SPECIES RICHNESS AND COMPOSITION OF ALIEN PLANT SPECIES IN MARAI PARAI, KINABALU PARK, MALAYSIA

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ABSTRACT

The spread of invasive alien plant species poses a significant challenge to global biodiversity, particularly in protected areas like Kinabalu Park in Sabah, Malaysia, a UNESCO World Heritage Site. This study investigates the species richness and composition of alien plants along two trails from Kampung Kiau Nuluh to Marai Parai on Mount Kinabalu's western slope, within an ultramafic forest ecosystem. The old trail spans elevations from 880 m to 1,670 m, while the new trail ranges from 1,020 m to 1,470 m. Opportunistic sampling yielded 102 specimens of alien plants, representing 76 species across 30 families. The old trail exhibited greater species richness (66 species) compared to the new trail (23 species), influenced by its proximity to the densely populated Kampung Kiau Nuluh. Many alien plants along the old trail were planted for ornamental purposes, while others spread naturally. The Asteraceae family, notably *Ageratum conyzoides* L. and *Bidens pilosa* L., are particularly invasive in Marai Parai. To address this, enhanced monitoring, public awareness initiatives, and collaboration with the Kampung Kiau Nuluh community are recommended to curb the spread of alien plants and protect indigenous biodiversity. This research highlights the need for understanding alien plant dynamics to manage conservation efforts in Kinabalu Park effectively.

Keywords: *Kinabalu Park, Marai Parai, ultramafic forest, alien plant species, species richness*

INTRODUCTION

Invasive Alien Species (IAS) are distinguished by their rapid reproductive rates, vigorous growth, and adeptness in adapting to novel conditions (Chinchio et al., 2020), frequently outcompeting native plants in competition. Their presence can lead to significant ecological disruptions, altering ecosystem structures and impeding biological and physical system organization (Witt et al., 2020). IAS can also contribute to pathogen pollution, leading to the emergence of diseases in the invaded area. These species are a significant threat to biodiversity conservation, especially in protected areas.

Understanding the diversity and distribution of Alien Plant Species (APS) is crucial for developing effective conservation and management strategies, particularly in Kinabalu Park protected area. Globally, tropical regions' biodiversity hotspots face high vulnerability (Brook et al., 2008). Rapid globalization and human-induced environmental changes worldwide have significantly raised concerns about the introduction and spread of APS (Bradley et al., 2012). These non-native species, often introduced unintentionally or intentionally for various purposes, can disrupt ecosystems, threaten native biodiversity and undermine ecosystem services (Polce et al., 2023).

Mountain ecosystems are becoming increasingly invaded by non-native plant species due to climate change, human activities, and disturbances such as tourism and recreation infrastructure (Iseli et al., 2023). Studies have shown that the number of non-native species is increasing along mountain roads and trails, with higher richness at lower elevations (Clavel et al., 2020). Anthropogenic factors, such as human disturbance and propagule pressure, significantly contribute to driving non-native plant invasions in mountain ecosystems. Implementing management strategies to reduce propagule pressure and disturbance in high-elevation environments is crucial for preventing further invasions and protecting the conservation significance of mountain ecosystems.

Access to Marai Parai, situated on the western slope of Mount Kinabalu, offers a unique ecological setting that warrants comprehensive investigation regarding APS species richness and composition. The Marai Parai ridge, encompasses an expansive grassy plateau, dense forest canopy, and a distinctive ultramafic forest, linking Alexandra’s Peak with Mount Nungkok, which was previously known as Mount Sadok-Sadok. Despite the critical importance of this area for biodiversity conservation, there exists a notable gap in scientific knowledge regarding the presence and spread of APS within its boundaries.

The objective of this study is to assess APS species richness and composition along the old and new trails in the Marai Parai area, crucial for understanding regional ecological dynamics. Analysing APS occurrences helps comprehend their potential impact, aiming to fill scientific knowledge gaps and design effective management strategies. Ultimately, the goal is to develop a management plan for APS in Marai Parai, Kinabalu Park, supporting the conservation of native biodiversity and ecosystem integrity.

MATERIALS AND METHODS

Marai Parai is situated in the vicinity of Kinabalu Park, a UNESCO World Heritage Site renowned for its rich biodiversity and unique montane ecosystems. The name "Marai Parai" comes from the Dusun language, where "parai" refers to hill paddy. The area is characterized

by the dominance of the grass-like sedge *Tetraria pilisepala*, which lends credence to its moniker "marai-parai," evoking the image of rice swaying in the breeze. Kampung Kiau Nuluh, Sabah, Malaysia, is the nearest village, located approximately 96 km from Kota Kinabalu and 37 km from the nearest township of Ranau.

Marai Parai sits atop a small, sloping plateau on the most accessible part of the spur, reaching an elevation of about 1,670 m, with the trail starting from Kampung Kiau Nuluh at approximately 880 m asl. Even from a distance, botanists have been drawn to the recognizable, distinctive open, grassy vegetation of Marai Parai since Sir Hugh Low and Sir Spenser Buckingham St. John explored the area in 1858.

