First investigations into moth diversity at Cloudbridge Nature Reserve

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Expedition Cloudbridge logo: Richard Whitbread
Page header photography: Jack Burton

Abstract

Despite the significant role of moths in neotropical ecosystems, and their status as the most speciose tropical arthropod group, moths are understudied in Costa Rica and have never previously been studied at Cloudbridge Nature Reserve. As part of our expedition we undertook a baseline study and determined that sheet traps are an effective trapping method at Cloudbridge, due to the challenging terrain and remote location. A species list was produced, which can be used to aid future research into moths at Cloudbridge, and can be extended with future study.

Introduction

Moths are critical to tropical forests, fulfilling important functional roles as selective herbivores, pollinators, detritivores, and prey for migratory passerines (Summerville and Crist, 2004). The neotropics are the most diverse biogeographical region at the species level (Myers et al., 2000), and with Lepidoptera being among the most speciose arthropod groups within tropical ecosystems (Erwin, 1982; Summerville and Crist, 2004), the number of moth species within this clade numbers 8,000 species in Costa Rica (Kavanagh, 2007). In the tropics, primary forest habitats face isolation as a result of deforestation, with cloud forests having a particularly high deforestation rate, resulting in isolated patches of primary forest in a mosaic of pastures, arable land, secondary forest and urban settlements (Wolf, 2005; Toledo-Acevez et al., 2011). Due to the threats faced by tropical forests, and cloud forests in particular, knowledge of such an important taxonomic group may prove vital for conservation of these threatened ecosystems.

During the planning stage of our expedition, the reserve staff suggested that we investigate moth diversity, an area which had never previously been researched at Cloudbridge despite a number of studies being undertaken on butterfly diversity and ecology on the reserve. As a result of the ecological significance of this taxonomic group, and with a key aim of the expedition being to benefit the reserve by conducting research on understudied topics, we decided that this would be an interesting and worthwhile area of research.

The aims of our study were to assess which methods for sampling moths would be the most practical for future studies within the reserve, so that the reserve can learn from our work and use our findings to design future surveys, and to begin a species list which the reserve and visiting researchers can continue to build upon. We also aimed to determine whether the number of sampling events that we used were sufficient to estimate the true species richness of moths within the reserve.

Methods

Trapping

We trialled four different light-trapping methods to determine which would be most practical for the reserve (see Fig. 1):

Homemade box trap

A plastic tub with an open top was fitted with mesh that slanted down from the top two sides of the box towards the center, with a gap between the mesh in the centre of the box. Moths, attracted by an incandescent light bulb centred at the base of the box, entered from the top and were directed by the mesh to the inside of the box where there were cardboard tubes to shelter underneath. The light bulb was powered using a 12V car battery. This trap was designed to be left out overnight and checked in the morning. However, the car battery did not last all night and any moths which were initially trapped exited the box once the light had gone out. **Consequently, this trapping method was not used for any of our sampling events.**

Sheet trap 1

A single bed sheet was assembled in a tree near the reserve base, with three incandescent light bulbs positioned above. The lights ran on the reserve's electrical grid using waterproofed extension leads.

Sheet trap 2

A freestanding, homemade bamboo frame holding a single bed sheet. We first used three incandescent light bulbs powered by a 12V car battery to illuminate the sheet (light A), but discovered that the battery was too heavy to hike with in the mountainous terrain and changed our method to use a rechargeable 1300 lumen LED torch belonging to a team member (light B), which was small enough to carry with ease.

Wall trap

We noticed that the reserve buildings' outdoor lights attracted a large number of moths, which settled on the walls, and decided to utilise this as a sampling method. One side of the Casita Blanca building, illuminated by one or more outdoor lights, was used as the sampling area.

Study sites

In order to record as many different species as possible within the reserve, we sampled different forest types to account for moth species composition varying between habitats (Hawes et al., 2009). Five sites were sampled, across four forest types (Table 1). Each site was sampled on two separate trap-nights, for two hours after dark from approximately 19:00 to 21:00. Sampling was not carried out in heavy rain as moths were unlikely to be flying. During each session, every species visiting the trap was photographed, alongside a ruler for scale where possible.

Figure 1. The different types of light traps that we trialled during our study (except for sheet trap 1). Clockwise from bottom left: box trap; wall trap; sheet trap 2.

