *C. dianae* individuals from the different populations. This is presumably the reason, that *E. trifasciata* was found at the Peaks and Casons, so far, and not at High Peak and The Barn. It also means that *C. dianae* individuals from the Barn should be kept separate from the other populations. Before starting this monitoring, we had a theory that *E. trifasciata* might have a life cycle associated with the seasons, with larvae present in the southern hemisphere autumn and winter when temperatures are lower and precipitation higher and swarming as an adult during southern spring and summer.

Each of the different studies of the ecology and distribution were conducted in different project years and they are referred to here as 'phases'. In Phase 1 at the start of 2022 of the Cloud Forest Project's invertebrate surveys, time was allocated to scope for the endemic sedge's distribution across different locations. The sedges (Lambdon, 2012) in the genus *Carex* were surveyed across all known sites of the Peaks National Park, the Central Peaks (Diana's Peak, Actaeon, Cuckholds), Casons, High Peak and the Depot, and at the Barn at Longwood. This was to map the distribution of *Carex spp.* and to find evidence of the St Helena silver grass miner *E. trifasciata,* as the sedge *C. dianae* on Diana's Peak is the only known foodplant of the larva of this moth species. See the Invertebrate Survey Baseline Report: St Helena Cloud Forest Project, Year 1 January to May 2022 report for more detail on *E. trifasciata* and *Carex spp.*, p.g. 23. The mapping and checking for evidence of the moth mines was started in Phase 1 (2022) indicating a correlation between humidity and the survival of the larva of E. trifasciata, which informed future monitoring years.

The ecology studies of *E. trifasciata* was continued in Phase 2 from June 2022 to June 2023, with monthly monitoring surveys set up at certain sites on the Peaks. This included new methods, which were specially invented for that species, and this document reports on these methods and results.

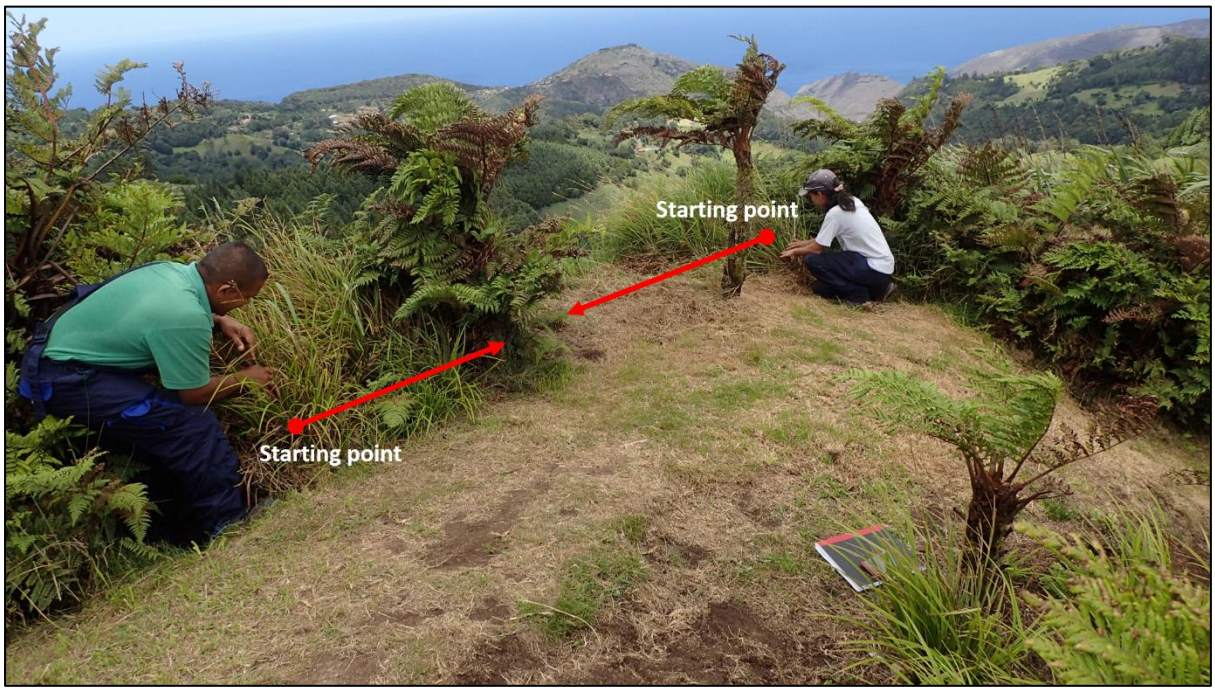
Methods

During phase 1 there are two areas where evidence of *E. trifasciata* mines were found, at Diana's Peak and Casons. During phase 2 the surveys were conducted with a total of six 10m long monitoring transect sites which were selected on Diana's Peak and 1 transect site at Casons, however, at the site at Casons, the transect was split into two 5 meter transects, as the sedge was very sparsely spread amongst the vegetation. Monitoring was carried out monthly (**Appendix 2: Table 2.2: Survey schedule**) for just over a year from June 2022 to June 2023. All of the monitoring sites were selected to be along the paths to reduce the impacts and disease transfer within the cloud forest habitat. Locations were GPS-ed, marked, and then timed (10min) observations and hand searches of adults and pupae were conducted monthly on each of the transects (starting from one end of the site to the other if only one person was present, or if 2 people are present starting from each end of the marked sites and met in the middle) (**Figure 1: A & B**) to find the *E. trifasciata* pupa and adults, and all results were recorded.

Fig 1: Methods used with one or more people for the 10 or 5 metre surveying transect sites.

A. Method used with one person observing and searching

B. Method used with two people observing and searching



Weather

On the high central ridge of Diana's Peak, Cason's and Stitches Ridge weather equipment has been installed at different locations to monitor mist and rainfall levels within the cloud forest vegetation compared with non-native plants (**Appendix 1: Map 1.6).**