The trail spans approximately 6 km from the starting point in Kampung Kiau Nuluh to Marai Parai. It takes about 5-6 hours to traverse, crossing several rivers with steep ridges before reaching a final ascent of about 1 km. APS collections covered both the old and new trails, linking five sites: Kiau Nuluh Base Camp (KNBC), Starting Point KM 0 (SP0), Nunuk Subcamp (NS), Marai Parai Subcamp (MPS), and Lanting Campsite (LC) (Figure 1). Since 1858, the old trail (KNBC – MPS), spanning elevations from 880 m to 1,670 m, has been the preferred route for most tourists and researchers ascending to Marai Parai. Conversely, the new trail (KM 0.7 – KM 4.6), ranging from 1,020 m to 1,470 m, has been accessible to the community since 2014, with its designation for ecotourism since 2017.

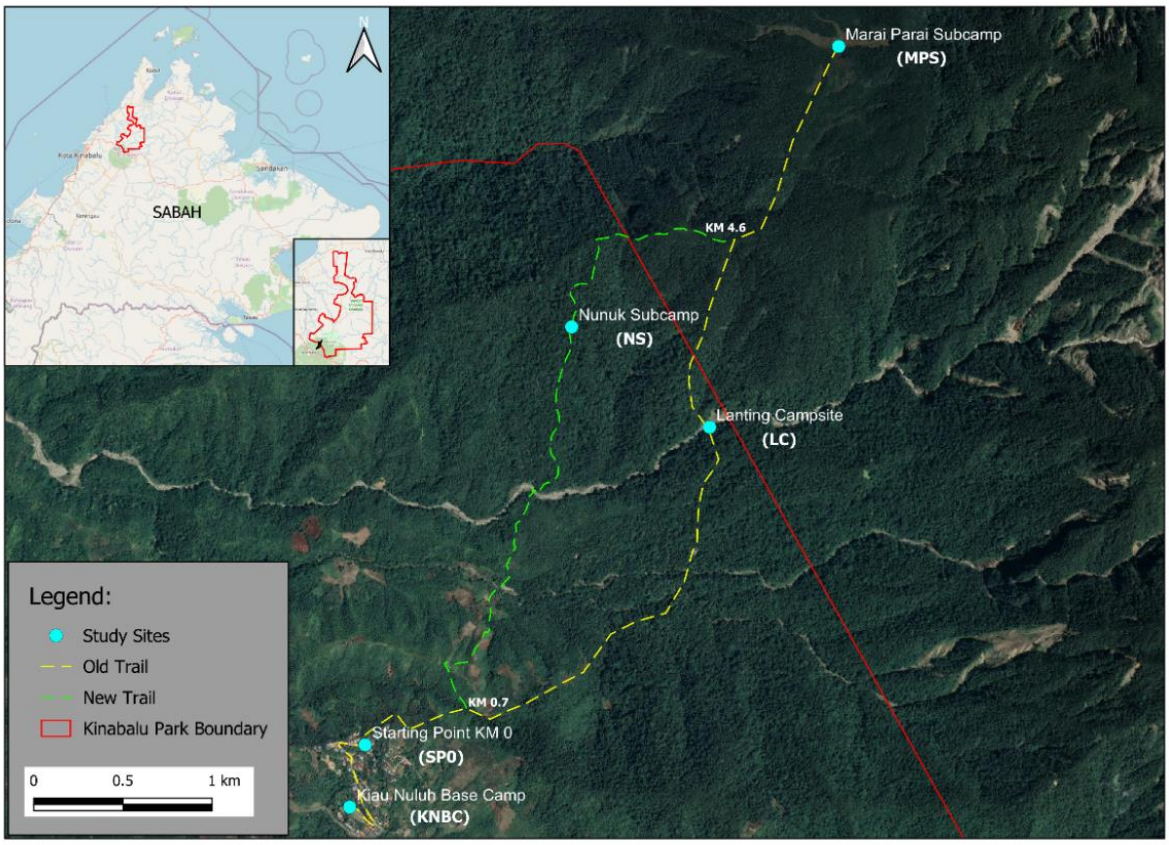

Figure 1. Study sites along the old and new trails in Marai Parai, Kinabalu Park. Inset is a map of Sabah showing the boundaries of Kinabalu Park.

APS samples were opportunistically collected within the study area from October 7th to 20th, 2023. To identify each species, herbarium specimens were collected, and multiple methods were utilized, including literature by Chen (2008) and Witt (2017) and mobile application tools

Pl@ntNet (Version 3.17.6) and Google Lens. Identified plant species were also verified via Sabah Parks' in-house botanists with Sabah Parks Herbarium (SNP) authentic records and collection. The scientific nomenclature of the identified species was derived from the World Flora Online (2023). We determined the origin of each alien plant species by referencing Plants of the World Online (2023). The identified APS specimens were preserved using standard procedures at SNP, which involved drying, pressing and mounting the plants on paper sheets. These sheets were then labelled with essential information such as the species name, collection location and date of collection, and deposited in SNP for storage and future accessibility for research or educational purposes.

