The biodiversity value of the Buton Forests

A 2018 Operation Wallacea Report

Contents

Executive summary

- Buton, the largest satellite island of mainland Sulawesi, lies off the coast of the SE peninsular and retains large areas of lowland tropical forest.

- The biodiversity of these forests possesses an extremely high conservation value. To date, a total of 53 mammal species, 149 bird species, 64 herpetofauna species, 46 freshwater fish species, 194 butterfly species and 222 tree species have been detected in the study area.

- This diversity is remarkably representative of species assemblages across Sulawesi as a whole, given the size of the study area. Buton comprises only around 3% of the total land area of the Sulawesi sub-region, but 70% of terrestrial birds, 54% of snakes and 35% of butterflies known to occur in the region have been found here.

- Faunal groups in the forests of Buton also display high incidence of endemism; 83% of native non-volant mammals, 48.9% of birds, 34% of herpetofauna and 55.1% of butterflies found in the island's forest habitats are entirely restricted to the Wallacean biodiversity hotspot.

- Numerous organisms are also very locally endemic to the study area. Three species of herpetofauna are endemic to Buton, and another has its only known extant population here. Other currently undescribed species are also likely to prove to be endemic to Buton. Additionally, one primate, one bird, and 30 butterflies are represented here by subspecies endemic to SE Sulawesi's offshore islands.

- Several of these endemic species also act as important regional flagships for Wallacean biodiversity, such as the Lowland Anoa (*Bubalus depressicornis*), Booted Macaque (*Macaca ochreata brunnescens*), Maleo (*Macrocephalon maleo*) and Knobbed Hornbill (*Aceros cassidix*).

- These unique, highly-endemic ecological communities are highly threatened by anthropogenic pressures, most significantly from habitat loss and degradation and unregulated hunting. The most recent estimates for land-change in southern Buton, for example, saw 13% of landcover change from forest to non-forest in an 11 year period.

- The mammalian fauna of Buton in particular possesses a highly elevated conservation concern. A total of 58.3% of non-volant mammals (and 100% of native large mammals) found here are considered threatened or near-threatened by the IUCN. The most significant threatened mammal here is the Endangered Lowland Anoa (*Bubalus depressicornis*). Approximately 5-10% of the remaining global population occurs in the Lambusango Forest Reserve, but populations here are in severe decline and could soon become extinct without immediate and effective conservation action.

- A further three bat species, 16 bird species, three herpetofauna species, two freshwater fish species, one butterfly species and four plant species found on Buton are considered to be globally threatened or near-threatened. Particularly notable examples include the Critically-endangered Yellow-crested Cockatoo (*Cacatua sulphurea*), the Endangered Maleo (*Macrocephalon maleo*), the Vulnerable King Cobra (*Ophiophagus hannah*) and the Endangered Bonthain Tiger Butterfly (*Parantica sulewattan*).

- To date the biodiversity of the Buton Forests represents one of the most comprehensively studied in the Wallacean region, but opportunities exist to implement new survey work targeting as-yet unstudied groups. Priority targets for new survey protocols include macro-moths, dragonflies, orchids, ferns, and potentially arachnids.

Section 1 – Study site overview

This report details the biodiversity value of the forests of Buton Island – the largest (560,000 ha) attendant island of Sulawesi, which is itself the largest landmass in the Wallacean biogeographical region in the Indonesian archipelago (Figure 1). The island is approximately 100 km long and 42 km wide at its broadest point. Altitude varies from 0-200 m in coastal areas to around 400m along the island's central spine, with isolated peaks reaching up to 1,000 m (O'Donovan 2001, Whitten *et al*. 2002).

