

# Mamara New Capital City Development Phase 1 Environment Impact Statement (EIS)

## Chapter 9: Terrestrial Flora and Fauna Assessment



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## 1.0 INTRODUCTION AND SUMMARY

This rapid baseline ecological survey highlights the status of the flora and fauna within the surroundings of the Mamara New Capital City proposed development project site. The survey was done in two days and covered all major areas from the coastal belt vegetation, along the riparian forest buffers of both the Mamara River and Poha River, through the grassland flats and grassland infested ridges and up to the upper valleys and deforested hilltops. Most of the terrestrial area covered has been noted to be highly degraded and altered due to on-going influences and impacts of human activities. As a consequence, the resultant vegetation is very anthropogenic and the status of fauna has changed very much due to increase in habitat loss.

Overall field site observations were carried out to determine the floristic habitats, occurrence, distribution, composition, conservation status and other related characteristics of the flora and fauna. Vegetation types (floristic habitats) were identified and described, and a flora checklist of plants was verified and presented in this report. All the fauna observed and identified were also treated and presented according to their respective groupings, such as birds, skinks, frogs, and insects.

As such, this is a general account of the findings of the rapid ecological study and contributes to the baseline knowledge and information on the ecology of the proposed development project site. It is also equally important to note that this scientific data and information presented the historical and biological nature of the area in terms of the existing habitats and their flora and fauna components which will be greatly affected and altered by the upcoming development activity. Therefore, the intrinsic values of biodiversity and ecosystem services were captured and expressed in the report to show their importance and validity in the planning of such development project in order to strike some balances between development aspirations and considerations and other environmental considerations relating to the impacts on the ecology, economy and community.

## 2.0 PROJECT LOCATION AND SITES VISITED

The project is located on the Northwest coast of Guadalcanal Island and west of Honiara. Its exact locality is bordered by the Poha River in the east to Mamara River in the westerly direction. It encompassed the beach and coastal region in the north to the upper ridges in the southerly direction. The random flora and fauna survey was conducted throughout most of the entire area. A general walk over was undertaken during the two days field trips due to the easy road access and openness of the vegetation cover and canopy within the project site. The specific sites visited comprised of coastal region along the shoreline, flat areas of grassland, riparian vegetation along the two rivers of Poha and Mamara, grassland ridges and uphill forested ridges and disturbed forest valleys. (See Project Site Maps for further details).

### 3.0 THE STATUS OF FLORA: HABITAT, SPECIES COMPOSITION AND DISTRIBUTION PATTERN

The various floristic habitats, that is, the different vegetation communities, which hosted the diversity of plant species within the project area included the followings:

- a. Coastal or beach habitat on the front line near the sea,
- b. The grasslands with randomly distributed medium size mixture of introduced legume Trees and shrubs, and coastal trees along the beach side of the main road,
- c. The riparian zones along the Mamara River buffer system,
- d. The freshwater swamps – ponds connected to the lower parts of both Poha and Mamara River system,
- e. The upland ridges invaded and covered by a diversity of grass species,
- f. The upper hills and midland-ridges, and valleys on the inland boundary with remnant primary forest tree species and old secondary forest re-growths.

The above main vegetation ecosystems were observed to be providing the natural but also modified distribution of the many plant species recorded during the survey. There is a clear distinction between these different vegetation communities. However, many overlaps on the composition and distribution patterns were noted. The flora diversity and status reflects the extent and degrees of severity of human and natural disturbances on the area and vegetation cover and the influences of soil nutrient, water, air and sunlight to stimulate plant restoration within the area. Most of the area is very vulnerable to regular fire occurrence during dry seasons during the year which is very common on this northern part of Guadalcanal.

Typical dominant floral species of beach strand plants along the coastal belt from Poha river mouth to Mamara river mouth includes these trees, *Barringtonia asiatica* (Fish poison tree), *Calophyllum inophyllum* (Beach Calophyllum), *Premna corymbosa* (Fire tree), *Morinda citrifolia* (Noni or Rotten cheese), *Milletia pinnata*, *Hibiscus tiliaceus* (Yellow hibiscus), *Terminalia catappa* (Beach Almond), *Cordia subcordata* (Kerosene wood), *Macaranga similis* and *Cocos nucifera* (Coconuts). Some introduced trees are *Broussonetia papyrifera* (Paper mulberry), *Mangifera minor* (Mango), *Delonix regia* (Christmas tree), *Samanea saman* (Rain tree), *Lucaena leucocephala* (Lucina), *Plumeria acuminata* (Frangipani) and *Ficus variegata* (Fig tree). Other shrubs, herbaceous plants, creepers, weeds and grasses are *Pandanus tectorius*, *Scaevola taccada*, *Bambusa blumeana* (Yellow bamboo), *Canavalia sp.* (Creeper), *Starchytapheta jamaicensis* (Blue rat's tail), *Mimosa pudica* (Sensitive or signal grass), *Mimosa invisa*, *Alpinia oceanica* (Beach ginger), *Passiflora foetida* (Sweet rope), *Ipomoea pes-caprae* (Beach morning glory), *Cassytha filiformis* (Parasitic vine).