RESULTS AND DISCUSSION

The collection of APS was conducted from both the old trail and the newly established trail along the Marai Parai route (Figure 1). A comprehensive checklist was compiled from 102 APS specimens (Appendix 1) collected across the study sites, representing 76 species and 30 families (Table 1). These specimens encompassed a diverse array of plant types, including herbs, shrubs, grasses, creepers, and trees.

Table 1. A checklist of alien plant species in Marai Parai.

Acanthaceae
Asystasia gangetica (L.) T.Anderson
Hypoestes phyllostachya Baker
Odontonema tubaeforme (Bertol.) Kuntze
Amaranthaceae
Amaranthus blitum L.
Amaranthus cruentus L.
Celosia argentea L.
Iresine diffusa f. herbstii (Hook.) Pedersen
Apiaceae
Eryngium foetidum L.
Araceae
Syngonium podophyllum Schott
Zamioculcas zamiifolia (G.Lodd.) Engl.
Asparagaceae
Cordyline fruticosa (L.) A.Chev.
Dracaena braunii Engl.
Dracaena fragrans (L.) Ker Gawl.
Asteraceae
Acmella caulirhiza Delile
Ageratum conyzoides L.
Bidens alba DC.
Bidens pilosa L.
Chromolaena odorata (L.) R.M.King & H.Rob.
Crassocephalum crepidioides S.Moore
Crepis pulchra L.
Elephantopus mollis Kunth

Erechtites valerianifolius (Wolf) DC.
Erigeron canadensis L.
Galinsoga parviflora Cav.
Galinsoga quadriradiata Ruiz & Pav.
Mikania micrantha Kunth
Sonchus oleraceus L.
Sphagneticola trilobata (L.) Pruski
Synedrella nodiflora Gaertn.
Tithonia diversifolia (Hemsl.) A.Gray

Balsaminaceae

Impatiens balsamina L.

Brassicaceae

Nasturtium officinale R.Br.

Caryophyllaceae

Arenaria serpyllifolia L.
Drymaria cordata Willd. ex Schult.

Convolvulaceae

Ipomoea purpurea (L.) Roth

Cucurbitaceae

Sicyos edulis Jacq.

Euphorbiaceae

Euphorbia pulcherrima Willd. ex Klotzsch
Hevea brasiliensis (Willd. ex A.Juss.) Müll.Arg.
Manihot esculenta Crantz

Fabaceae

Aeschynomene americana L.
Arachis duranensis Krapov. & W.C.Greg.
Senna papillosa (Britton & Rose) H.S.Irwin & Barneby

Lamiaceae

Clerodendrum quadriloculare (Blanco) Merr.
Plectranthus decurrens Gürke J.K.Morton
Plectranthus monostachyus (P.Beauv.) B.J.Pollard
Holmskioldia sanguinea Retz.
Hyptis brevipes Poit.

Lythraceae

Cuphea hyssopifolia Kunth

Malvaceae

Hibiscus rosa-sinensis L.

Mazaceae

Mazus pumilus (Burm.f.) Steenis

Melastomaceae

Miconia crenata (Vahl) Michelang.

Moraceae

Morus alba L.

Onagraceae

Ludwigia erecta (L.) H.Hara

Pandanaceae
Pandanus amaryllifolius Roxb.
Plantaginaceae
Plantago major L.
Scoparia dulcis L.
Poaceae
Axonopus compressus (Sw.) P.Beauv.
Ehrharta erecta Lam.
Imperata cylindrica (L.) Raeusch.
Panicum capillare L.
Paspalum paniculatum L.
Polygalaceae
Polygala paniculata L.
Polygonaceae
Antigonon leptopus Hook. & Arn.
Rubiaceae
Coffea arabica L.
Mitracarpus hirtus (L.) DC.
Spermacoce exilis (L.O.Williams) C.D.Adams ex W.C.Burger & C.M.Taylor
Solanaceae
Solanum americanum Mill.
Solanum betaceum Cav.
Solanum nigrum L.
Solanum torvum Sw.
Verbenaceae
Duranta erecta L.
Lantana camara L.
Stachytarpheta cayennensis (Rich.) Vahl
Viburnaceae
Sambucus canadensis L.
Sambucus nigra L.
Zingiberaceae
Curcuma longa L.

APS have been found on both old and newly established trails. Studies revealed that the old trail has a higher number of APS, totalling 66 species, compared to the new trail, which has 23 species. We observed a notable abundance of APS along the old trail from KNBC to SP0 during our sampling, likely due to the dense human population in the vicinity. Additionally, this route is situated farthest from the protected area. This aligns with the research conducted by Hanberry (2023), which identified a correlation between high human population densities and increased occurrences of alien plant species.