Table 1. Sampling sites and trapping methods used for each site.

SITE	FOREST TYPE	TRAPPING METHOD
Casa Amanzimtoti (adjacent to Principal Trail)	Human-dominated	Sheet trap 1
Casita Blanca	Human-dominated	Wall trap
El Jilguero Trail (EP)	Planted	Sheet trap 2 - Light A on first night - Light B on second night
Gavilán Trail (GR<30)	Naturally regenerated, under 30 years old	Sheet trap 2 - Light B
Gavilán Trail (GR>30)	Naturally regenerated, over 30 years old	Sheet trap 2 - Light B

Analysis

Photographs were collated and each unique species photographed on a given night was assigned an identification number.

To allow us to calculate the number of species recorded during each sampling event, in each forest type, and overall within the reserve, the identification numbers were entered into a database and each individual moth photographed was identified to the lowest taxonomic group possible, using online resources and field guides (Iowa State University, 2019; Moul, 2018; Pacific Northwest Moths, 2018; Kavanagh, 2007; Prybol, 2018; Ziegler, 2018; Ratnasingham & Herbert, 2007). Where identification to species level was not possible, morphospecies names were assigned (for example, Geometridae sp.1). Identifications and current taxonomy were reviewed by the Scientific Coordinator of the reserve, and current taxonomy updated based on the following resources: Lepidoptera (Ziegler, 2018; Ratnasingham & Herbert, 2007), Bombycoidea (Kitching et al., 2018), Geometridae (Scoble & Hausmann, 2007), Noctuoidea (Lafontaine & Schmidt, 2010; Zahiri et al., 2010), Pterophoroidea (Gielis, 2005), Pyraloidea (Nuss et al., 2003-2019), Sphingidae (Kitching, 2019), and Torticidae (Gilligan et al., 2018).

In order to determine whether or not we had captured the true species richness of Cloudbridge Nature Reserve, we plotted a species accumulation curve, with number of sampling nights on the x-axis and number of species recorded on the y-axis.

Owing to the non-standardised trapping methods utilised between sampling events and forest types, and the absence of replicates, no statistical tests were performed for this study.

Results

A total of 247 moths were photographed across the 10 sampling nights, consisting of 212 unique species. We were able to identify 40 species to the species level, 14 to genus, 13 to subfamily, 35 to family, and 110 remain unknown. See Appendix A, Table A1 for a list of the identified species, and Appendix B for photographs of each moth species, both identified and unidentified.

Of the 102 species identified to at least family level, the largest number of species belong to the Geometridae family (n=41), followed by Crambidae (n=27) and Erebidae (n=17). Between one and four species were identified across 11 other families (Fig. 2).

The greatest number of moth species were recorded at Casita Blanca (n=94), an area of human-dominated forest, closely followed by GR<30, forest which has been naturally regenerating for under 30 years (n=77; Fig. 3).