The flora composition from the main road to the areas above the coastal belt vegetation zone comprise mainly of mixed species of grasses and herbaceous weeds. They occupy the substrate floor level to about two metres vegetation heights. Also widespread within this zonation but occupying mid to higher canopy heights (3m to 10m) above the grasslands are the protrusion of some identifiable trees such as the Rain tree (*Samanea saman*), Christmas tree

(*Delonix regia*) *Lucina (Leucaena leucocephala)*, Paper mulberry (*Broussonetia papyrifera*), *Psidium guajava* and *Macaranga similis*. Near Poha River Bridge on the eastern end are *Canarium indicum*, *Melochia umbellata*, *Macaranga similis*, *Merremia peltata* and *Trema orientalis*.

Pure taxonomically grass species found in the grassland flats and ridges in northern Guadalcanal are a mixture of *Pennisetum polystachyon*, *Themeda australis*, *Imperata cylindrica* (Mueller-Dombois 1998) and *Cenchrus species*. Many other minor grass species were noted as recent introductions into the surrounding areas.

The riparian flora upland the Mamara River bridge and towards the water source and river catchment on the western portion of the project site was dominated by the following mixed species of trees, *Sterculia conwentzii*, *Erythrina sp.*, *Ficus virgate*, *Barringtonia racemosa*, *Theobroma cacao*, *Macaranga tanarius*, *Rhus taitensis*, *Pipturus argenteus*, *Ficus septica*, *Rhus taitensis*, *Spondias dulcis* and *Terminalia sp.* The famous useful endemic palm, *Metroxylon solomonensis* was planted on the upper part of Mamara River for its leaves while the famous Betel Nut palm was planted to be harvested and sold for its complementary narcotic effects. Other shrubs, herbs, climbers and creepers, ferns and grasses recorded are *Sida rhombifolia*, *Solanum torvum* (Devil's fig), *Costus speciosus*, *Kleinhovia hospital*, *Merremia peltata* and *Dendrocnide inerme*, *Cassia alata* and several other grass species.

Also discovered during the field survey is the existence of four exotic aquatic plant species and three indigenous aquatic species of flora in the freshwater ecosystem of the Mamara river. The four introduced aquatic plants includes two important vegetable crops, the Kangkong (*Ipomoea aquatica*) and the Water Cress (*Nasturtium officinale*) and two ornamentals are Water Lilly (*Nymphaea sp.*) and Water Hyacinth (*Eichhornia crassipes*). The three uncommon native aquatic plants are: *Ceratophyllum demersum* (*Ceratophyllaceae*), *Potamogeton sp.* (*Potamogetonaceae*) and *Ceratopteris sp.* (*Pteridaceae*).

The southern boundary of the project site inland was where the upland ridges and valleys located. This was right behind the mid grassland ridges. It was dressed with the forest hat, decorated and comprised of several species of the original primary forest trees such as *Vitex cofassus* (*Vasa*), *Pometia pinnata* (*Akwa*), *Elaeocarpus sphericus*, *Calophyllum peekelli*, *Celtis latifolia*, *Burckella obovata*, *Pterocarpus indicus* (*Rosewood*), *Albizzia falcata* and *Terminalia complanata*. Most of the original flora of the place was found here. The species diversity, composition and distribution pattern of this particular region is comparative to a lowland rainforest habitat except that it is found just within the seasonally dry forest and grassland. Also distributed along the ridges are medium size trees like *Cananga odorata*, *Terminalia sepicana*, *Litsea purglabra*, *Timonius timon*, *Pandanus sp.*, *Flagellaria indica*, *Schleinitzia novoguineensis*, *Homalanthus sp.*, *Clerodendron buechanani*, *Dianiella ensifolia*, *Myristica irya*, *Piper betel*, *Pseuderanthemum sp.*, *Cyrtosperma merkusii* and *Physalis angulata*.

