

GMP Project Update –Queensland, Australia

July 2017

OVERVIEW

The Global Malaise Program (GMP) is an international collaboration between the Centre of Biodiversity Genomics (CBG, previously Biodiversity Institute of Ontario) and a growing number of international contributors. The program represents a first step toward the acquisition of detailed temporal and spatial information on terrestrial arthropod communities across the globe. Past efforts to include arthropods in terrestrial assessments have faced two serious barriers: ineffective sampling due to habitat complexities, and unreliable tools for species identification. The latter barrier has now been circumvented by DNA barcoding, a method that utilizes sequence variation in a standardized gene fragment to rapidly sort and objectively differentiate species. This approach also makes it possible to carry out large-scale sampling programs and enables a time- and cost-efficient approach for biodiversity assessments. To date, GMP has reached out to over forty countries and sampling has occurred at 63 sites.

As part of GMP, a single Malaise trap was deployed at the Daintree Discovery Centre in Queensland, Australia (16.2382 S, 145.427 E, 86m asl) from September 2014 to August 2015 (Figure 1). Staff at the centre collected trap samples on a weekly basis for approximately one year. A total of 50 samples were collected and sent to CBG in Guelph, Ontario, Canada for DNA barcoding (Table 1).



Figure 1. Image of the Malaise trap (view from above) deployed in September 2014 at Daintree Discovery Centre, Queensland, Australia.

At CBG, samples were accessioned and every other week of collection was chosen for analysis. Specimens were identified to order, labeled, and entered into an internal database. Specimen tissue (either a leg from large specimens or the entire voucher for small specimens) were arrayed into microplates and sent to the lab for DNA extraction and sequencing. All arthropods from samples selected for processing were barcoded, with the exception of a few very common species of Collembola, where only a few individuals from each trap sample were analyzed. Standard barcoding protocols (<http://ccdb.ca/resources.php>) were followed to recover the barcode region of cytochrome c oxidase subunit I (COI) gene. Barcoded specimens were assigned to an existing or new Barcode Index Number (BIN), a proxy for a formal Linnean species name. When a unique BIN was encountered (new BINs to the Barcode of Life Datasystems, BOLD www.boldsystems.org), the voucher was retrieved from the specimen archive and photographed. All barcode sequences, specimen images and collateral data are stored online and the project is available in the 'Global Malaise Program' campaign on BOLD. Identifications were assigned by the BOLD-ID Engine where possible, allowing a preliminary species inventory to be completed for this location and facilitating comparisons among other samplings sites in GMP.

RESULTS

Twenty-five bi-weekly samples were processed which contained a total of 13 269 specimens and a barcode recovery rate of 90.5% was observed. The vast majority of specimens were flies (Diptera), followed in abundance by springtails (Collembola) and bees, ants, and wasps (Hymenoptera) (Figure 2). A range between 291 to 1019 individuals were processed per sample (week). An excess number of springtails (Collembola), soldier fly larvae (Diptera: Stratiomyidae), and ants (Hymenoptera: Formicidae) was observed and excluded from sequencing. A total of 2284 BINs were documented and 90% are new to BOLD as of July 2017. At least 60% of the BINs of each taxon are unique to the Queensland site (Figure 3).