The number of moth species recorded within the reserve increased with sampling effort for the first three nights, plateaued between nights three and five, and then increased steeply over the final five trapping nights. This increase was almost four-fold, with the number of species recorded rising from 56 by the fifth night, to 212 by the tenth night (Fig. 4).
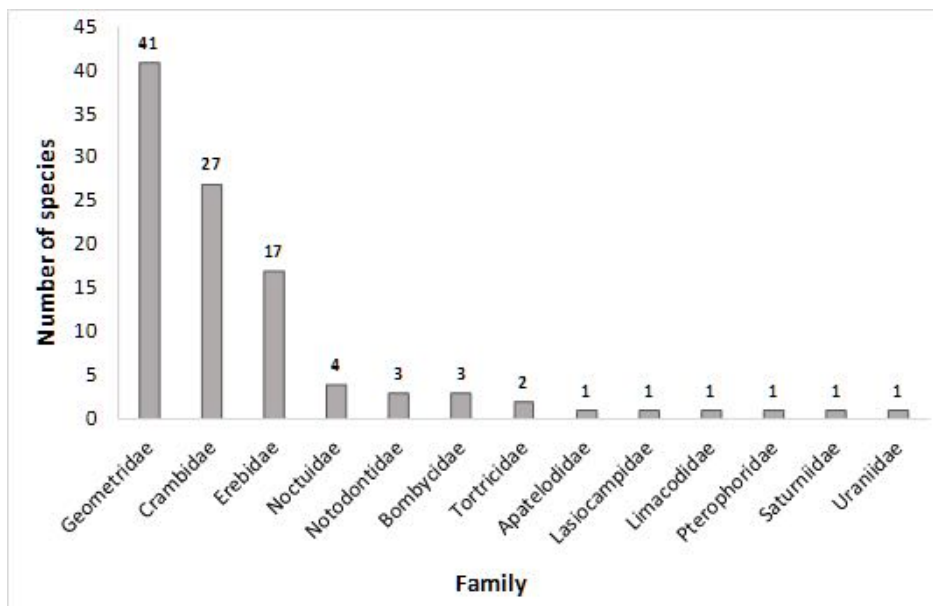
Figure 2. The total number of moth species recorded at Cloudbridge Nature Reserve (n=212) during our study, organised by family.
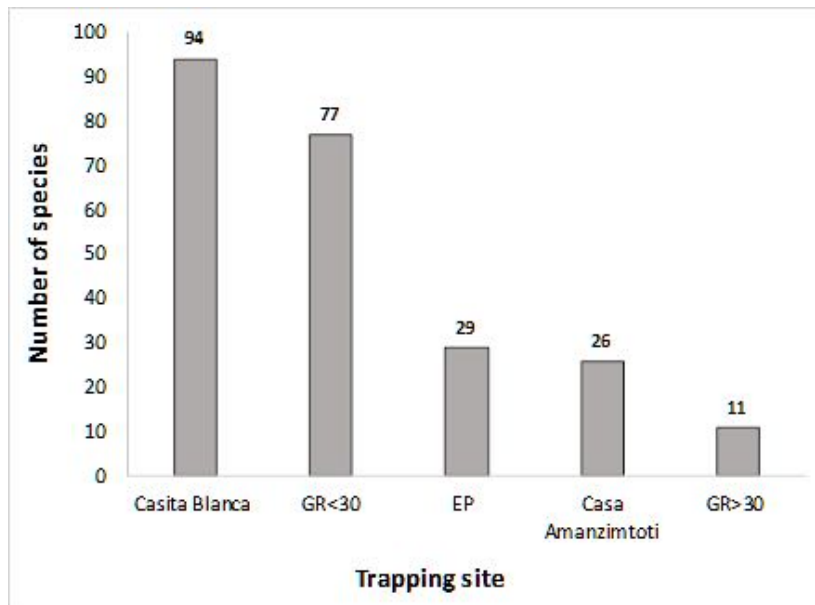
Figure 3. The number of unique moth species recorded at each trapping site. 'Casita Blanca' and 'Amanzimtoti' = human-dominated forest; 'EP' = planted forest; 'GR<30' = forest which has naturally regenerated for under 30 years; 'GR>30' = forest which has naturally regenerated for over 30 years.
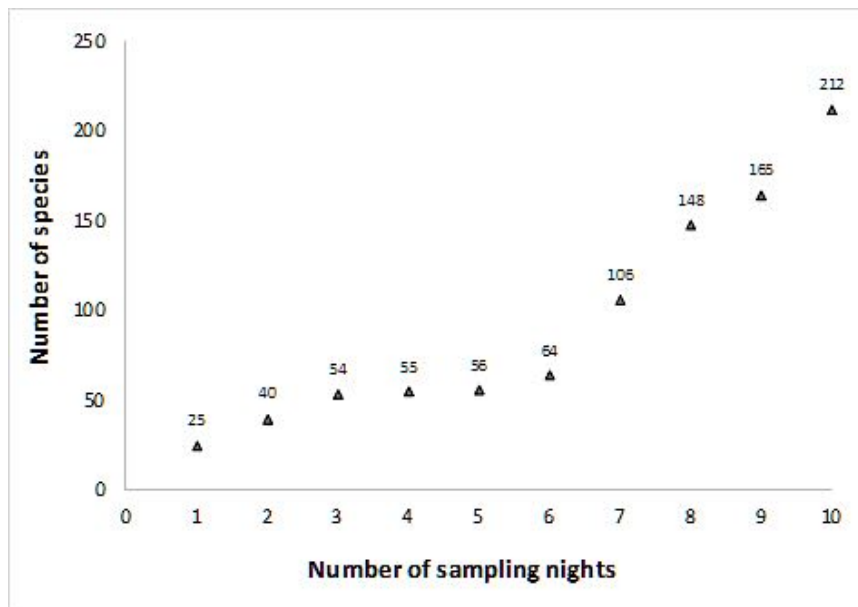
Figure 4. The total number of moth species recorded within the reserve, with increasing survey effort.