Notably, many of the alien plants encountered along the old trail were intentionally cultivated by the local community for landscaping purposes. Nonetheless, it was observed that some of the APS were disseminated naturally. Therefore, it is crucial to acknowledge the potential risks associated with such practices, as certain alien species have the capacity to become invasive and pose a threat to the ecosystem. The effects of invasive species are profound and can result

in irreparable harm to ecosystems, prompting alterations in the composition of native species and the overall ecological balance (Loop et al., 2023).

Remarkably, no APS has been detected along the new trail from KM 4.6 to MPS, likely due to the infrequent human traffic along this route, yet the forest ecosystem in the region remains undisturbed. Additionally, the trail from KM 4.6 to MPS is located within Kinabalu Park, at an elevation ranging from approximately 1,470 to 1,670 m. This result agrees with studies indicating an overall trend of relatively low occurrence of alien plant species along trails near protected areas in high elevations (Barros et al., 2022; Liedtke et al., 2020).

From this study, it's important to note that for a better comparison of APS species richness, a total of four sampling units was suggested for future studies. The new trail and the old trail, both starting from KM 0.7 and extending to KM 4.6, functioned as two distinct units. Meanwhile, the trail segments before KM 0.7 and after KM 4.6 acted as separate sampling units. The data from all four units were compiled into a comprehensive list. However, subsequent comparisons of APS species richness focused solely on the old versus new trails (KM 0.7 – KM 4.6).

The dominance of the Asteraceae family, with 17 species representing 57% of the total APS recorded in the study areas (Figure 2), underscores its significant presence and impact within these ecosystems. Significantly, Wagh & Jain (2018) emphasized the Asteraceae as a family of invasive alien plants that exhibit superior reproductive capabilities and greater potential for expansion compared to other plant families. This suggests that the characteristics of the Asteraceae family, such as efficient seed dispersal mechanisms and rapid growth rates, contribute to its invasive success in various environments.

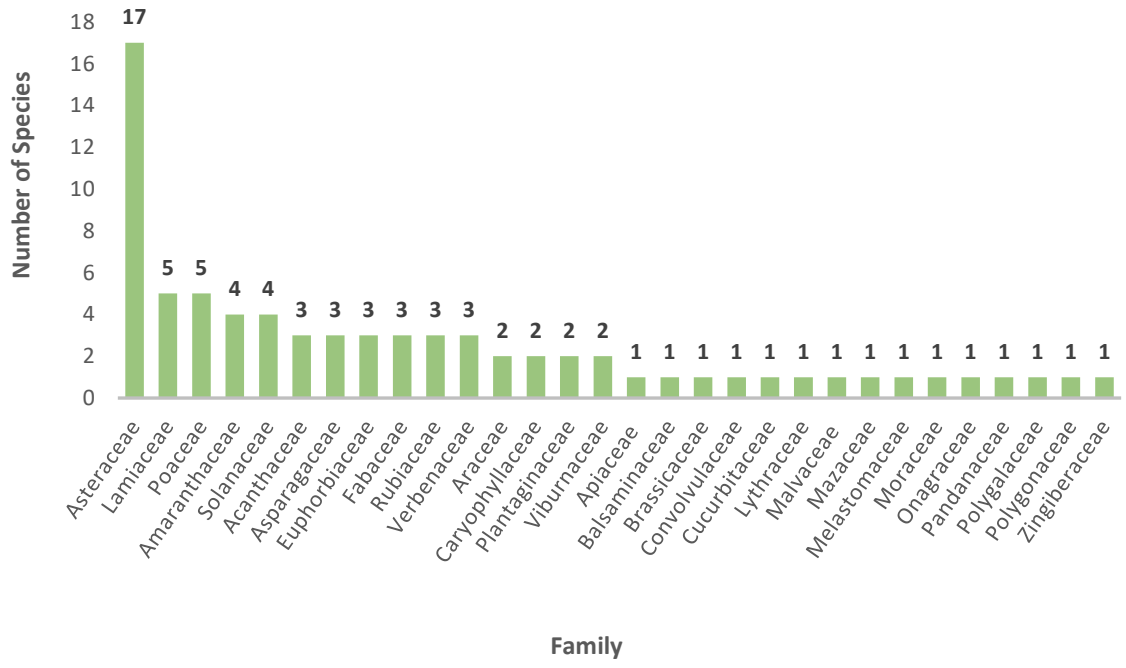

Figure 2. The number of alien plant species categorized by family that were recorded in Marai Parai.