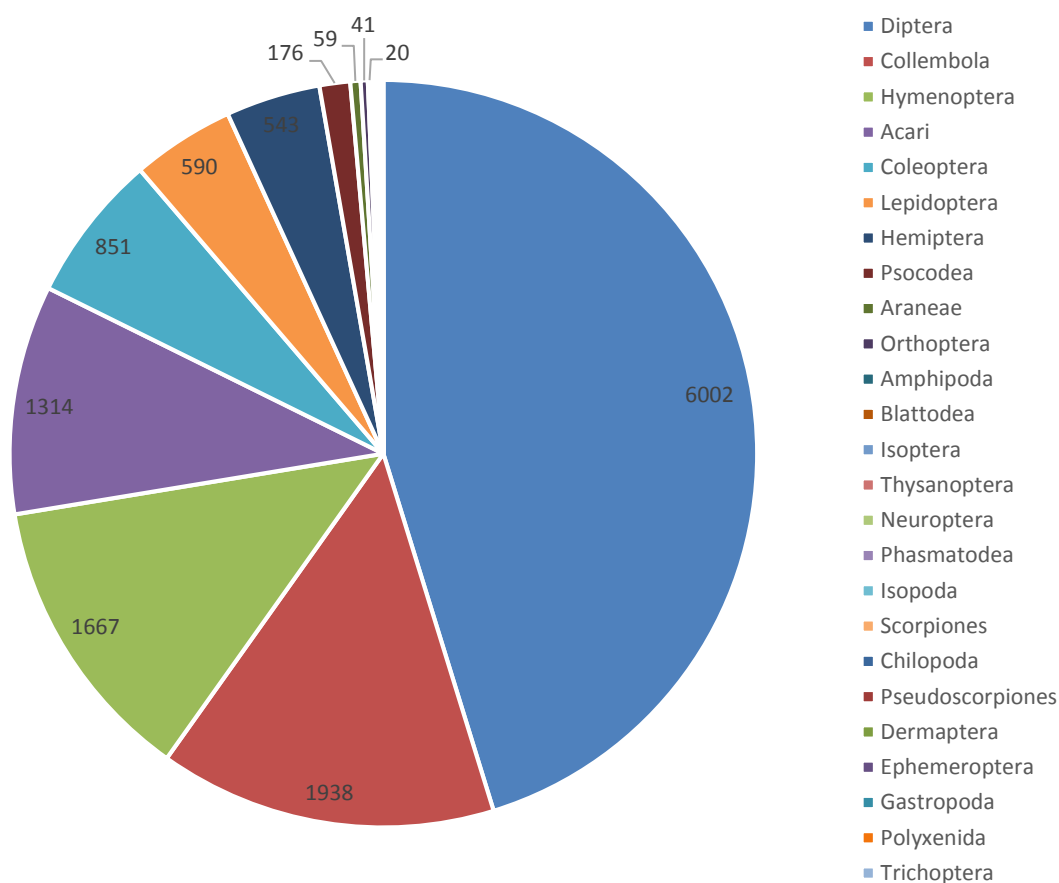


Figure 2. Taxonomy breakdown of specimens processed from the Malaise samples collected in Queensland.

Rarefaction analysis suggests that approximately 3920 BINs are present in this location and could be collected with this method if sampling effort was extended (Figure 4). The pattern of relative species abundance is typical, with a few species represented by many individuals (14 species with >100 individuals) – including 367 individuals of one mite species – and a large number of species with few individuals (1137 singletons) (Figure 5).