Discussion

A key reason for undertaking moth studies at Cloudbridge Nature Reserve was the previous lack of research into this taxonomic group. By trialling different methods of moth surveying, both near to the base and in more remote parts of the reserve, we were able to determine which methods may be most suitable for future studies. Additionally, by positively identifying 40 species, we were able to begin a species list for moths at Cloudbridge, which the reserve can continue to build upon.

Surveying using the outdoor building lights and on the wall at Casita Blanca (wall trap) attracted the largest number of species. This could be due to the relative brightness of the light source when compared with the portable lights used in our other traps, or the larger sampling area provided by the wall compared to the single bed sheet. The area was also much more open than the other trapping sites, potentially making the light visible from a greater distance than at sites with dense vegetation, where light is attenuated quickly (Ricketts et al., 2001). Additionally, the site is surrounded by planted flower beds, which might provide an attractive food source.

We would not recommend using the wall trap as a primary surveying technique because it can only be used at the reserve buildings. Moth species composition and structure differs between forest types (Hawes et al., 2009), making the wall trap unsuitable for determining which moth species are present anywhere but in human-dominated habitat at Cloudbridge. In order to capture the true species richness of Cloudbridge Nature Reserve, which is predominantly composed of four forest types (old-growth, naturally regenerated over 30 years old, naturally regenerated under 30 years old, and planted) with only small pockets of human-dominated habitat, we would advise using a portable sheet trap to enable sampling in all forest types, at any distance from base. However, because a large number of species were attracted to the illuminated walls at Casita Blanca, we would suggest including the wall trap as a supplementary method in studies aiming to extend the species list for the reserve.

The most practical method of surveying was the portable sheet and LED light (sheet trap 2). Carrying the heavy car battery proved impractical on the steep, muddy trails and we were quick to rule out using it. Our homemade bamboo frame was light to carry and quick to erect, making it suitable for surveying even in the most remote parts of the reserve. We would suggest testing a portable black light with this trap, as black light traps can attract significantly more moth species than LED traps (White et al., 2016). We initially ordered black light bulbs to be delivered to the reserve for our study, but when they did not arrive we had to improvise with alternative light sources.

We would also recommend standardising trapping methods across sites and including replicates in future studies. As the main aim of our study was to determine the most practical method for sampling, we did not include replicates and our light sources differed, meaning that we were unable to perform any comparative analyses between forest types. It would be interesting to compare the number of species and the community compositions in the different types of forest present at the reserve.

Another suggestion for future projects is mindfulness of the lunar cycle. Conversely, we believe that the lunar cycle may have affected the presence of moths at the light traps during our study, with moth attraction to the traps seeming lower at full moon (Nowinszky, 1979 & 2012). This may be due to the moon's effect on flight activity, linked to levels of lunar polarized light. When a high proportion of light is polarized, flight activity increases, which varies with each quarter of the lunar cycle (Nowinszky, 2012). If comparisons are to be made between different sites on the reserve, the lunar cycle should be considered in order to prevent differences in abundance recorded as a result of sampling at different times of the month; therefore different sites should be sampled at the same time during the lunar cycle in order to be accurate. Furthermore, the moon's effect would change depending on the weather, so thoroughly checking the forecast and recording weather conditions during sampling might be useful in future studies.

Species accumulation curves can be used to indicate whether or not the species richness of a sample represents the true species richness of an assemblage. The curve is a function of sampling effort on the x-axis and observed species richness on the y-axis, rising steeply at first as sampling effort increases and becoming shallower as rare species require progressively more sampling effort for detection (Gotelli and Chao, 2013). An asymptote represents the maximum number of unique species and the point at which the curve plateaus indicates the sampling effort required to find the true species richness of an area (Gotelli and Chao, 2013). The curve that we plotted shows no sign of plateauing, suggesting that many more moth species are present on the reserve and a greater sampling effort would be required to estimate the species richness at Cloudbridge.