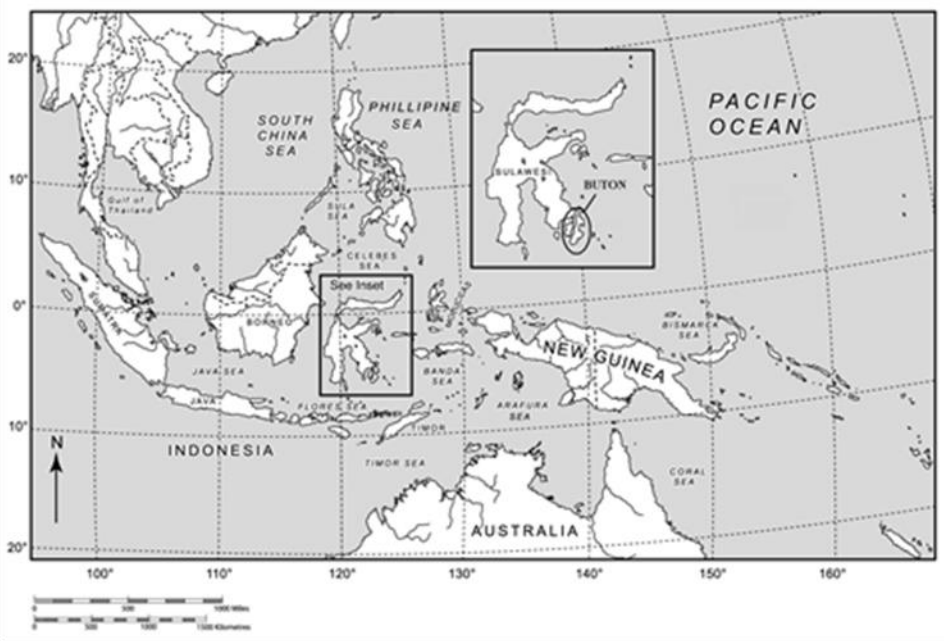

Figure 1. The Indonesian archipelago. Inset displays the location of Sulawesi and Buton island.

Buton experiences a tropical monsoon climate with a June-September dry season and a November-April wet season. Mean annual rainfall ranges between 1,500 and 2,000 mm, peaking between April and June. Mean annual temperatures range between 25◦ and 27◦ (Whitten et al. 2002). The geology of the island is complex; much of the lowlands consist of uplifted karst and other limestones, while the more mountainous interior is more varied, with sandstones, chert and ultra-mafic soils overlying ophiolitic rock. A large (70,000 ha) asphalt deposit, one of the most significant in South-East Asia, underlies a 60 km north-south strip of southern Buton (Whitten et al. 2002).

Despite heavy anthropogenic pressures, Buton retains much of its original forest cover. The most significant forested area in the south of the Island is the Lambusango Forest Reserve (LFR); a 65,000 hectare area of protected tropical forest. Together with its surrounding forest ecosystems, most notably the adjacent Kakenauwe Forest Reserve, it encompasses a large section of southern Buton, much of which remains relatively undisturbed. (Figure 2).

Figure 2 – The Lambusango and Kakenauwe Forest Reserves (in dark green) and their location within Buton Island. Reproduced from Wheeler (2011).

The majority of Northern Buton also remains forested, much of which is protected within forest reserves – notably the Buton Utara Wildlife Reserve. Non-forest habitats on the island include coastal mangroves and beachs, rough scrub, 'Alang-alang' *Imperata cylindrica* grassland, and agriculture. Major agricultural crops include rice, maize, sweet potatoes, cassava and plantations of cashew nuts, cocoa and coconut (Priston 2005).

As the evidence in this report demonstrates, this area possesses a remarkably high conservation value, supporting a disproportionate high ratio of Sulawesi's highly endemic species assemblages within its relatively small spatial area. As a quick summary indication, while Buton represents approximately 3% area of the Sulawesi sub-region (Wheeler 2011), data collected to date shows it supports a total of 67% of the terrestrial birds, 42% of the snakes and 35% of the butterflies known to occur in the whole region. As much of Buton

remains scientifically under-explored, and there may be more species in these groups remaining to be discovered (especially butterflies), the true proportions represented in these groups are in likelihood even higher.

Not only are taxonomical groups on Buton highly representative of their respective community assemblages across the entirety of the Sulawesi sub-region, but most also display the high rates of endemism that characterise the region. Tables 1a and 1b show endemism rates for different groups across the whole of Buton and Buton's protected forest habitats respectively.

Table 1 – Endemism rates for faunal groups in **A)** Buton Island, and **B)** for species found in protected forest habitats on Buton Island. Wallacean endemics are defined as those occurring only within the Wallacean biodiversity hotspot as defined by Myers *et al*. (2000).