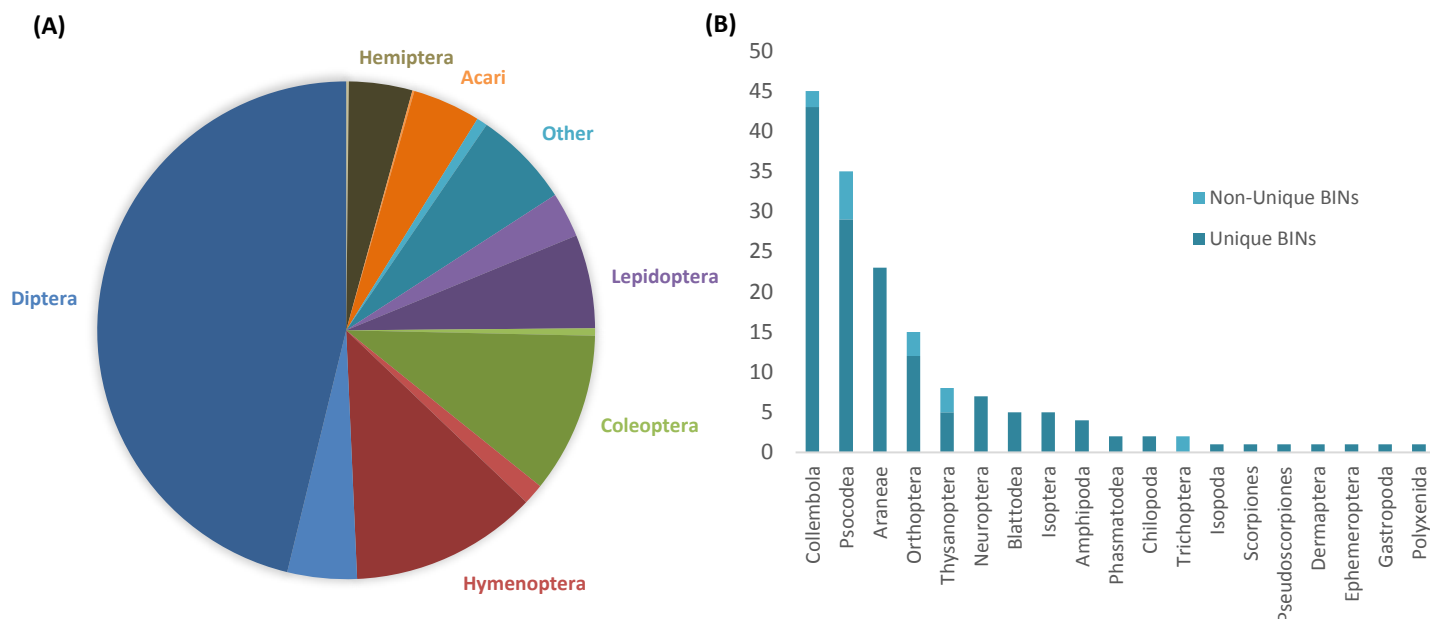


Figure 3. (A) Taxonomy breakdown of BINs collected in Queensland; darker shade of a colour represents the proportion of unique BINs of that taxon. (B) Summary of unique and non-unique BINs contained in “Other” category of (A).

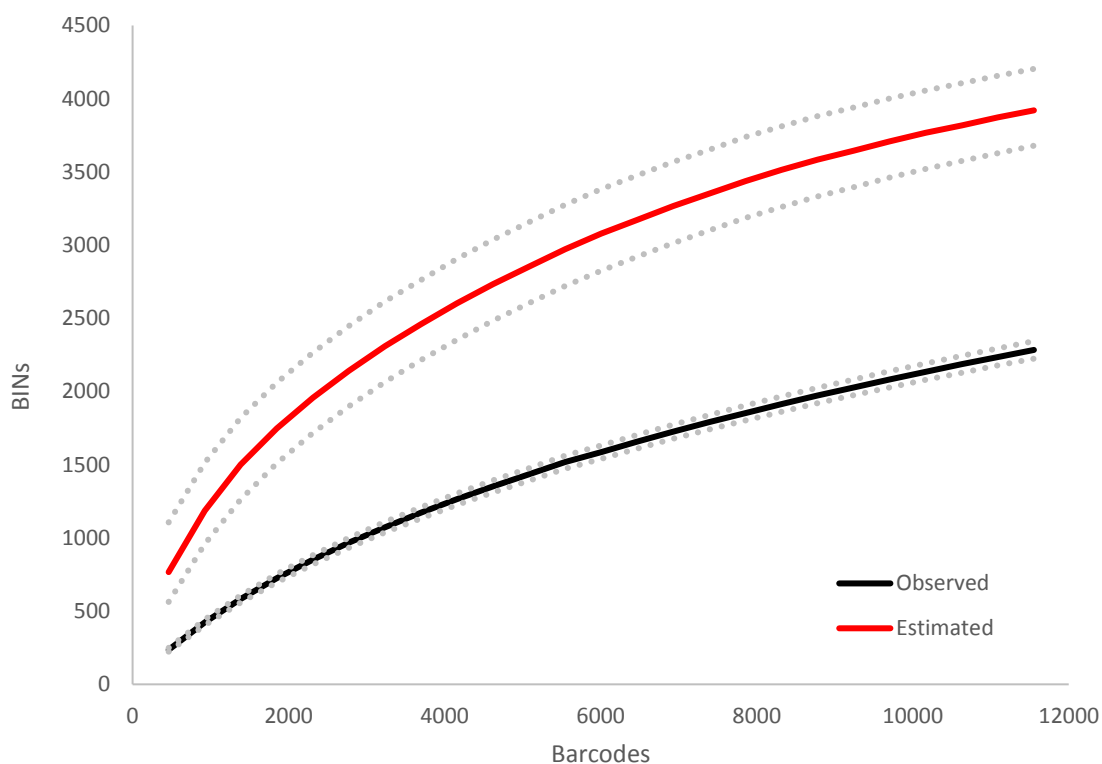


Figure 4. BIN accumulation curve for all specimens collected by the Malaise trap in Queensland.