Overall, our study was highly effective educationally, providing the reserve with a number of practical suggestions for the future study of moths. The database that we compiled includes information detailing which species were found at which sites, in order to aid future moth identification at the reserve, and provide understanding of the structure of the Lepidopteran community at Cloudbridge. We hope that by taking good quality photographs and identifying moths present on the reserve, we have provided a useful and worthwhile resource for Cloudbridge to build upon and use for further research into moth ecology.

Figure 5. A selection of the moths species which were identified. Clockwise from top left: *Rhabdatomis draudti,* Erebidae; *Anticla antica*, Bombycidae; *Colla rhodope*, Bombycidae; *Acrosemia tigrata,* Geometridae.

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Appendix A: Species list

Table A1. Moth species identified to species level at Cloudbridge Nature Reserve

Family	Species
Apatelodidae	*Apatelodes turrialba*
Arctiidae	*Pseudomya afflicta*
Bombycidae	*Anticla antica*
	Colla rhodope
Crambidae	*Anarmodia repandalis*
	Diaphania nitidalis
	Lineodes integra
	Neoleucinodes elegantalis
	Patania silicalis
	Syllepis hortalis
Erebidae	*Amastus suffusa*
	Dysschema leda
	Dysschema zeladon
	Epitausa dilina
	Eucereon costulatum
	Eucereon discolor
	Macrocrambus plateada
	Rhabdatomis draudti
Geometridae	*Acrosemia tigrata*
	Anisoperas tessellata
	Argyrotome prospectata
	Charca canopus
	Eois dorisaria
	Hammaptera improbaria
	Idaea similinea
	Iridopsis validaria
	Lomographa argentata

Family	Species
Geometridae *(cont'd)*	*Nematocampa completa*
	Nemoria astraea
	Pero clana
	Phrygionis polita
	Racasta spatiaria
	Scopula umbilicata
	Synchlora dependens
Lasiocampidae	*Euglyphis fibra*
Limacodidae	*Euclea bidiscalis*
Noctuidae	*Emarginea niphoplaga*
Notodontidae	*Chrysoglossa submaxima*
Saturniidae	*Paradirphia talamancaia*
Uraniidae	*Morphomima fulvitacta*

Appendix B: Photographs of Moth Species, by Family

Contents:
- Apatelodidae
- Arctiidae
- Bombycidae
- Crambidae
- Erebidae
- Geometridae
- Lasiocampidae
- Limacodidae
- Noctuidae
- Notodontidae
- Pterophoridae
- Saturniidae
- Tortricidae
- Uraniidae
- Unknown

APATELODIDAE

Moth Number	Species	Photo
043 (pictured, left), 085, 109 (pictured, right)	*Apatelodes turrialba* (colouration dependent on light?)	

ARCTIIDAE

Moth Number	Species	Photo
216	*Pseudomya afflicta*	

BOMBYCIDAE

Moth Number	Species	Photo
006, 036, 158 (pictured), 177	*Anticla antica*	
208	*Colla rhodope*	

CRAMBIDAE

Moth Number	Species	Photo
012 (pictured), 132, 167	*Anarmodia repandalis*	
141, 185 (pictured)	*Desmia sp.1*	
143	*Diaphania nitidalis*	

Moth Number	Species	Photo
075 (pictured), 114	*Diaphania sp.1*	
040	*Lineodes integra*	
013 (pictured), 045	*Neoleucinodes elegantalis*	
039	*Patania silicalis*	

Moth Number	Species	Photo
131	*Spilomelinae sp.1*	
228	*Syllepis hortalis*	
007 (pictured), 106, 122	*Crambidae sp.1*	
129	*Crambidae sp.2*	

Moth Number	Species	Photo
136	*Crambidae sp.3*	
059	*Crambidae sp.4*	
019 (pictured), 137	*Crambidae sp.5*	

Moth Number	Species	Photo
076	*Crambidae sp.6*	
237	*Crambidae sp.7*	
243	*Crambidae sp.8*	