A)

Group	Number of species	Number of Wallacean endemics	% endemism
Mammals (all)	53	18	34%
Mammals (Non-volant)	13	10	77%
Bats	40	8	20%
Birds	157	52	33.1%
Herpetofauna	64	19	29.7%
Freshwater fish	46	1	2.17%
Butterflies	194	92	47.4%
Trees	222	20	8.97%

B)

Group	Number of species	Number of Wallacean endemics	% endemism
Mammals (all)	48	14	29.2%
Mammals (Non-volant)	13	10	77%
Bats	34	6	17.6%
Birds	89	44	49.4%
Herpetofauna	49	17	34.70%
Freshwater fish	29	1	3.45%
Butterflies	107	59	55.1%

These tables indicate that rates of endemism in mammals, birds, herpetofauna and butterflies are very high, as is typical of these groups in other parts of the Wallacea region (Conservation International 2014). Many of these endemic species are also very locally endemic to SE Sulawesi or Buton Island, or have locally endemic subspecies – a characteristic that is most markedly shown in butterfly assemblages, where a total of 30 subspecies found on Buton are locally endemic (Appendix 2b).

As well as being highly diverse in a regional context, and possessing a high incidence of endemic species and locally endemic sub-species, the forests of Buton also provide habitats for a large number of globally threatened species. Appendix 1 indicates that a total of 46 threatened, near-threatened and Data-deficient species (1 Critically Endangered, 3 Endangered, 14 Vulnerable, 17 Near-threatened and 11 Data-deficient) occur in the islands' forests and immediately surrounding habitats. The Buton forests represent key strongholds for many of these species – notable examples including the Lowland Anoa (*Bubalus depressicornis*), Sulawesi Wild Pig (*Sus celebensis*), the locally-endemic sub-species of the Booted Macaque (*Macaca ochreata brunnescens*), the Maleo (*Macrocephalon maleo*) and the two species of Sulawesi Hornbill – (*Aceros cassidix*) and (*Penelopides exarhatus*). Some of these species –perhaps most notably *B. depressicornis*, *M. ochreata*, *M. maleo*, and *A. cassidix*, also act as important regional flagships of Wallacean biodiversity.

Despite possessing an elevated biological importance, the forests of Buton are under threat from considerable anthropogenic pressures. Forest clearance, both from legal and illegal logging, mineral extraction, and expansion of agricultural land, represents a major threat. Very current estimations of land use have been restricted by the availability of good quality, cloud-free satellite imagery, but an 11-year time-lapse study between 1991 and 2002 estimated southern Buton has experienced a deforestation rate of 13% (27,809 hectares) during this time period (Seymour 2004). The large asphalt deposit underlying a large segment of the LFR (Whitten 1987) also represents a significant potential catalyst for major habitat destruction in the future. Illegal hunting is also a major threat to several species found in the Buton forests. Perhaps the most striking example of this is its impact on populations of Lowland Anoa (*Bubalus depressicornis*), which is discussed further in section 2. Urgent action is thus needed if the threats posed by both habitat destruction and hunting pressues are to be curtailed and the extremely high biological value of the Buton forests maintained.

Section 2 – Mammals

Since survey work commenced in 1996 a total of 53 mammal species have been detected in the forests of Buton and the immediately surround landscapes – 13 non-volant mammal species and 40 bat species (Appendix 3a and 3b). The non-volant mammal assemblage displays characteristics typical of most Wallacean faunal groups – a relatively low richness compared with other parts of South-East Asia but a very high incidence of regional endemism. Table 1b shows that 77% of all non-volant mammals known to occur on Buton are endemic to the Wallacean biodiversity hotspot; a figure which rises to 83.3% if the introduced Malay Civet (*Viverra tangalunga*) is discounted. A further five small mammal species have been detected in the Buton forests, but have yet to be identified to a species level (Appendix 3c) - at least several of these are also likely to be Wallacean endemics.

As well as being highly endemic, the non-volant mammalian fauna of Buton is also highly threatened. A total of seven species found here are considered by the IUCN to be either threatened or near-threatened (58.33% of native species), with a further species being considered Data-deficient (Appendix 1). Notably, 100% of native species occurring in the larger-bodied mammalian families (Marsupialia, Artiodactyla and Primata) are considered to be threatened or near-threatened. A total of eight species are considered by the IUCN to have populations in global decline, with two being assessed as unknown. Only a single native species - the Sulawesi Giant Rat (*Paruromy dominator*) - is considered to have a stable population.

Almost certainly the most notable threatened mammalian species in the Buton forests is the Lowland Anoa (*Bubalus depressicornis*). It is currently classified as Endangered (C1+2a) due to its small, fragmented and declining population. A precise global population estimate for this species has been difficult to quantify, but in 2005 it was estimated to be <2500 mature individuals (Burton *et al*. 2005). The LFR in particular remains an important site for this species, supporting an estimated 5-10% of the global population (Wheeler 2004). However the species here is in severe decline due to illegal hunting and predictions based on occupancy analysis indicate it could become extinct in the Reserve within a decade (Wheeler 2011). Immediate conservation action, supported by continued monitoring efforts, is required to improve enforcement methods and control unsustainable hunting if the long-term future of this species in the Reserve is to be secured.