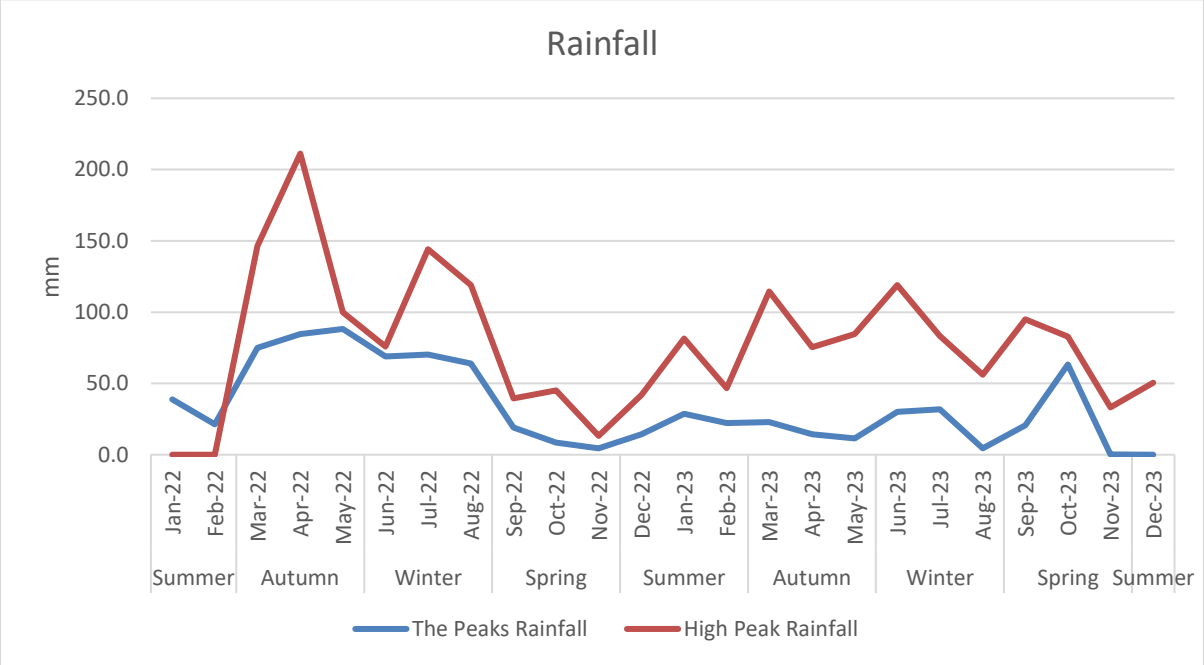
The DPLUS103 project established two different types of equipment to record the precipitation, Hobo Rain Garages (HRG) to record both rain and mist, and Automatic Weather Stations (AWS) to record only rainfall and other conditions e.g. temperature. Most of the Hobo Rain Gauges and Automatic Weather Stations were placed together, however some were placed in slightly different positions, and as a result their data records are different as they were sheltered by the slope(s) or vegetation of the hill(s) (**Appendix 1: Map 1**).

During the survey period from June 2022 to June 2023 there were high levels of rain fall (**Graph 1**) recorded by the Hobo Rain Garages, especially at Diana's Peak with July having the highest average rainfall of 161.8mm for 2022 and 141.2 mm for 2023.

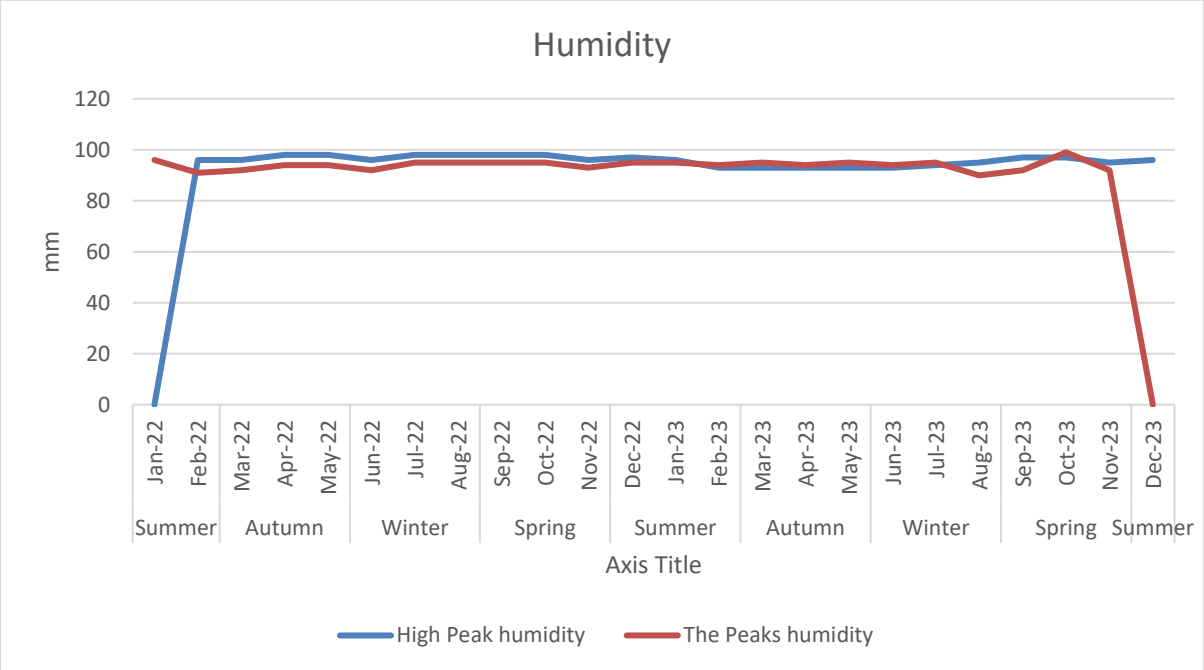
The main weather conditions that are analysed for this report are mist, humidity and temperature as *E*. *trifasciata* is very sensitive to changes of humidity in the soil and air as found under laboratory conditions where the larvae died. During the summer and autumn months the highest mist capture at Cason in 2022 was in Dec with 169.4mm and in 2023 it was March with 97.4mm. Throughout 2022 the temperature was similar to 2023 on both the Peaks and also High Peak with the highest temperatures between Jan to March 2022 and Jan to April in 2023. In general, Diana's Peak had the highest mist capture and rainfall recorded in both 2022 and 2023 (**Graph 1 A-D**).

Graph 1: A-D: Showing the different weather conditions recorded by the Automatic Weather Stations & Hobo Rain Garages for 2022-23.