Interestingly, *Ageratum conyzoides* L. (billygoat weed) and *Bidens pilosa* L. (black-jack), both belonging to the Asteraceae family, are invasive species in Malaysia (Figure 3). They have

emerged as the most prevalent species within the study area. These two species were found in old and new trails, yet they were notably absent from the trail connecting KM 4.6 to MPS. *Ageratum conyzoides* is native to Mexico and has been introduced to many tropical and subtropical regions worldwide (Plants of the World Online, 2023). Sharma & Shivani (2020) identified *A. conyzoides* as one of the four invasive alien species examined in the vicinity of Jalandhar, India. Their study indicates that this species has the potential to adapt to abiotic stress, which may contribute to its invasiveness. This finding underscores the significant threat that *A. conyzoides* poses to the local environment in Marai Parai area. *Bidens pilosa* is locally found in the Tropical and Subtropical of America but has spread to various parts of the world. *Bidens pilosa*, as an invasive species, demonstrates remarkable adaptability to varying conditions of water, light and nutrient availability, as well as temperature (Kato-Noguchi & Kurniadie, 2024). This adaptability enables it to outcompete native species across a broad range of environmental conditions. Therefore, comprehending the underlying mechanisms driving the invasive behaviour of these species is essential for formulating effective management strategies to mitigate their impact on native ecosystems.

Figure 3: The most widespread alien plant species in Marai Parai. (A) *Ageratum conyzoides* L. (invasive) and (B) *Bidens pilosa* L. (invasive).

The occurrence of APS within the study area highlights the complex interplay among human actions, ecosystem processes and the preservation of biodiversity. Although certain APS was deliberately introduced for landscaping and practical reasons, their invasive potential highlights the importance of meticulous management approaches. It is essential to grasp the distribution trends and ecological consequences of APS, especially within protected regions such as Marai Parai, Kinabalu Park, to safeguard indigenous biodiversity and maintain ecosystem resilience.

CONCLUSION

The comprehensive checklist obtained from this study recorded 76 alien plants in Marai Parai, Kinabalu Park, with notable concentrations observed along certain trails, especially in areas with dense human populations and instances of disturbance. The prevalence of specific invasive species, such as *A. conyzoides* and *B. pilosa*, emphasizes the necessity for proactive management strategies. Understanding APS dynamics along nature trails is crucial for preserving the local ecosystem's integrity and ensuring the sustainability of recreational and conservation activities. Recommendations based on these findings include implementing measures to prevent further APS spread, particularly along trails with high human activity, through increased monitoring, public awareness campaigns and targeted invasive species removal. Additionally, fostering collaboration among local communities, conservation

organizations and governmental agencies is essential for implementing sustainable management practices to preserve indigenous biodiversity and maintain ecosystem resilience within protected areas of Kinabalu Park.

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AUTHOR CONTRIBUTIONS

Conceptualization: VTJ; Data curation: VTJ, KKJ, HJ; Formal analysis, Software and Visualization: VTJ, KKJ; Writing – original draft: VTJ; Methodology: VTJ; Data validation, Review and editing: VTJ, KKJ; Supervision and Project administration: VTJ; Revision: VTJ. All authors have read and approved the final manuscript. Figure 3 in this manuscript were photographed by VTJ.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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APPENDIX

Appendix 1. The specimens of alien plant species were collected in Marai Parai, Kinabalu Park.

NO.	SNP NO.	FAMILY	SPECIES	TYPE OF PLANT	ORIGIN (Country/ Continent)	ENGLISH NAME	SITES	LATITUDE (N)	LONGITUDE (E)	ELEVATION (m a.s.l)
1	SNP 43101	Acanthaceae	*Asystasia gangetica* (L.) T.Anderson	herbs	Indian Subcontinent to N. & E. Australia	Chinese violete	KNBC to MPS (Old trail)	6.04305 (KNBC) 6.08188 (MPS)	116.49589 (KNBC) 116.52055 (MPS)	880 - 1670
2	SNP 43102	Asteraceae	*Ageratum conyzoides* L.	herbs	Mexico	Billygoat-weed				
3	SNP 43103	Melastomaceae	*Miconia crenata* (Vahl) Michelang.	shrubs	Mexico to Tropical America	Koster's curse				
4	SNP 43104	Plantaginaceae	*Plantago major* L.	herbs	Temp. Eurasia to Arabian Peninsula, Macaronesia, N. & S. Africa	Greater plantain				
5	SNP 43106	Solanaceae	*Solanum torvum* Sw.	shrubs	Mexico to N. South America, Caribbean, E. Brazil	Turkey berry				
6	SNP 43107	Verbenaceae	*Lantana camara* L.	shrubs	Mexico to Tropical America	Lantana				