## 4.0 THE STATUS OF FAUNA: HABITAT, SPECIES COMPOSITION AND OCCURRENCE

The presence of wildlife and different faunal groups throughout the overall project area was also taken into account during the survey. Plants and animals are inseparable because they need each other to thrive (Lavery, Pikacha and Fisher 2016). The much degraded and open nature of the grassland dominated vegetation determines the species composition, abundance and distribution of birdlife and other fauna species observed in the lower sites.

However, it was noted that on the coastal vegetation belt as in the grasslands, there were less fauna occurrences than on the upper ridges with large primary forests and on valleys having older secondary forests. More birds were seen and heard further away inland from the coast and main road where human presence and vehicle noises were very heavy. Birds are more active for feeding and interactions early in the mornings and late in the evenings. The high level of the presence of birds in the forested ridges and valleys were attributed also to the season of flowering and fruiting of many trees, shrubs and herbaceous plants in the area. This was particularly noted on some trees hosting a lot of birds. One fig tree (*Ficus* sp.) with thousands of fruits is found to be infested with an estimated 30 to 40 individual birds from 3 or 4 different species. The timing of the survey and field visits did not allow a full and or complete assessment to be done at different times of the day and night to make good observations, counting and recordings. Bird identification was based on their call and songs and actual sightings while other animals, insects, etc. were physically encountered.

Apart from birds enlisted, many unidentified species of insects (grasshoppers, butterflies, moths, beetles, cicadas, dragon flies, katydids, ants), spiders, lizards and skinks, millipedes, centipedes and snails were being observed. In the freshwater habitat, some fish species (*Kuhlia maginata*), Gobies, *Giuris margaritacea* (moro), *Oreochromis mossambicus* (Tilapia) and the famous mud skippers were noted. Along the beach shorelines, several species of crustaceans (crabs and hermit crabs) were noted. These other organisms are fundamental to the health of the environment. They play important roles in regulating, supporting and provision of ecosystem services in the surrounding environment.

## 5.0 CHECKLIST OF AVIFAUNA AND OTHER FAUNAL GROUPS

### Birds

#### Scientific Name:

1. *Haliaster indus girrenera*
2. *Chalcopsitta cardinalis*
3. *Acridotheres tritis*
4. *Centropus milo milo*
5. *Urodynamis taitensis*
6. *Mino kreffti*
7. *Aplonis metallica mitida*
8. *Hemiprocne mystacea aeroplanes*
9. *Chalcophaps longirostris*
10. *Accipiter ablogularis*
11. *Porphyrio porphyria*
12. *Trichoglossus haematodus Massena*
13. *Ducula rubricera rubricera*
14. *Aplonis cantoroides*
15. *Coracina papuensis perpallida*
16. *Rhipidura leucophrys*
17. *Ptilinopus solomonensis ocularis*
18. *Cacatua ducorpsii*

#### Common Name:

- Brahminy Kite  
 Cardinal Lory  
 Common minor or Police bird  
 Red-Headed Coucal  
 Long-tailed Cuckoo  
 Long-tailed Myna  
 Metallic Starling  
 Moustached Tree swift  
 Pacific Emerald Dove  
 Pied-Goshawk  
 Purple Swamp Hen  
 Coconut Lorikeet  
 Red-Knobbed Imperial Pigeon  
 Singing Starling  
 White-bellied Cuckooshrike  
 Willie Wag Tail  
 Yellow-bibbed Fruit Dove  
 Solomons Cockatoo

### Other Fauna

#### Scientific Name:

1. *Rhinella marina*
2. *Emoia pseudocynura*
3. *Emoia sp.*
4. *Ethmostigmus rubripes*
5. *Kuhlia maginata*
6. *Giuris margaritacea*
7. *Oreochromis mossambicus*

#### Common Name:

- Cane toad  
 Forest Skink  
 Coastal or Beach Skink  
 Centipede  
 Freshwater fish  
 Moro (Freshwater fish)  
 Tilapia (Freshwater fish)

## 1. Checklist of the Flora:

### (A) Trees and Shrubs:

#### Scientific name:

1. *Barringtonia asiatica*
2. *Calophyllum inophyllum*
3. *Delonix regia*
4. *Terminalia catappa*