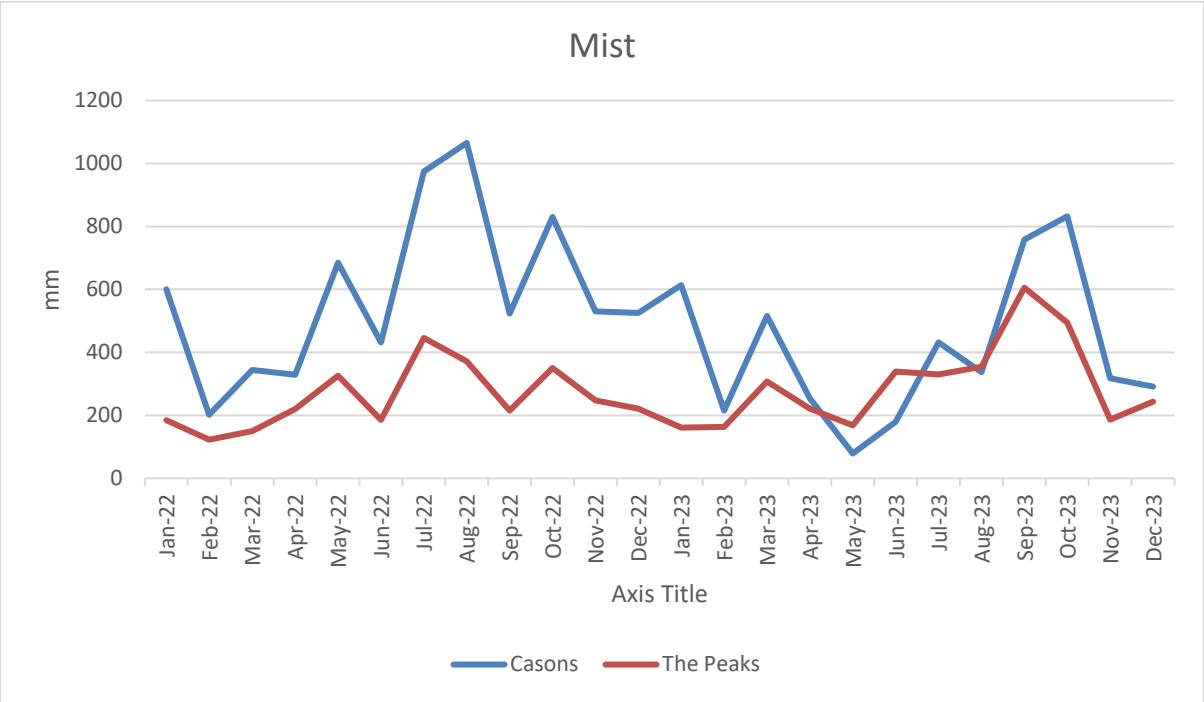
A. Graph showing rainfall



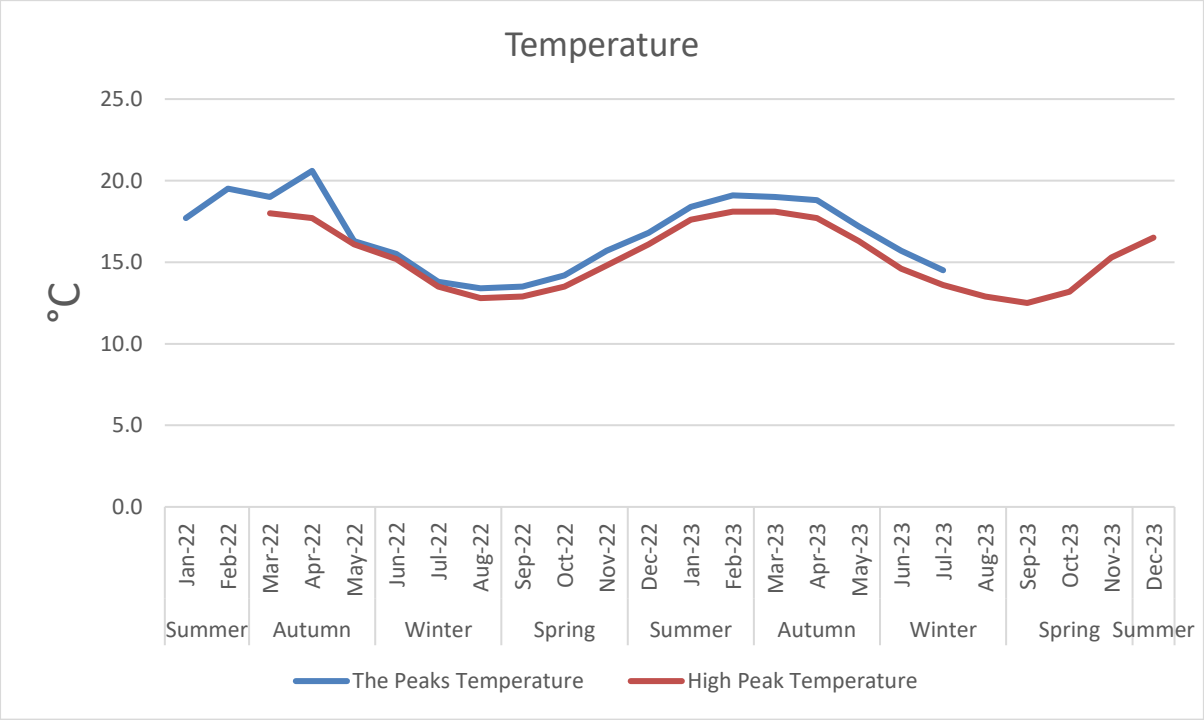
B. Graph showing humidity



C. Graph showing mist



D. Graph showing temperature



Results

In Phase 1 a cluster size (Invertebrate Baseline Survey Report, January – May 2022), see table 1, was used to estimate the abundance of the sedges. At the monitoring sites there was a combination of sedge sizes (**Table 1**). However, the size of the clusters seemed to have a limited effect on *E. trifasciata* presence, as the moth was found on all the different sized sedge clusters at all the sites but with a

slight preference for medium and large clusters. The abundance or density of the sedge doesn't seem to make a difference either, as one site at Well's only recorded 1 pupa. However, the highest abundance of *E. trifasciata* was observed at sites where *C. dianae* was less shaded than on the other sites (Bellflower, Taylors) (**Graph 2**).

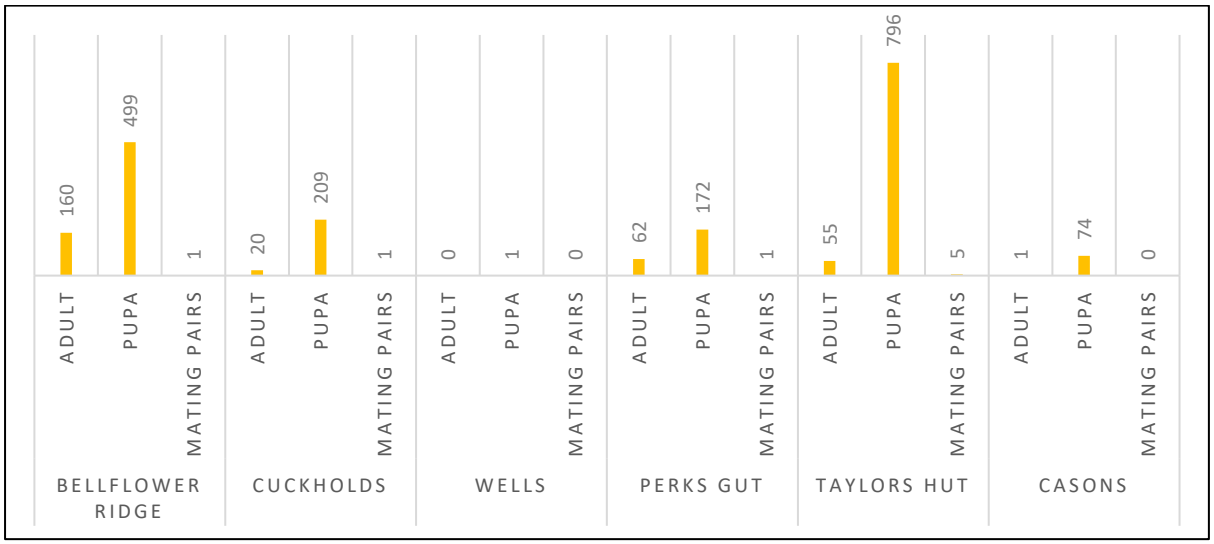
Table 1: Showing *Carex spp*. estimated cluster sizes for each monitoring site