7	SNP 43110	Euphorbiaceae	*Euphorbia pulcherrima* Willd. ex Klotzsch	shrubs	Mexico to Guatemala	Poinsettia				
8	SNP 43111	Amaranthaceae	*Iresine diffusa* f. *herbstii* (Hook.) Pedersen	shrubs	N. Peru	Bloodleaf				
9	SNP 43112	Asteraceae	*Mikania micrantha* Kunth	creepers	Tropical & Subtropical America	Bitter vine				
10	SNP 43113	Polygalaceae	*Polygala paniculata* L.	herbs	Mexico to Tropical America	Island snake -root				
11	SNP 43114	Lamiaceae	*Clerodendrum quadriloculare* (Blanco) Merr.	shrubs	Philippines, New Guinea	Philippine glorybower				
12	SNP 43115	Viburnaceae	*Sambucus nigra* L.	tree	Azores, Europe to W. Iran	Elderberrry				
13	SNP 43118	Acanthaceae	*Hypoestes phyllostachya* Baker	shrubs	Madagascar	Polka dot plant				
14	SNP 43120	Rubiaceae	*Spermacoce exilis* (L.O.Williams) C.D.Adams ex W.C.Burger & C.M.Taylor	herbs	Mexico to Tropical America	Pacific false buttonweed				
15	SNP 43121	Asteraceae	*Sonchus oleraceus* L.	herbs	Macaronesia, Europe to Medit., Sahara to Arabian Peninsula	Sowthistle				
16	SNP 43122	Balsaminaceae	*Impatiens balsamina* L.	herbs	W. & S. India, Sri Lanka	Garden balsam				

17	SNP 43123	Convolvulaceae	*Ipomoea purpurea* (L.) Roth	creepers	Tropical & Subtropical America	Morning - glory				
18	SNP 43124	Onagraceae	*Ludwigia erecta* (L.) H.Hara	herbs	Tropical & Subtropical America	Primrose				
19	SNP 43125	Apiaceae	*Eryngium foetidum* L.	herbs	Mexico to Tropical America	Spiritweed				
20	SNP 43126	Solanaceae	*Solanum nigrum* L.	herbs	Temp. Eurasia, Macaronesia, N. & NE. Tropical Africa	Black nightshade				
21	SNP 43129	Verbenaceae	*Stachytarpheta cayennensis* (Rich.) Vahl	herbs	S. Mexico to Tropical America	Snakeweed				
22	SNP 43130	Lythraceae	*Cuphea hyssopifolia* Kunth	shrubs	Mexico to Central America	False heather				
23	SNP 43131	Fabaceae	*Aeschynomene americana* L.	shrubs	Tropical & Subtropical America	Shyleaf				
24	SNP 43132	Asteraceae	*Erigeron canadensis* L.	herbs	Tropical & Subtropical America	Horseweed				
25	SNP 43133	Asteraceae	*Galinsoga parviflora* Cav.	herbs	Mexico to Tropical America	Potato weed				
26	SNP 43134	Polygonaceae	*Antigonon leptopus* Hook. & Arn.	creepers	Mexico to Central America	Coral Vine				

27	SNP 43135	Asparagaceae	*Dracaena fragrans* (L.) Ker Gawl.	shrubs	Tropical Africa	Fortune plant				
28	SNP 43136	Lamiaceae	*Plectranthus monostachyus* (P.Beauv.) B.J.Pollard	shrubs	W. Tropical Africa to Sudan	Monkey's potato				
29	SNP 43138	Fabaceae	*Arachis duranensis* Krapov. & W.C.Greg.	creepers	S. Bolivia to NW. Argentina	Wild peanut				
30	SNP 43139	Acanthaceae	*Odontonema tubaeforme* (Bertol.) Kuntze	shrubs	S. Mexico to Colombia	Firespike				
31	SNP 43140	Araceae	*Syngonium podophyllum* Schott	creepers	Mexico to Tropical America	Arrowhead plant				
32	SNP 43141	Asteraceae	*Acmella caulirhiza* Delile	herbs	Tropical & S. Africa, W. Indian Ocean	Toothache plant				
33	SNP 43143	Caryophyllaceae	*Drymaria cordata* Willd. ex Schult.	herbs	Mexico to S. Tropical America, Tropical & S. Africa	Tropical Chickweed				
34	SNP 43144	Asteraceae	*Tithonia diversifolia* (Hemsl.) A.Gray	shrubs	Mexico to Central America	Mexican sunflower				
35	SNP 43145	Poaceae	*Panicum capillare* L.	herbs	Canada to NE. Mexico, Caribbean	Witchgrass				
36	SNP 43146	Asteraceae	*Bidens pilosa* L.	herbs	Tropical & Subtropical America	Spanish needle				