Another species of key conservation concern is the locally endemic subspecies of Booted Macaque (*Macaca ochreata brunnescens*) (Appendix 2b). This subspecies – the 'Buton Macaque', is found only on Buton and neighbouring Muna island, and is considered by the IUCN to be Vulnerable (A3c) due to its small (<14,000 individuals) declining population which is threatened by habitat destruction and fragmentation (Priston *et al*. 2011). Although several of the Sulawesi macaque species are considered threatened, *Macaca ochreata* (including the Buton subspecies) is particularly notable as very little of the remaining population occurs in protected areas. An old estimate by Whitten *et al*. (1987) predicted that only 8% of its total population occurs in reserves, and few new protected areas have been created in SE Sulawesi since this assessment was made. As such the LFR and other reserves on Buton may represent some of the few areas where a significant population of this species benefits from occurring within a formal protected area.

Other endemic non-volant mammals of conservation concern in the Buton forests include two species of endemic Cuscus - the Bear Cuscus (*Ailurops ursinus*) and Sulawesi Dwarf Cuscus (*Strigocuscus celebensis*) - both of which are considered Vulnerable due to a projected

population decline of >30% in the next ten years from hunting, habitat loss and, in the case of the former, collecting for the pet trade. The Spectral Tarsier (*Tarsius spectrum*), is also assessed as Vulnerable due to losing at least 30% of its suitable habitat in the past 20 years. The Timor Deer (*Rusa timorensis*) – a rare species on Buton – is also considered Vulnerable, and the Sulawesi Wild Pig (*Sus celebensis*) is considered Near-Threatened due to threats from hunting and habitat loss. The LFR in particular appears to be a stronghold for this last species: while it is in decline throughout much of its range, occupancy analysis indicates that a fairly high density, stable population remains here (Wheeler 2011).

None of the five rodent species currently identified in the Buton forests have yet been assessed as threatened, although two of the endemic species are in decline. Further investigation of the as-yet unidentified rodents and insectivores listed in appendix 2c could also reveal more species of global conservation concern as occurring in the study area.

The bat community of the Buton forests also displays a high incidence of endemism and a significant number of species of high conservation concern occur, albeit to a lesser degree than the non-volant mammals. Table 1 shows that 20% of all chiropteran species detected in the Buton forests and the surrounding non-forest landscape are Wallacean endemics, although this falls to 17.6% within the protected forest areas themselves. This is in likelihood at least partially an artefact of the limitations of survey methods. Endemic bat assemblages in Wallacea are dominated by the large, frugivorous Pteropodidae which are difficult to sample in dense forest habitats as they spend much of their time feeding at night in the canopy, but are relatively straight-forward to detect in more open habitats where they can be seen and trapped at their roosts. Many of the endemic fruit bats known to occur on the fringes of the Buton forest reserves in likelihood do also use these protected areas as a resource for nocturnal foraging, but are under-recorded as their presence is hard to detect using the harp-trapping methodologies which prove successful for trapping smaller insectivorous species (F. Lasmana, *pers comm.*).

Two endemic bat species known to occur on the fringes of the Buton forests -the Manado Fruit Bat (*Rousettus bidens*), and the Sulawesi Harpy Fruit Bat (*Harpionycteris celebensis*) are considered to be Vulnerable (A3cd) due to pressures from hunting and habitat loss, and a further endemic species, the Stripe-faced Fruit Bat (*Styloctenium wallacei*) is considered near-threatened. A further six species are also known to be in global decline and it is possible that the threat status of several species with currently unassessed population trends could be underestimated.

Plate 1 – Pallas' Tube-nosed Bat (*Nyctimene cephalotes*) mist-netted in the Lambusango forest. Photo T. Martin.

Section 3 – Birds

Systematic bird surveys commenced on Buton in 1999, and since then a total of 157 species from 53 families have been detected in the forest reserves and their immediately surrounding non-forest landscapes, with 87 species having been recorded within the boundaries of the protected areas themselves (Appendix 4). This represents a considerably high richness in the species-depauparate context of the Wallacean region; 70% of the 224 terrestrial bird species known to occur in the Sulawesi sub-region being found here (Waltert *et al*. 2004).