Carex. dianae cluster sizes	Scale (No of *C. dianae* plants)	Diana's Peak sites					Casons site
		Cuckholds	Nr. Bellflower Ridge	Nr. Perks Gut	Taylors hut	Well's	Transect 1 & 2
Very small	1-5	X				X	X
Small	5-20	X		X	X	X	X
Medium	20-100			X	X		
Large	100-200		X				
Very Large	200+						
Adult		20	160	62	55	0	1
Pupa		209	499	172	796	1	74
Mating Pairs		1	1	1	5	0	0

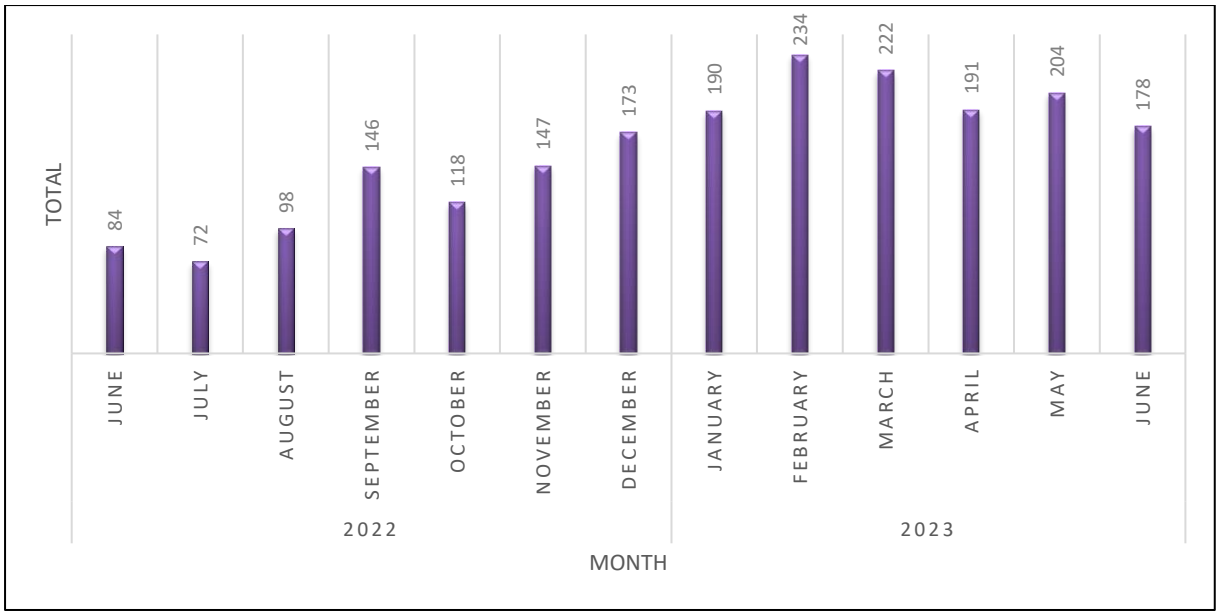
Overall, during Phase 2 there were 2057 *Elachista trifasciata* pupa and adults recorded from 6 sites. The 5 Diana's Peak sites totalled 1677 pupa, 297 adults and 8 mating pairs were also recorded, with an average per site of 335 pupa, 59 and 2 mating pairs. While Casons single site recorded much lower numbers when compared with the Diana Peak average, with a total of 74 pupa and 1 adult. On Diana's Peak there were 1 site that had the highest recorded adult and pupa, Bellflower Ridge with 499 pupa and 160 adults and Taylors with 796 pupa and 80 adults (**Graph 2**).

Interestingly, this moth species is active throughout the year (**Graph 3**). At the start of the survey from June to August 2022 records totalled between 84-98 and then from September 2022 to January 2023 the abundance of this species steadily increased into hundreds of records. In 2023, February, March and May displayed the highest abundance (204-234). In April & June the abundance reduced again (178-191) (**Graph 4**). The adults of this species were found throughout the year and the highest records were recorded during September 2022 (early spring) to January 2023 (summer) and the pupa were at their highest in Feb 2023 (summer). The lowest (46) pupae records were recorded in June 2022 (**Graph 4**). The mating pairs were recorded in June and December of 2022 and January 2023, which could suggest that this species might have more than one breeding period.

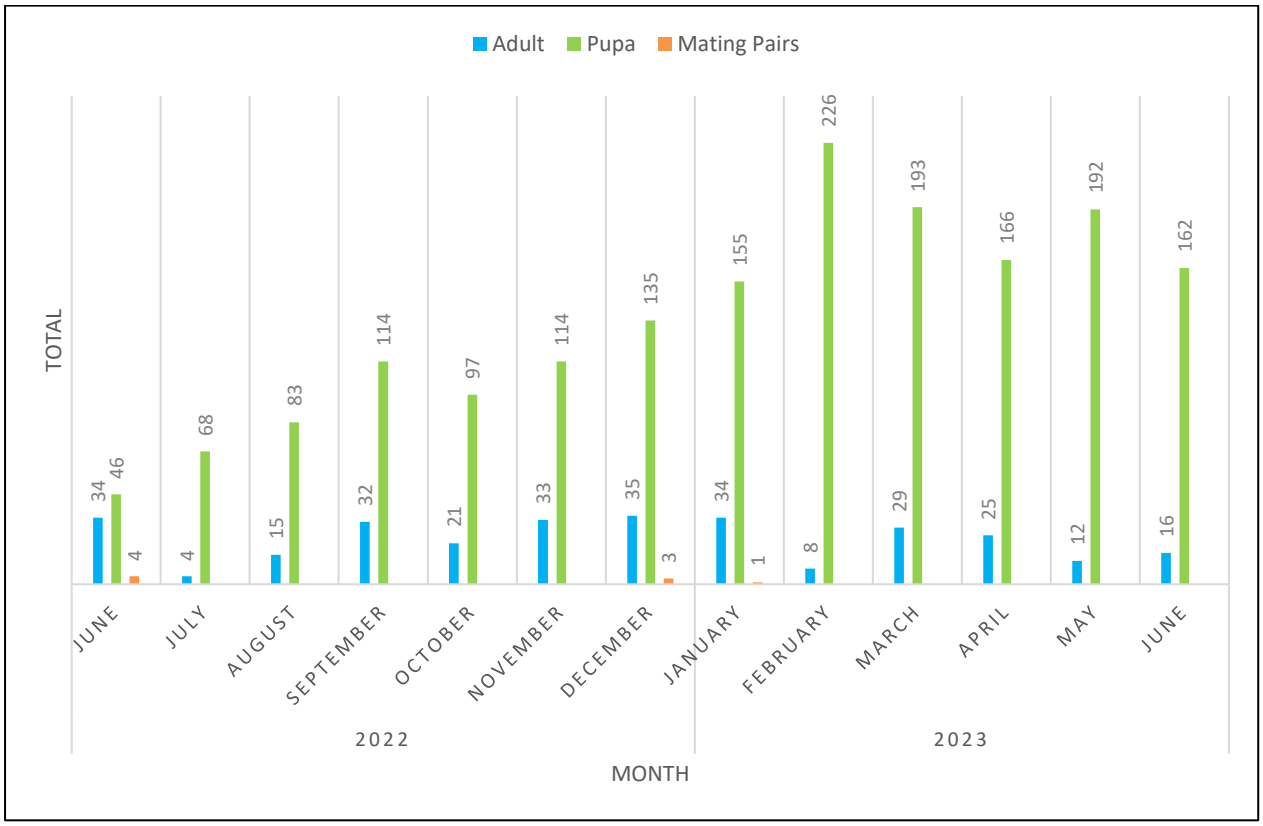
Graph 2: Showing the adult and pupa counts of *Elachista trifasciata* totals by sites