#### Known Common name:

- Fish Poison tree  
 Beach Calophyllum  
 Christmas tree  
 Beach Almond

5. <i>Premna corymbosa</i>	Premna
6. <i>Mangifera indica</i>	Local Mango
7. <i>Mangifera minor</i>	Introduced Mango
8. <i>Ficus variegata</i>	Fig tree
9. <i>Morinda citrifolia</i>	Noni or Rotten Cheese fruit
10. <i>Hibiscus tiliaceus</i>	Yellow Hibiscus
11. <i>Milletia pinnata</i>	Pongamia
12. <i>Scaevola taccada</i>	Scaevola
13. <i>Kleinhovia hospital</i>	Kleinhovia
14. <i>Cassia alata</i>	Candle tree
15. <i>Erythrina orientalis</i>	Erythrina
16. <i>Schleinitzia novo-guineensis</i>	
17. <i>Canarium indicum</i>	Ngali nut
18. <i>Melochia umbellata</i>	Melochia
19. <i>Broussonetia papyrifera</i>	Paper Mulberry
20. <i>Phyllanthus ciccoides</i>	Phyllanthus
21. <i>Sterculia conwentzii</i>	Sterculia
22. <i>Sterculia parkinsonii</i>	Sterculia
23. <i>Bombax sp.</i>	Kapok
24. <i>Macaranga tanarius</i>	Macaranga
25. <i>Macaranga similis</i>	Macaranga
26. <i>Rhus taitensis</i>	Rhus
27. <i>Spondias dulcis</i>	Spondias
28. <i>Pipturus argenteus</i>	Pipturus
29. <i>Terminalia complanata</i>	Terminalia
30. <i>Terminalia sepicana</i>	Terminalia
31. <i>Artocarpus altilis</i>	Bread fruit
32. <i>Litsea purglabra</i>	Litsea
33. <i>Timonius timon</i>	Timonius
34. <i>Pometia pinnata</i>	Akwa or Taun
35. <i>Vitex cofassus</i>	Vitex or Vasa
36. <i>Pterocarpus indicus</i>	Rosewood
37. <i>Ficus chrysochaete</i>	Ficus
38. <i>Dendrocnide inermis</i>	Poison leaf
39. <i>Homalanthus sp.</i>	
40. <i>Pseuderanthemum sp.</i>	
41. <i>Clerodendrum b Buchananii</i>	Pagoda plant
42. <i>Buckella obovata</i>	Burckella
43. <i>Celtis latifolia</i>	Celtis
44. <i>Artocarpus vriense</i>	Wild bread fruit
45. <i>Syzygium nemorale</i>	Wild apple
46. <i>Canarium asperum</i>	Wild nut
47. <i>Elaeocarpus sphaericus</i>	Elaeocarpus



48. <i>Ficus benjamina</i>	Ficus or Abalolo
49. <i>Albizzia falcata</i>	Albizzia
50. <i>Theobroma cacao</i>	Cocoa
51. <i>Psidium guajava</i>	Guava
52. <i>Leucaena leucocephala</i>	Lucina
53. <i>Citrus limon</i>	Lemon or Bush Lime
54. <i>Carica papaya</i>	Pawpaw
55. <i>Ficus septica</i>	Ficus or fig tree
56. <i>Ficus wassa</i>	Ficus or fig tree
57. <i>Alstonia spectabilis</i>	Alstonia
58. <i>Myristica irya</i>	Myristica
59. <i>Leea indica</i>	Leea

### (B) Palms, Pandanus and Bamboos

Scientific name:	Common name:
1. <i>Areca catechu</i>	Betel nut
2. <i>Cocos nucifera</i>	Coconut
3. <i>Calamus vestitus</i>	Rattan or Lawyer cane
4. <i>Ptychosperma solomonense</i>	Local Palm
5. <i>Elaeis guineensis</i>	Oil Palm
6. <i>Pandanus tectorius</i>	Beach Pandanus
7. <i>Pandanus poronaliva</i>	Swamp Pandanus
8. <i>Bambusa blumeana</i>	Yellow Bamboo
9. <i>Schizostachyum tessellatum</i>	Small Green Bamboo
10. <i>Metroxylon solomonensis</i>	Sago Palm
11. <i>Heterospathe minor</i>	Heterospathe Palm