Moth Number	Species	Photo
082	*Crambidae sp.9*	
100	*Crambidae sp.10*	
142	*Crambidae sp.11*	
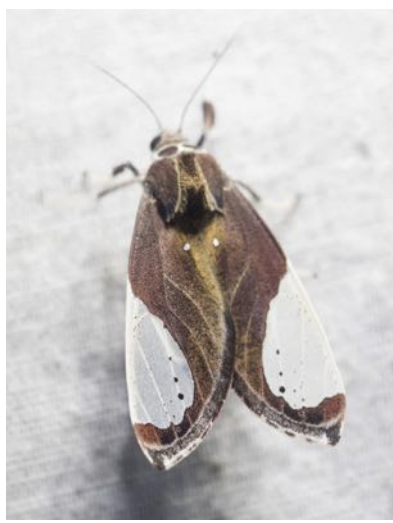
Moth Number	Species	Photo
077	*Crambidae sp.12*	
066	*Crambidae sp.13*	
110	*Crambidae sp.14*	

Moth Number	Species	Photo
146	*Crambidae sp.15*	
128	*Crambidae sp.16*	
232	*Crambidae sp.17*	

Moth Number	Species	Photo
200	*Crambidae sp.18*	

EREBIDAE
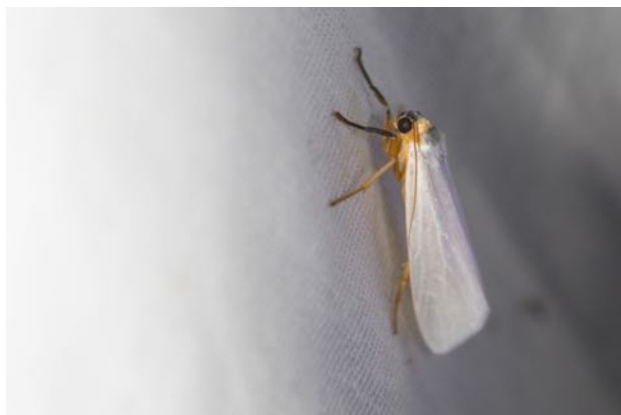
Moth Number	Species	Photo
218	*Amastus suffusa*	
048	*Arctiinae sp.1*	

Moth Number	Species	Photo
213	*Arctiinae sp.2*	
211	*Bertholdia sp.*	
207	*Dysschema leda*	

Moth Number	Species	Photo
206	*Dysschema zeladon*	
017	*Epitausa dilina*	
035 (pictured), 095	*Eucereon costulatum*	

Moth Number	Species	Photo
192	*Eucereon discolor*	
001	*Eucereon sp.1*	
056	*Eucereon sp.2*	

Moth Number	Species	Photo
233	*Herminiinae sp.1*	
015 (pictured), 170	*Macrocrambus plateada*	
171	*Rhabdatomis draudti*	

Moth Number	Species	Photo
134	*Erebidae sp.1*	
058	*Erebidae sp.2*	

GEOMETRIDAE

Moth Number	Species	Photo
101	*Acrosemia tigrata*	
123	*Anisoperas tessellata*	
026, 126 (pictured)	*Argyrotome prospectata*	

Moth Number	Species	Photo
042	*Charca canopus*	
091 (pictured), 258	*Ennominae sp.1*	
163	*Ennominae sp.2*	

Moth Number	Species	Photo
209	*Ennominae sp.3*	
098 (pictured), 210	*Eois dorisaria*	
080	*Epimecis sp.*	

Moth Number	Species	Photo
032	*Eupithecia sp.1*	
118	*Eupithecia sp.2*	
065	*Eupithecia sp.3*	
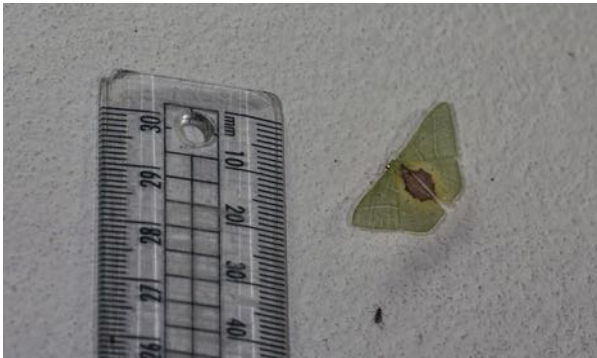
Moth Number	Species	Photo
231	*Eupithecia sp.4*	
50, 115 (pictured), 253	*Geometrinae sp.1*	
227	*Hammaptera improbaria*	