Graph 3: Showing the total records for each month of *Elachista trifasciata*

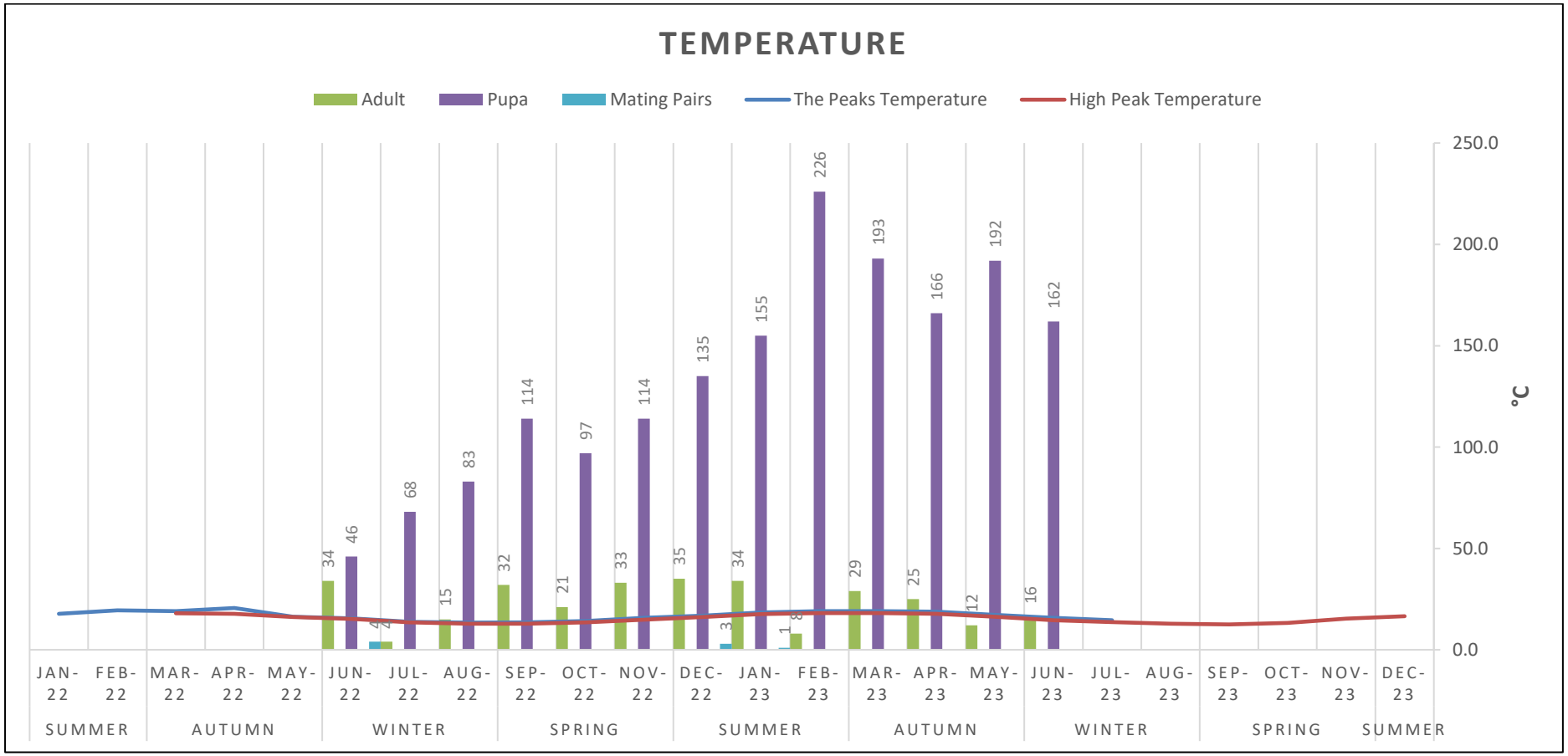


Graph 4: Showing the lifecycle stages for each month.