37	SNP 43148	Asteraceae	*Sphagneticola trilobata* (L.) Pruski	creepers	Mexico to S. Tropical America and Trinidad	Creeping oxeye				
38	SNP 43149	Asteraceae	*Crepis pulchra* L.	herbs	Europe to Medit. and Caucasus	Smallflower hawksbeard				
39	SNP 43201	Solanaceae	*Solanum betaceum* Cav.	shrubs	S. Tropical America	Tree tomato				
40	SNP 43202	Mazaceae	*Mazus pumilus* (Burm.f.) Steenis	herbs	Asia	Japanese mazus				
41	SNP 43203	Asteraceae	*Mikania micrantha* Kunth	creepers	Tropical & Subtropical America	Bitter vine				
42	SNP 43204	Euphorbiaceae	*Manihot esculenta* Crantz	shrubs	W. South America to Brazil	Cassava				
43	SNP 43205	Rubiaceae	*Spermacoce exilis* (L.O.Williams) C.D.Adams ex W.C.Burger & C.M.Taylor	herbs	Mexico to Tropical America	Pacific false buttonweed				
44	SNP 43207	Asteraceae	*Bidens pilosa* L.	herbs	Tropical & Subtropical America	Spanish needle				
45	SNP 43208	Asteraceae	*Erigeron canadensis* L.	herbs	Tropical & Subtropical America	Horseweed				
46	SNP 43209	Asteraceae	*Crassocephalum crepidioides* S.Moore	herbs	Tropical & S. Africa, Madagascar	Ebolo				

47	SNP 43210	Asteraceae	*Ageratum conyzoides* L.	herbs	Mexico	Billygoat-weed				
48	SNP 43211	Asparagaceae	*Cordyline fruticosa* (L.) A.Chev.	shrubs	Papuasia to W. Pacific	Ti plant				
49	SNP 43212	Caryophyllaceae	*Drymaria cordata* Willd. ex Schult.	herbs	Mexico to S. Tropical America, Tropical & S. Africa	Tropical chickweed				
50	SNP 43213	Asteraceae	*Chromolaena odorata* (L.) R.M.King & H.Rob.	shrubs	Tropical & Subtropical America	Siam weed				
51	SNP 43214	Melastomaceae	*Miconia crenata* (Vahl) Michelang.	shrubs	Mexico to Tropical America	Koster's curse				
52	SNP 43215	Euphorbiaceae	*Manihot esculenta* Crantz	shrubs	W. South America to Brazil	Cassava				
53	SNP 43217	Asteraceae	*Elephantopus mollis* Kunth	herbs	Tropical & Subtropical America	Devil's grandmother				
54	SNP 43219	Cucurbitaceae	*Sicyos edulis* Jacq.	creepers	Mexico to Belize	Cyayote plant				
55	SNP 43220	Apiaceae	*Eryngium foetidum* L.	herbs	Mexico to Tropical America	Spiritweed				
56	SNP 43221	Asteraceae	*Crassocephalum crepidioides* S.Moore	herbs	Tropical & S. Africa, Madagascar	Ebolo				
57	SNP 43222	Moraceae	*Morus alba* L.	tree	Central China	Mulberry				

58	SNP 43223	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A.Juss.) Müll.Arg.	tree	S. Tropical America	Rubber tree				
59	SNP 43224	Asteraceae	*Bidens alba* DC.	herbs	America	Shepheard's needle				
60	SNP 43225	Zingiberaceae	*Curcuma longa* L.	herbs	SW. India	Turmeric				
61	SNP 43226	Pandanaceae	*Pandanus amaryllifolius* Roxb.	shrubs	Maluku	Pandan				
62	SNP 43227	Asteraceae	*Ageratum conyzoides* L.	herbs	Mexico	Billygoat-weed				
63	SNP 43228	Lamiaceae	*Plectranthus decurrens* Gürke J.K.Morton	herbs	Nigeria to Uganda and Angola	Spurflower				
64	SNP 43230	Lamiaceae	*Hyptis brevipes* Poit.	herbs	Central Mexico to Tropical America	Lesser roundweed				
65	SNP 43231	Polygalaceae	*Polygala paniculata* L.	herbs	Mexico to Tropical America	Island snake -root				
66	SNP 43232	Verbenaceae	*Duranta erecta* L.	shrubs	S. Florida to Caribbean, Mexico to N. America	Golden dewdrop				
67	SNP 43234	Araceae	*Zamioculcas zamiifolia* (G.Lodd.) Engl.	herbs	Kenya to KwaZulu-Natal	Zanzibar gem				

68	SNP 43236	Viburnaceae	*Sambucus canadensis* L.	shrubs	N. America to Venezuela and Bolivia	American elderberry				
69	SNP 43237	Lamiaceae	*Holmskioldia sanguinea* Retz.	shrubs	Himalaya to Myanmar	Chinese hat plant				
70	SNP 43238	Fabaceae	*Senna papillosa* (Britton & Rose) H.S.Irwin & Barneby	shrubs	Mexico to Venezuela	Sena, candelillo				
71	SNP 43239	Rubiaceae	*Coffea arabica* L.	tree	E. South Sudan, SW. Ethiopia, N. Kenya (Mt. Marsibit)	Coffee tree				
72	SNP 43240	Asparagaceae	*Dracaena braunii* Engl.	grasses	W. Central Tropical Africa	Lucky bamboo				
73	SNP 43241	Poaceae	*Axonopus compressus* (Sw.) P.Beauv.	grasses	Tropical & Subtropical America	Carpet grass				
74	SNP 43242	Solanaceae	*Solanum americanum* Mill.	herbs	Tropical & Subtropical America	American black nightshade				
75	SNP 43243	Malvaceae	*Hibiscus rosa-sinensis* L.	shrubs	Vanuatu	Chinese hibiscus				
76	SNP 43245	Poaceae	*Ehrharta erecta* Lam.	grasses	Eritrea to S. Africa, Réunion, Arabian Peninsula	Firegrass				