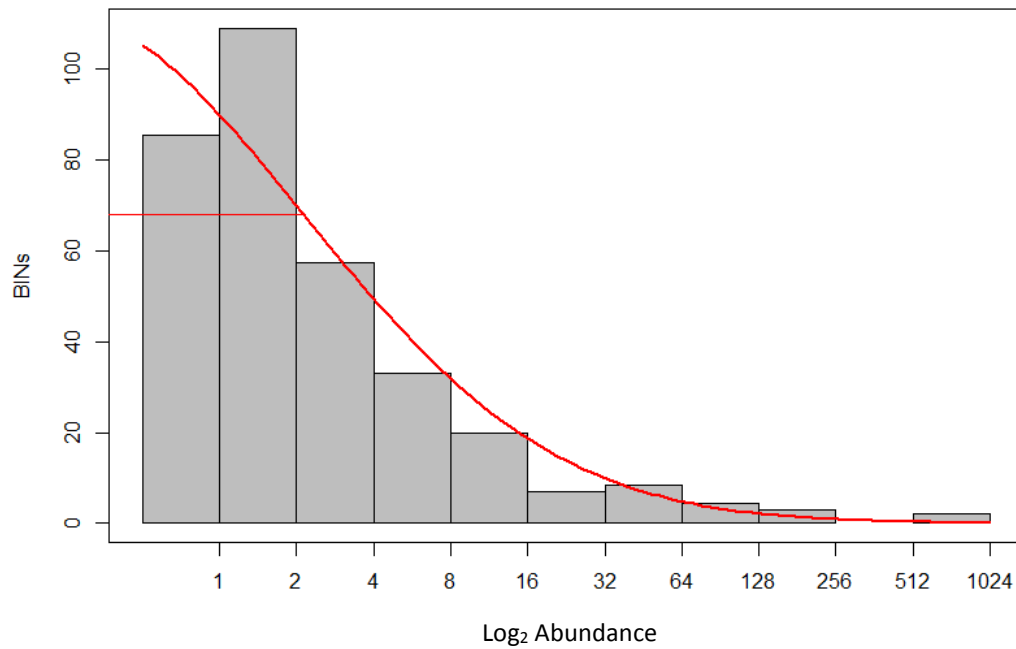


Figure 5. Lognormal species abundance curve, showing the total BINs within each \log_2 abundance frequency interval.

After preliminary taxonomic assignment of BINs, 65 arthropod species were named, representing only 2.8% of the specimens barcoded from the site (Table 2). Over 80% of the BINs were assigned to at least family and 5.8% were assigned to a genus. Specimens collected from Queensland represent 180 different families and 106 genera. It is important to emphasize that it will be possible to identify many of the taxa which currently lack a species name as the barcode reference library becomes more complete.

Table 1. Tracking Sheet of Malaise Samples collected from Queensland.