### (C) Herbaceous Plants – Orchids, Gingers, Grasses, Weeds, Creepers and Climbers

Scientific name:	Common name:
1. <i>Alpinia oceanica</i>	Beach Ginger
2. <i>Guillainia purpurata</i>	Ginger
3. <i>Merremia pacifica</i>	Merremia
4. <i>Merremia peltata</i>	Merremia
5. <i>Convolvulus sp.</i>	
6. <i>Heliconia lanata</i>	Heliconia
7. <i>Passiflora foetida</i>	Sweet Rope
8. <i>Starchytapheta jamaicensis</i>	Blue Rat's tail
9. <i>Mimosa pudica</i>	Sensitive or Signal grass
10. <i>Cenchrus sp.</i>	Crows foot grass
11. <i>Euphorbia hirta</i>	Milky weed
12. <i>Canavalia sp.</i>	

13. <i>Ipomoea pes-caprae</i>	Morning glory
14. <i>Musa maclayi</i>	Banana
15. <i>Commelina sp.</i>	Swamp grass
16. <i>Cassytha filiformis</i>	Beach toddler
17. <i>Cyrtosperma chamissonis</i>	Swamp taro, Kakake
18. <i>Mikania micrantha</i>	Mile-a-minute
19. <i>Setaria sp.</i>	Cyperus
20. <i>Colocasia esculenta</i>	Taro
21. <i>Manihot esculenta</i>	Cassava, Tapioka
22. <i>Scindapsus altissimus</i>	
23. <i>Mucuna sp.</i>	Cover crop
24. <i>Pueraria sp.</i>	Legume grass
25. <i>Themeda australis</i>	Australian grass
26. <i>Pennisetum polystachyon</i>	Grass
27. <i>Sida rhombifolia</i>	Sida grass
28. <i>Dioscorea sp.</i>	Wild Yam
29. <i>Euphorbia atoto</i>	Grass
30. <i>Costus speciosus</i>	Costus herb
31. <i>Dianiella ensifolia</i>	Dianiella herb
32. <i>Piper betel</i>	Piper leaf
33. <i>Cordyline terminalis</i>	Cordyline

#### (D) Ferns

##### Scientific name:

1. *Asplenium nidus*
2. *Diplazium esculenta*
3. *Cyathea vittata*
4. *Microsorium sp.*
5. *Lygodium palmatum*

##### Common name:

- Bird's nest fern  
 Edible swamp fern  
 Tree fern  
 Microsorium fern  
 Lygodium fern

#### (E) Aquatic Plants

1. *Nymphaea sp.*
2. *Eichhornia crassipes*
3. *Potamogeton sp.*
4. *Ceratophyllum demersum*
5. *Ceratopteris sp.*
6. *Nasturtium officinale*
7. *Ipomoea aquatica*

- Water Lilly  
 Water Hyacinth  
 Aquatic plant  
 Aquatic plant  
 Aquatic plant  
 Water Cress  
 Kang Kong

## 6.0 RECOMMENDATIONS ON THE PROTECTION OF NATURE AND FOR A GREEN TOWNSHIP

Based on the critical observations made during the rapid ecological survey, the following recommendations are intended for considerations to inform and guide the proposed project activities to take into account all possible measures as safeguards for harmonizing the environment, community and economic aspirations.

1. The forested ridges surrounding the water catchment area immediately above and below the water source of Mamara River must be accorded protection. This will help sustain the long term supply of water for both commercial and domestic uses and to possibly extend to the nearby local communities who currently depend on this water source for their livelihoods.
2. Protection of the Mamara River watershed will also cater for the existing needs of the wildlife (fauna) and biodiversity within this unique site to enhance an ecological balance of nature. The establishment of a small nature reserve area for a Nature Park is highly recommended in this particular spot.
3. The upper part of the Mamara River has been used by the local communities to farm Water Cress vegetable for sale to earn income and for family consumptions. This will be greatly affected by the new development. Considerations for protection of these community owned resources and or any other alternative livelihood options be given priority.
4. The protection of parts of the coastal green belt vegetation cover along the shore line between the Mamara River mouth and Poha River mouth is vital. This will provide a natural green space and buffer to slow down strong wind forces and strong sea surges during periods of bad weather normally experienced every year throughout the country. It can also be developed for public space as picnic areas for residents and visitors.
5. Outsource tree and plant seedlings from the Honiara Botanical Garden Nursery (Ministry of Forestry) for replanting in the upper watershed of Mamara River, along the coastal green space and in other selected sites for ornamental purposes.