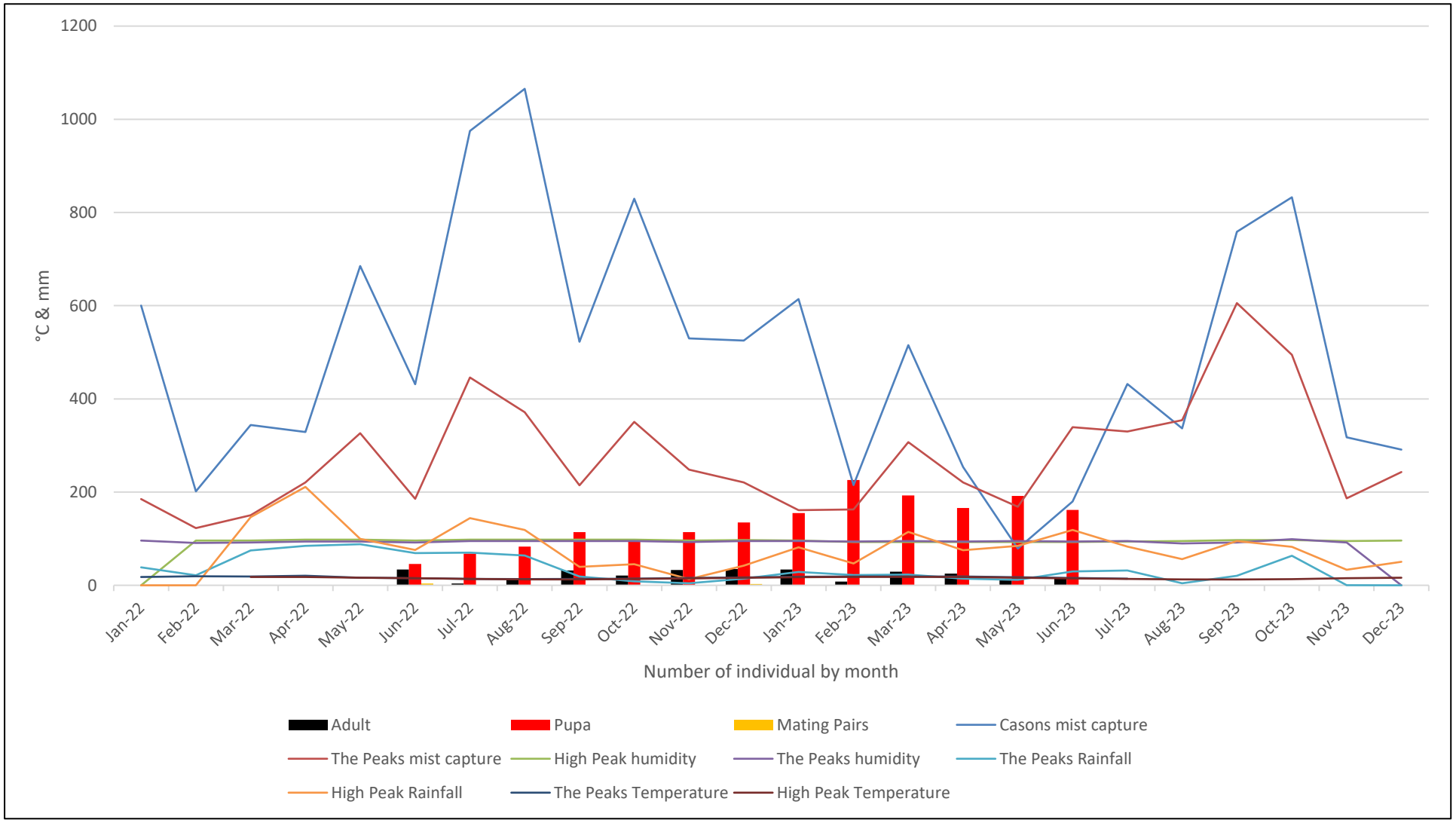
The weather conditions (rainfall, mist, humidity, temperature) are also interesting when compared to the number of *E. trifasciata* pupa and adults at each site (Casons, the Peaks) that was recorded throughout the surveying period. The mist captured were much higher than the rainfall (Casons, The Peaks). The mist capture was at its highest between the months of Jul 2022 to Jan 2023 and during this time the pupa and adult were at their lowest counts. However, once the mist started to reduce between the months of Jan to Jun 2023 the pupa numbers increased **(Graph 6)**. The temperature had similar readings between the Peaks and High Peak and was quite consistent throughout the year with average temperature between 13 and 18 °C, the highest temperature of 19°C and 20.6°C was recorded in March to April 2022 and again in 19°C February and March 2023, although there did not appear to be an impact on adults or pupa **(Graph 5)**.

Graph 5: Comparing temperature with *E. trifasciata* pupa and adults



The rainfall was lower than the mist capture and the rainfall fluctuated more, and didn't really mirror each other between the different sites (High Peak and the Peaks). The rainfall also didn't seem to affect the population throughout the year. There is no reliable correlation between the monthly precipitation and the number of individuals of E. trifasciata. Interestingly the humidity was stable throughout the year on both the Peaks and High Peak in contrast to an expected influence from mist and rainfall (**Graph 6**)

6: Comparing rainfall, mist capture, temperature and humidity with *E. trifasciata* pupa and adults



Please note: two of the monitoring sites, Taylors & Casons that recorded the highest numbers of *E. trifasciata* during the monitoring period of Feb 2023 was revisited during the same month, Feb 2025, to assess the population stability. It was found that *E. trifasciata* is still present at both sites with Taylors having a total number of 53 pupa & 2 adult and Cason with 5 adults.

Discussion

The cloud forest is a unique and diverse habitat within a 60-acre area of the high central ridge, with the Peaks (Diana's Peak, Actaeon, Cuckholds) being the largest cloud forest area, followed by High Peak, whereas the Depot is the smallest and most fragmented area.

The unique invertebrates that have been previously recorded from the cloud forest habitat alone, with approximately 120 endemic species and over 400 endemic invertebrate species recorded. Thirty two of the 120 cloud forest's endemic invertebrate species were chosen as representative priority species for the Cloud Forest Project. These were from a range of different orders including, Hemiptera, Coleoptera, Crustaceans, Lepidoptera, Mollusca and Araneae.

The monitoring sites (**Map 1.1**) that were selected throughout the Peaks covered different altitudes and abundances of the sedge (**Map 1.2**). This has demonstrated that *E. trifasciata* has a wide distribution across the Peaks (Diana's, Acteon, Cuckholds) on the *C. dianae* sedge. The sites with larger denser clusters of sedge at more exposed places, in particular, are supporting the larger populations of *E. trifasciata.* These sites are Bellflower Ridge and Taylors on Diana's Peak; however, the smaller sizes of the sedge clusters should not be dismissed from any future surveys as they still support *E. trifasciata* (Well's) and will provide important back up populations if any sites are lost.

Adult *E. trifasciata* is active throughout the year and has a high turnover of pupae. This could suggest that their lifecycle is quite short or there is a long pupation period between mating, as there were only three months in which mating pairs were found, during June, Dec and Jan. However, this could also be due to overlooking adults during searches, or the possibility of the adults using a broader habitat range within the cloud forest zone to fly around, to display and to mate, or mating at times of day when surveys don't occur. Breeding of other species in this genus in other places in the world has shown, that members of the genus are univoltine, e.g. Elachistidae in Northern Europe, whereas some species have two or three breeding seasons during a year in Southern Europe (Traugott-Olsen & Schmidt Nielsen 1977). Unfortunately, despite of the foodplant of the larva and the mines, nothing is yet known on the bionomics of *E. trifasciata*.

Before starting this monitoring, we had a theory that *E. trifasciata* might have a stronger seasonality, existing with larva present at lower temperatures and higher precipitation in the southern hemisphere, winter, and swarming as an adult during southern spring and summer. The results of the monitoring do support this theory, with high numbers of pupae in the cooler, wetter months and adults in the warmer, drier months, but there is no indication of a pronounced seasonality. All first instars are found in every month of the year, with pupae and adults too. However, the results do not give any implication on the length of the life cycle of *E. trifasciata*.

Unfortunately, no data loggers were available to record microclimate at the different sites, however, the general weather suggests that the weather between Dec to Jun is more favourable for the larvae to emerge to pupate, as seen at both the Peaks and Casons. As the highest number of pupae have been found after the mist levels in the areas of occurrence decreased, it is assumed that a period with

less clouds and more sunshine will lead to more adults hatching. This makes sense as the moths have a better chance to survive with less moisture in the air and on the vegetation. Therefore, a longer period of monitoring is necessary for this species. However, you could also target monitoring in certain seasonal windows to get a representative snapshot of adults or pupae numbers, for long-term assessment of population.

At the beginning of monitoring the abundances were much lower than at the end, the reason for this is unknown. Also, if long-term oscillation in population abundances exists then annual monitoring could answer such questions as - are there changes in the microclimate, which will influence the time of pupation or hatching? To investigate the length of the instars and the pupation experimental methods are necessary. The linkage between precipitation, mist capture, temperature and humidity will also be better visible after a longer period of monitoring, when considerable changes of the weather conditions will show the reaction of *E. trifasciata*.