Sample #	Start Date	End Date	Duration (Days)	BOLD Project	Specimens	Notes
GMP#04988	7-Sep-14	14-Sep-14	7	GMAQA	326	
GMP#04989	14-Sep-14	21-Sep-14	7			
GMP#04990	21-Sep-14	28-Sep-14	7	GMAQB	487	Excess Collembola, Diptera larvae
GMP#04991	28-Sep-14	5-Oct-14	7			
GMP#04992	5-Oct-14	12-Oct-14	7	GMAQC	478	Excess Collembola
GMP#04995	12-Oct-14	19-Oct-14	7			
GMP#04996	19-Oct-14	26-Oct-14	7	GMAQD	414	Excess Collembola
GMP#04997	26-Oct-14	2-Nov-14	7			
GMP#04998	2-Nov-14	9-Nov-14	7	GMAQE	346	Excess Collembola
GMP#04999	9-Nov-14	16-Nov-14	7			
GMP#05000	16-Nov-14	23-Nov-14	7	GMAQF	460	Excess Collembola
GMP#05001	23-Nov-14	30-Nov-14	7			
GMP#05002	30-Nov-14	6-Dec-14	6	GMAQG	291	Excess Collembola
GMP#05003	6-Dec-14	14-Dec-14	8			
GMP#05004	14-Dec-14	21-Dec-14	7	GMAQH	447	Excess Collembola
GMP#05005	21-Dec-14	28-Dec-14	7			
GMP#05006	28-Dec-14	4-Jan-15	7	GMAQI	421	Excess Collembola
GMP#05007	4-Jan-15	11-Jan-15	7			
GMP#05008	11-Jan-15	18-Jan-15	7	GMAQJ	943	Excess Collembola
GMP#05009	18-Jan-15	25-Jan-15	7			
GMP#05010	25-Jan-15	1-Feb-15	7	GMAQK	901	Excess Collembola, Diptera larvae
GMP#05011	1-Feb-15	7-Feb-15	6			
GMP#05012	7-Feb-15	14-Feb-15	7	GMAQL	993	Excess Formicidae, Diptera larvae, Collembola
GMP#05013	14-Feb-15	21-Feb-15	7			
GMP#05014	21-Feb-15	28-Feb-15	7	GMAQM	809	Excess Collembola
GMP#05015	28-Feb-15	7-Mar-15	7			
GMP#05016	7-Mar-15	14-Mar-15	7	GMAQN	387	Excess Collembola
GMP#05017	14-Mar-15	21-Mar-15	7			
GMP#05018	21-Mar-15	28-Mar-15	7	GMAQO	499	Excess Collembola
GMP#05020	28-Mar-15	4-Apr-15	7			
GMP#05021	4-Apr-15	11-Apr-15	7	GMAQP	571	Excess Collembola
GMP#05022	11-Apr-15	18-Apr-15	7			
GMP#05023	18-Apr-15	25-Apr-15	7	GMAQQ	1019	Excess Collembola
GMP#05019	25-Apr-15	2-May-15	7			
GMP#05028	2-May-15	9-May-15	7	GMAQR	389	Excess Collembola
GMP#05024	9-May-15	16-May-15	7			
GMP#05025	16-May-15	23-May-15	7	GMAQS	442	Excess Collembola
GMP#05026	23-May-15	30-May-15	7			
GMP#05027	30-May-15	6-Jun-15	7	GMAQT	516	Excess Collembola
GMP#05029	6-Jun-15	13-Jun-15	7			
GMP#05030	13-Jun-15	20-Jun-15	7	GMAQU	534	Excess Collembola
GMP#05031	20-Jun-15	27-Jun-15	7			
GMP#05032	27-Jun-15	4-Jul-15	7	GMAQV	514	Excess Collembola
GMP#05033	4-Jul-15	11-Jul-15	7			
GMP#05034	11-Jul-15	18-Jul-15	7	GMAQW	340	Excess Collembola
GMP#05035	18-Jul-15	25-Jul-15	7			
GMP#05036	25-Jul-15	1-Aug-15	7	GMAQX	431	Excess Collembola
GMP#05037	1-Aug-15	8-Aug-15	7			
GMP#05038	8-Aug-15	15-Aug-15	7	GMAQY	311	Excess Collembola
GMP#05039	15-Aug-15	22-Aug-15	7			

Table 2. Taxonomic summary of the BINs collected in Queensland including identification assignment progress.

Class	Order	BINs	Family assignment	Genus assignment	Species assignment
Insecta		2101	1794	130	63
	Lepidoptera	206	151	69	38
	Diptera	1158	1046	29	10
	Hymenoptera	309	282	19	8
	Psocodea	35	35	1	
	Blattodea	5	5		
	Coleoptera	249	238	8	5
	Dermaptera	1	1		
	Ephemeroptera	1			
	Hemiptera	98	15		
	Isoptera	5	5		
	Neuroptera	7	5		
	Orthoptera	15			
	Phasmatodea	2	1		
	Thysanoptera	8	8	2	1
	Trichoptera	2	2	2	1
Arachnida		129	47	2	2
	Araneae	23	22	2	2
	Mesostigmata	4	4		
	Pseudoscorpiones	1	1		
	Sarcoptiformes	5	3		
	Scorpiones	1	1		
	Trombidiformes	16	16		
	Unassigned	79			
Collembola		45	30		
	Collembola	23	20		
	Poduromorpha	6	2		
	Symphyleona	16	8		
Malacostraca		5			
	Amphipoda	4			
	Isopoda	1			
Chilopoda		2	1		
	Scolopendromorpha	1	1		
	Unassigned	1			
Diplopoda		1	1		
	Polyxenida	1	1		
Gastropoda		1			
	Unassigned	1			
Grand Total		2284	1873	132	65