## 7.0 POTENTIAL IMPACTS AND MITIGATION MEASURES

Development Phase	Potential Impacts on Biodiversity	Mitigation Measures
<b>Phase 1 – Excavation and Reclamation</b>		
	Destruction and Alteration of Biodiversity habitats	Undertake flora and fauna inventory of the area, Identify important species (Endemics, Rare or Threatened).
	- Deforestation and Loss of Flora species.	Identify valuable trees and plants species, identify areas for protection of vegetation cover.
	- Migration and Loss of Fauna species within the area.	Identify important bird habitats and corridors for wildlife.
	Loss of trees and plants through habitat destruction during land clearance.	Select priority sites for rehabilitation works and replanting.
	Damage to terrestrial and aquatic areas.	Assess sites for restoration and green space corridors.
	Stripping-off topsoils, removal and compaction of soils.	Identify soil types for species matching, Set up soil storage area for rehabilitation.
<b>Phase 2 Construction building, roads, and utilities</b>		
	Destruction and Alteration of Biodiversity habitats	Planning habitat rehabilitation and restoration, Establish plant seedlings for replanting in designated areas.
	- Loss of Flora species	Identify and prepare seedlings for replanting, protect important existing trees.
	- Migration and Loss of Fauna species	Assess conservation status of different fauna groups (birds, amphibians, reptiles, etc), Design rescue plans.
	Damage to important trees	Collect valuable tree seeds and seedlings.

	Removal of wildlife habitats	Assess severity of biodiversity loss
	Removal and compaction of soil	Safe storage of top-soil for restoration and replanting
<b>Phase 3 Operation of 1234 house, water plants and Diesel Generator</b>	Cutting trees and collection of plant products	Enforce township management rules or bye – laws, Put of signposts to inform people.
	Collection and harvesting of wildlife.	Inform and enforce township bye-laws and rules. Control and manage human activities in wildlife corridors,
	Destruction of vegetation cover.	Put up public notice, enforce township bye-laws, Control human activities.
	Human disturbances	Manage Nature Park and green spaces corridors, Impose City Bye-Laws.
	Destruction and damaging aquatic plants	Establish “No-go” zones and “protected spots” along the streams, Put up sign posts. Propagate and cultivate more aquatic/water plants on selected sites along the stream.
	Diesel Generator	Select appropriate site for the Diesel Generator, minimize noise pollution during night time and manage hourly operations of the Generator. Use alternative power supply: Solar Power Energy or other green energy source. Avoid excessive noise at dusk and at dawn (early morning and late evening) – most active periods for biodiversity movements.

## 8.0 CONCLUSION

In conclusion, the ecological survey on the flora and fauna undertaken during the two days covered approximately 90% of the entire area of the project as required. The easy road access and open nature of the area and the shorter vegetation canopy heights have allowed quick movements and coverage. These have contributed positively to the success of field data collection on the various components of the ecosystems and the flora and fauna biodiversity within the area surveyed.

As a result, a total of 115 different plant species were identified and recorded in the field and cross examined in the Herbarium of the Ministry of Forestry and Research for confirmation. There are about 10 species of recently introduced grasses and weeds that are not being identified due to their rareness. Of the 115 plant species recorded, 59 species are categorized as either trees or shrubs, 33 of them are comprised of mix groups of Herbs, Grasses, Weeds, Gingers, Orchids, Climbers or Creepers, 11 species of Palms, Pandanus and Bamboos, 7 species of Aquatic plants and 5 Fern species. Four of the 7 Aquatic plants are being introduced into the country as food (vegetable crops) and ornamentals.

There is a very notable presence of bird life from the coastal shorelines to the upper inland boundary. A total of 18 different bird species were recorded within the short time frame. The birds range from coastal dwellers to those who normally reside in the upland forest ridges. There is act bird migrations between the coastal areas and the lowland rainforest as was observed. If more variant timing of bird watching and bird calling were made or extended to early mornings and late evenings, the number of bird diversity will certainly be increased. Many other fauna species such as the different groups of insects (grasshoppers, butterflies, moths, beetles, cicadas, dragon flies and ants), spiders, lizards and skinks, millipedes, centipedes and snails were being observed. In the freshwater habitats of Mamara River, some freshwater fish species and the famous mud skippers were noted. Crabs and Hermit crabs are common on the coastal sandy areas.

## APPENDIX

### 1. Appendix i: Photos of the Flora and Vegetation Cover





Metropolis Pacific



Telios Corporate and Consultancy Services







Metropolis Pacific



Telios Corporate and Consultancy Services







Metropolis Pacific



Telios Corporate and Consultancy Services



## 11. Appendix ii: Photos of Different Faunal Species encountered



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