Moth Number	Species	Photo
021 (pictured), 060	*Idaea similinea*	
151 (pictured), 241, 244	*Iridopsis sp.1*	
107, 111 (pictured)	*Iridopsis validaria*	

Moth Number	Species	Photo
186	*Larentiinae sp.1*	
004	*Larentiinae sp.2*	
064	*Larentiinae sp.3*	

Moth Number	Species	Photo
215	*Larentiinae sp.4*	
009 (pictured), 223	*Lobocleta sp.*	
189	*Lomographa argentata*	

Moth Number	Species	Photo
002, 049 (pictured), 194	*Nematocampa completa*	
044	*Nemoria astraea*	
148	*Oxydia sp.1*	

Moth Number	Species	Photo
225	*Pero clana*	
053, 149 (pictured), 219	*Phrygionis polita*	
051	*Racasta spatiaria*	

Moth Number	Species	Photo
047	*Scopula umbilicata*	
023	*Synchlora dependens*	
247	*Geometridae sp.1*	

Moth Number	Species	Photo
245	*Geometridae sp.2*	
079	*Geometridae sp.3*	
046	*Geometridae sp.4*	

Moth Number	Species	Photo
071	*Geometridae sp.5*	
072	*Geometridae sp.6*	
073	*Geometridae sp.7*	

Moth Number	Species	Photo
217	*Geometridae sp.8*	
198	*Geometridae sp.9*	

LASIOCAMPIDAE

Moth Number	Species	Photo
087	*Euglyphis fibra*	

LIMACODIDAE

Moth Number	Species	Photo
214	*Euclea bidiscalis*	

NOCTUIDAE

Moth Number	Species	Photo
205	*Emarginea niphoplata*	
078	*Noctuidae sp. 1*	

Moth Number	Species	Photo
183	*Noctuidae sp.2*	
174	*Noctuidae sp.3*	

NOTODONTIDAE

Moth Number	Species	Photo
003	*Chrysoglossa submaxima*	
018	*Dudusinae sp.1 (Crinodes* or *Oligocentria* sp.)	
54	*Notodontidae sp.1*	

PTEROPHORIDAE

Moth Number	Species	Photo
119	*Pterophoridae sp.1*	

SATURNIIDAE

Moth Number	Species	Photo
212 (pictured), 256	*Paradirphia talamancaia*	

TORTRICIDAE
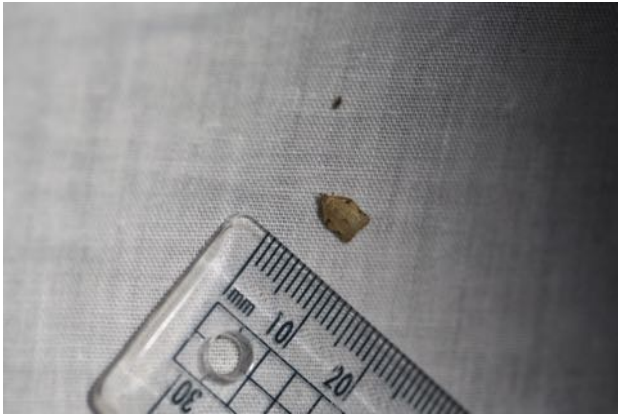
Moth Number	Species	Photo
089	*Amorbia* sp.1 *(productana?)*	
190	*Tortricidae sp.1*	

URANIIDAE

Moth Number	Species	Photo
033	*Morphomima fulvitacta*	

UNKNOWN MOTHS

Moth Number	Species name	Photo	Noticeable Features/Potential Family
173	Unknown sp.1		Geometridae/Erebidae
181	Unknown sp.2		Geometridae/Erebidae
182	Unknown sp.3		Geometridae/Erebidae
055	Unknown sp.4		Geometridae/Notodontidae Wing shape could be from either family, can't find correct markings

Moth Number	Species name	Photo	Noticeable Features/Potential Family
034 (pictured), 168	Unknown sp.5		Limacodidae
010	Unknown sp.6		Amorbia sp. ? (Crambidae, Tortricidae subfamily) Looks like the right shape, but cannot find a species with the right markings
062	Unknown sp.7		Erebidae?