This study of *E. trifasciata* has now raised further questions to those that were put forward in 2022, such as why is there a much high portion of pupae recorded compared to the adults? How many pupae become adults (mortality, parasites)? Is there a special microclimate required for this species? Is their breeding stage more than 3 time a year? Also, the nature of the seasonality of the life cycle and the length of development stage could be ascertained by experiments.

Conclusion

This monitoring of the St Helena silver grass miner moth *E. trifasciata* has provided an insight into its size of the population, lifecycle, and distribution across the Peak National Park, as well as favourable weather conditions for both larvae and adults. With mist capture appearing to be particularly important for pupa, which increased as they decreased but with limited impact of rainfall and temperature. Also, the seasonality of the species was further evidenced with more adult's present spring/summer and pupa in autumn. However, not the overall impact of climate as the monitoring period of one year is too short to discover implications of climate change (e. g. effects of longer drought or very rainy periods) on this species.

It is shown that future monitoring should be focused on larvae and pupae, as these are much easier to search for and to count than the moths. The pupae can be considered as an indication of the moths hatching very soon. Pupa could be used for an annual monitoring method during a specific time in the autumn and winter months, providing a snapshot of the species, to understand it population changes in the long-term.

However, the distribution and abundance of the St Helena silver grass miner moth *E. trifasciata* is widespread across the Peak on both natural and cultivated *C. dianae* populations, but they are present in much smaller numbers at some of the sites. Therefore, there is a need for restoration at sites, such as Wells and Casons, see recommendations section below.

Recommendations

In the Invertebrate Baseline Survey Report, January – May 2022 recommendations made were, to continue mapping at new locations for *C. dianae* and search for evidence of *E. trifasciata*. Also, to propagate and strategically plant *C. dianae*, in non-shaded areas, in collaboration with Environmental Management Division (EMD) - to expand exist sites of *C. dianae* increasing the range of *E. trifasciata*

and its habitat. In addition, to this we recommend that the recent cultivated *C. dianae* population at Cabbage Tree Road be surveyed to see whether *E. trifasciata* has colonised this area, *as C. dianae* were planted there in 2021/22 through the Cloud Forest Project, as well as comparison work undertaken on shaded and non-shaded sedge populations to see whether it makes a difference to plant growth and *E. trifasciata* numbers etc.

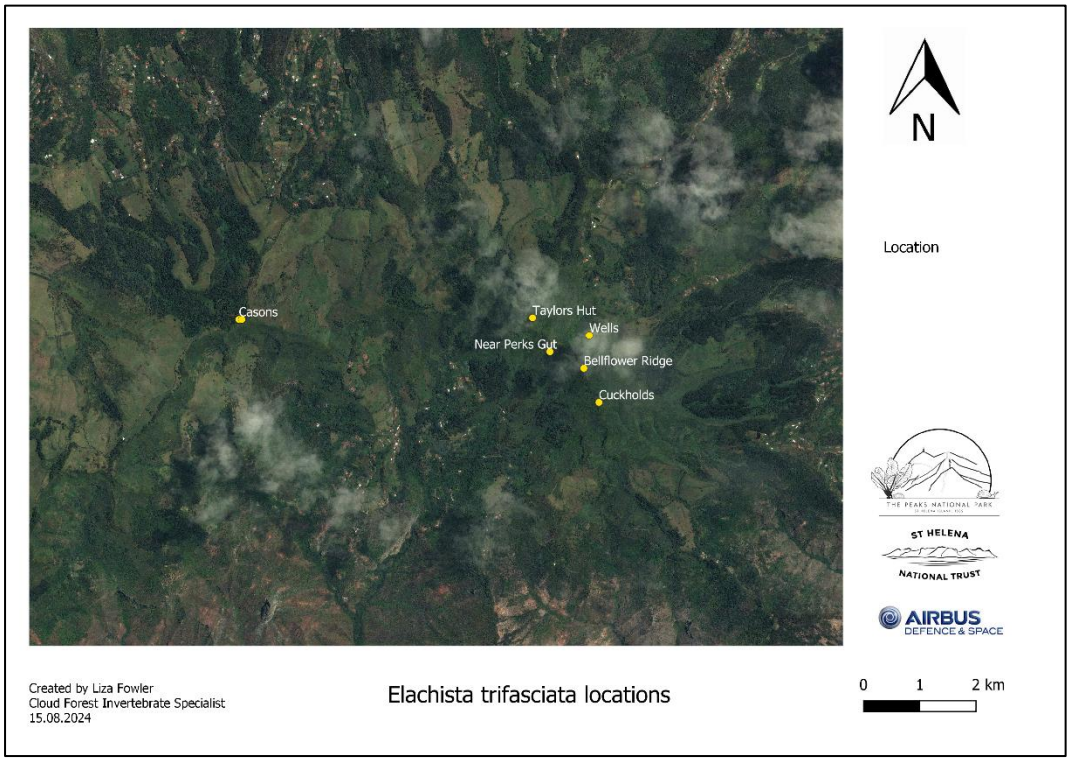
Restoration efforts should be made to expand the sedge at all sites where *E. trifasciata* is present, but particularly at sites such as Well's, Taylors and Cuckholds where patches of sedge are smaller and so will be more vulnerable to local extinctions. The Casons site is vulnerable to being lost as it is the most isolated and smallest site, with a very small population of sedge and so it should be prioritised for sedge restoration. In addition, when restoring areas the planting of *C. dianae* in deep shade should be avoided

Most importantly, a long-term field monitoring of at least five to ten years (the longer the better) should be implemented on this moth species, in order to answer some of these important questions relating to seasonality, change of population size in relation to weather conditions and climate change. In addition to this the lifecycle of *E. trifasciata* should be investigated by experimental approaches. This could be done by creating an enclosed area within the Peaks Nursey area which would reduce the mortality of both *C. dianae* and *E. trifasciata* as seen under laboratory conditions. E. trifasciata females can be released within enclose/caged areas to observe developing mines to monitor their progress over time in collaboration with EMD conservation staff. This would contribute to the research gaps and provide a greater understanding of this species' ecology.