77	SNP 43246	Poaceae	*Paspalum paniculatum* L.	grasses	Mexico to Tropical America	Broomsedge				
78	SNP 43247	Poaceae	*Imperata cylindrica* (L.) Raeusch.	grasses	Medit. to Africa and Afghanistan	Cogongrass				
79	SNP 43235	Asteraceae	*Bidens pilosa* L.	herbs	Tropical & Subtropical America	Spanish needle				
80	SNP 43150	Melastomaceae	*Miconia crenata* (Vahl) Michelang.	shrubs	Mexico to Tropical America	Koster's curse	KM 0.7 to KM 4.6 (New trail)	6.04814 (KM 0.7) 6.07192 (KM 4.6)	116.50168 (KM 0.7) 116.5139 (KM 4.6)	1020 - 1470
81	SNP 43153	Polygalaceae	*Polygala paniculata* L.	herbs	Mexico to Tropical America	Island snake -root				
82	SNP 43155	Asteraceae	*Mikania micrantha* Kunth	creepers	Tropical & Subtropical America	Bitter vine				
83	SNP 43156	Asparagaceae	*Cordyline fruticosa* (L.) A.Chev.	shrubs	Papuasia to W. Pacific	Ti plant				
84	SNP 43157	Moraceae	*Morus alba* L.	tree	Central China	Mulberry				
85	SNP 43158	Apiaceae	*Eryngium foetidum* L.	herbs	Mexico to Tropical America	Spiritweed				
86	SNP 43159	Amaranthaceae	*Amaranthus blitum* L.	herbs	Peru to Brazil and N. Argentina	Purple amaranth				
87	SNP 43160	Brassicaceae	*Nasturtium officinale* R.Br.	herbs	Europe to Central Asia and	Watercress				

					Arabian Peninsula, Macaronesia, N. & NE. Tropical Africa					
88	SNP 43162	Asteraceae	*Bidens pilosa* L.	herbs	Tropical & Subtropical America	Spanish needle				
89	SNP 43164	Asteraceae	*Ageratum conyzoides* L.	herbs	Mexico	Billygoat-weed				
90	SNP 43165	Lamiaceae	*Hyptis brevipes* Poit.	herbs	Central Mexico to Tropical America	Lesser roundweed				
91	SNP 43167	Asteraceae	*Erigeron canadensis* L.	herbs	Tropical & Subtropical America	Horseweed				
92	SNP 43169	Caryophyllaceae	*Drymaria cordata* Willd. ex Schult.	herbs	Mexico to S. Tropical America, Tropical & S. Africa	Tropical Chickweed				
93	SNP 43171	Amaranthaceae	*Celosia argentea* L.	herbs	Tropical Africa	Silver cock's comb				
94	SNP 43173	Amaranthaceae	*Amaranthus cruentus* L.	herbs	Central Mexico to Nicaragua	Red amaranth				
95	SNP 43174	Asteraceae	*Galinsoga quadriradiata* Ruiz & Pav.	herbs	Mexico to S. Tropical America	Shaggy soldier				

96	SNP 43175	Asteraceae	*Crassocephalum crepidioides* S.Moore	herbs	Tropical & S. Africa, Madagascar	Ebolo				
97	SNP 43176	Asteraceae	*Erechtites valerianifolius* (Wolf) DC.	herbs	Mexico to Tropical America	American burnweed				
98	SNP 43177	Rubiaceae	*Mitracarpus hirtus* (L.) DC.	shrubs	Mexico to Tropical America	Rough matgrass				
99	SNP 43180	Asteraceae	*Chromolaena odorata* (L.) R.M.King & H.Rob.	shrubs	Tropical & Subtropical America	Siam weed				
100	SNP 43181	Plantaginaceae	*Scoparia dulcis* L.	herbs	Tropical & Subtropical America	Sweet broom				
101	SNP 43184	Asteraceae	*Synedrella nodiflora* Gaertn.	herbs	Tropical & Subtropical America	Pig grass				
102	SNP 43188	Caryophyllaceae	*Arenaria serpyllifolia* L.	herbs	Temp. Eurasia to Philippines (Luzon), N. Africa to Ethiopia	Thyme-leaf sandwort				

Legend: KNBC – Kiau Nuluh Base Camp
MPS – Marai Parai Subcamp