Moth Number	Species name	Photo	Noticeable Features/Potential Family
081	Unknown sp.8		Geometridae?
008	Unknown sp.9		Erebidae/Crambidae?
014	Unkown sp.10		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
024	Unknown sp.11		
025	Unknown sp.12		Noctuidae/Notodontidae?
028	Unknown sp.13		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
031	Unknown sp.14		
041	Unknown sp.15		
052, 184	Unknown sp.16		Noctuidae?
030	Unknown sp.17		Noctuidae? Almost identical to moth 005 - different species or male/female??

Moth Number	Species name	Photo	Noticeable Features/Potential Family
005	Unknown sp.18		Noctuidae? Almost identical to moth 030 - different species or male/female??
063	Unknown sp.19		
074	Unknown sp.20		Pyralidae snout moth?

Moth Number	Species name	Photo	Noticeable Features/Potential Family
083, 202	Unknown sp.21		
086	Unknown sp.22		
088	Unknown sp.23		
090	Unknown sp.24		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
097	Unknown sp.25		
094	Unknown sp.26		
103	Unknown sp.27		Geometridae?
104	Unknown sp.28		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
105	Unknown sp.29		
112	Unknown sp.30		
113	Unknown sp.31		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
116	Unknown sp.32		
117	Unknown sp.33		
147	Unknown sp.34		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
222	Unknown sp.35		
226	Unknown sp.36		
229	Unknown sp.37		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
230	Unknown sp.38		
236	Unknown sp.39		
196	Unknown sp.40		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
197	Unknown sp.41		
124	Unknown sp.42		
125	Unknown sp.43		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
130	Unknown sp.44		
138	Unknown sp.45		Crambidae?
139	Unknown sp.46		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
145	Unknown sp.47		
121	Unknown sp.48		
133	Unknown sp.49		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
127 (pictured), 153	Unknown sp.50		Geometridae, Eupithecia?
150	Unknown sp.51		
152	Unknown sp.52		
154	Unknown sp.53		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
155	Unknown sp.54		
156	Unknown sp.55		
157	Unknown sp.56		
159	Unknown sp.57		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
160	Unknown sp.58		
161	Unknown sp.59		
162	Unknown sp.60		
164	Unknown sp.61		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
166	Unknown sp.62		
176	Unknown sp.63		
178	Unknown sp.64		
179	Unknown sp.65		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
180	Unknown sp.66		
187	Unknown sp.67		
188	Unknown sp.68		
191	Unknown sp.69		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
193	Unknown sp.70		
195	Unknown sp.71		
199	Unknown sp.72		
201	Unknown sp.73		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
203	Unknown sp.74		
204	Unknown sp.75		
221	Unknown sp.76		
224	Unknown sp.77		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
235	Unknown sp.78		
238	Unknown sp.79		Crambidae?
239	Unknown sp.80		
240	Unknown sp.81		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
242	Unknown sp.82		
248	Unknown sp.83		
249	Unknown sp.84		
250	Unknown sp.85		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
252	Unknown sp.86		
254	Unknown sp.87		
257	Unknown sp.88		
175 (pictured), 246	Unknown sp.89		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
234	Unknown sp. 90		
172	Unknown sp. 91		
169	Unknown sp. 92		
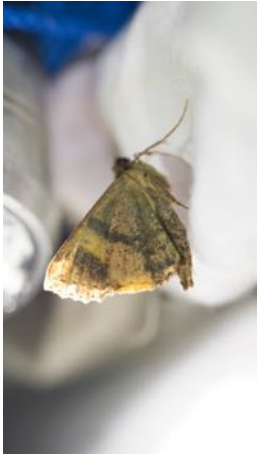
Moth Number	Species name	Photo	Noticeable Features/Potential Family
165	Unknown sp. 93		
140	Unknown sp. 94		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
135	Unknown sp. 95		
120	Unknown sp. 96		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
108	Unknown sp. 97		
102	Unknown sp. 98		
99	Unknown sp. 99		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
93	Unknown sp. 100		
92	Unknown sp. 101		
84	Unknown sp. 102		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
61	Unknown sp. 103		
57	Unknown sp. 104		
38	Unknown sp. 105		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
37	Unknown sp. 106		
27	Unknown sp. 107		
22	Unknown sp. 108		

Moth Number	Species name	Photo	Noticeable Features/Potential Family
20	Unknown sp. 109		
16	Unknown sp. 110		
11	Unknown sp. 111		