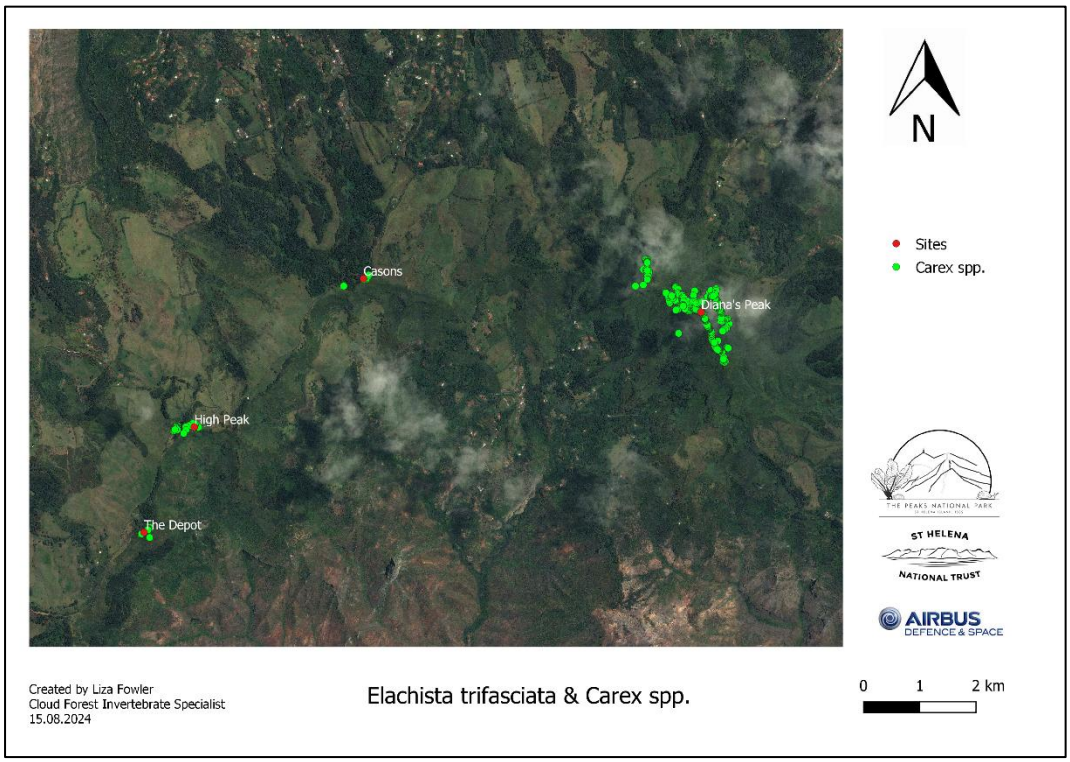
Appendix 1

Appendix 1: Maps

Map 1.1: Showing the monitoring sites



Map 1.2: Showing Casons and Diana's Peak and Carex spp. distribution



Appendix 2: Tables

Table 2.1: Site Description

Site Description	
Name of Peaks: Diana's Peak **Area name:** Cuckhold's	Below the point of Cuckhold's (**Appendix 3 3.1: Site photographs A**) on an approx. 45° slope along the closed path just before the steps, the site for monitoring was set up. This site is mostly sheltered from the strong wind that can occur over this point, but it retains moisture in the soil throughout the year. There are small clusters of sedge growing sparely amongst other vegetation. However, there are no springs in this area.
Name of Peaks: Diana's Peak **Area name:** Nr. Bellflower Ridge	This site is on the path on the ridge between Cuckholds and Diana's Peak. Very dense clusters of sedge grow along side of the path (Sandy Bay side) (**Appendix 3 3.1: Site photographs B**) with some Tree fern growing in between and on the opposite side there are mainly tree ferns.
Name of Peaks: Diana's Peak **Area name:** Nr. Perks Gut	Pass the Canon and at the sharp turning (Aceton) where the path continues towards Newfoundland, the site (**Appendix 3 3.1: Site photographs B**) for monitoring *E. trifasciata* was set up. The sedge is mainly growing sparsely on the bank amongst invasive and endemic plant species and on the opposite side of the path are flax growing on the slop.
Name of Peaks: Diana's Peak **Area name:** Taylors Hut	The monitoring sites is situated on the point opposite of the 'Peaks staff' hut, and the site extends downward on the path which continues toward Halley's Mount. The monitoring site consists of low growing tree fern and other endemic and non-native vegetation (**Appendix 3 3.1: Site photographs D**).
Name of Peaks: Diana's Peak **Area name:** Well's	The sedge is growing sparely on the vertical bank on the path in the area of Well's in amongst other vegetation and on the opposite side there are flax growing on the path. (**Appendix 3 3.1: Site photographs E**).
Name of Peaks: Casons **Area name: Sites A & B**	This site at Casons was the only site that was split into 2 monitoring transects as the sedge is so sparse there, some nearing the path and higher up the slop. (**Appendix 3 3.1: Site photographs F**).

Table 2.2: Survey schedule

Month	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23
Date													
10													
11													
12							Diana's Peak sites						
13							Casons				Diana's Peak sites/Casons		Diana's Peak sites
14		Diana's Peak sites				Casons			Diana's Peak sites	Diana's Peak sites			
15	Diana's Peak sites/Casons	Casons	Diana's Peak sites	Diana's Peak sites/Casons		Diana's Peak sites			Casons	Casons			Casons
16			Casons					Diana's Peak sites				Casons/Diana's Peak sites	
17					Diana's Peak sites/Casons			Casons					
18													
19													
20													

Appendix 3: Site Photographs

3.1: Site photographs A-J

A. Cuckholds

Upper side	Lower side
	

B. Bellflower Ridge

Rigth side


Middle

Left side

C. Nr Perks Gut

D. Taylors Hut

Upper sider

Lower sider

E. Wells

F. Casons

Acknowledgments

This Cloud Forest Project '*Restoring St Helena's Internationally Important Cloud Forest for Wildlife, Water Security & People*' was funded by the UK Foreign, Commonwealth & Development Office (FCDO), and managed by the Royal Society for the Protection of Bird (RSPB), working in collaboration with local, and international partners. The local partners are the St Helena Government's (SHG) Environmental Management Division (EMD), Sustainable Development and Education departments and the St Helena Research Institute (SHRI), Connect St Helena and the Bottom Woods Met Office. The international partners are Arctium, the UK Centre for Ecology and Hydrology (CEH), the Royal Botanic Gardens Kew and Dr Quentin Cronk from the University of British Columbia (UBC).

I would particularly like to thank **Kirsten Ellis**, St Helena Cloud Forest Project Manager, **Shayla Ellick** St Helena Cloud Forest Project Coordinator for all of your support throughout the fieldwork and completion of this report.

Director **Helena Bennett,** and **Martina Peters**, Head of Conservation of the St Helena National Trust (SHNT) for supporting the invertebrate work and ensuring that the work was tracked according to the outcomes of the project, feedback with updates and giving valuable feedback to other areas of work. The SHNT's Darwin Plus (DPLUS104) (ended March 2022) project staff, **Natasha Stevens,** Cloud Forest Invertebrate Control Project Manager, **Christy Jo Scipio-O' Dean,** Cloud Forest Invasive Invertebrate Field Officer and **Daryl Joshua** Cloud Forest Invertebrate Field Officer, all of which transferred to the Cloud Forest Project from April 2022, and **Gavin Ellick** now the Field and Monitoring Officer on the DPLUS190 project**,** for their support and assistance in the field.

Vicky Wilkins IUCN Atlantic Islands Invertebrate Specialist Group (AIISG) (name changed in 2023) c/o Species Recovery Trust (SRT) of which have supported the writing and feedback of this documents; and keeping track of many other aspects of invertebrate work e.g. DNA.

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