The incidence of endemism in the forest bird community is high, with 49.4% of species being restricted entirely to the Wallacean biodiversity hotspot (Table 1a). This drops to 33.1% if bird species in the non-forest habitats surrounding the forest reserves are included, as many wide-ranging generalists can be found on the farmland and scrub habitats on the fringes of the protected areas (Table 1b). Perhaps the most notable endemic bird occurring in the Buton Forests is the Maleo (*Macrocephalon maleo*). This unique megapode is well-known for its unusual breeding behaviour; selecting communal nesting sites on sunny river banks, beaches, hot springs and other areas which receive a high degree of natural solar or geothermal heating. Unfortunatly, these nesting sites are easy to locate, usually poorly monitored, and the price of Maleo eggs remains high across Sulawesi, making their exploitation attractive (Baker & Buchart 2000). Unsustainable harvesting of these incubation sites has thus led to a rapid reduction in Maleo populations, and the species is now considered Endangered by the IUCN (2017). Other key threatened bird species in the Buton forests include the two species of Sulawesian Hornbill – the Knobbed Hornbill (*Aceros cassidix*) and Sulawesi Hornbill (*Penelopides exarhatus*). Both of these charismatic 'flagship' species are in global decline due to rapid habitat loss, hunting, and collecting for the pet trade, and as such are considered Vulnerable by the IUCN. Both hornbills remain widespread throughout the protected areas, although research here has demonstrated they are dependent on fairly undisturbed forest habitats with high densities of large trees, especially in the case of *A. cassidix*. (Martin &

Blackburn 2010, Winarni & Jones 2011). Further habitat degradation in the Buton forests will therefore have a strong negative impact on these threatened species.

Other important endemic species include the Finch-billed Myna (*Scissirostrum dubium*), the sole member of its genus which possesses unusual communal breeding behaviour, the Pale-bellied White-eye (*Zosterops consobrinorum*) which is endemic to South-eastern Sulawesi, and the Yellow-billed Malkoha (*Phaenicophaeus calyorhynchus*), a colourful species which is represented by *P. c. rufilorisa* - a subspecies endemic to Buton (Appendix 2b).

Aside from the Maleo and the two hornbills previously mentioned, 15 further species found in the Buton forests and surrounding landscapes are considered threatened or near-threatened by the IUCN (2017). The most prominent threatened species found here is the Critically-endangered (A2cd+3cd+4cd) Yellow-Crested Cockatoo (*Cacatua sulphurea*) – the only Critically-endangered species from any taxa found on Buton. The species has suffered a catastrophic decline due to trapping for the cage bird trade and is now found only in a scattered number of small, fragmented populations, the combined global population of which numbers <7000 individuals. The LFR supports a tiny population of this species, but it remains vulnerable to continued pet-trade persecution and its long-term viability is uncertain.

The Blue-faced Rail (*Gymnocrex rosenbergii*) is another species of important conservation concern. It is considered Vulnerable (C2a) due to its globally small, declining, and heavily fragmented population. A highly secretive, cryptic species, it was detected for the first time in 2013 in the northern Buton forests as part of a camera-trap survey, and was detected by camera traps again in the southern forests several times in 2014. It is likely that it occurs throughout the forest habitats on the island, although its reclusive nature means its prescense is usually overlooked and its population underestimated.

Other notable species of conservation concern which are supported by the Buton forests include the recently-split Black-headed Kingfisher (*Actenoides capucinus*) a poorly-studied Near-threatened species, the beautiful Sulawesi Dwarf Kingfisher (*Ceyx fallax*) which is considered Near-threatened due to pressures of habitat loss, and the Near-threatened Small Sparrowhawk (*Accipiter nanus*) which is considered a montane species on mainland Sulawesi but can be found at altitudes close to sea-level on Buton.

Although the number of threatened or near-threatened species found in the Buton Forests and their surrounds currently stands at 17, it should be noted that 36% of all known species (and 37% of endemic species) in the area have globally declining populations, and given the alarming projections of future rates of habitat loss predicted for Sulawesian forests, and that most Wallacean species are poorly studied and their conservation assessment may currently be under-estimated, it is likely that more of Buton's birds may become considered as threatened or near-threatened in the short-to-medium term future.

Section 4 – Herpetofauna

Intensive herpetological surveys have been run in the Buton forests since 1999, and in the course of this survey work a total of 64 species have been identified – 11 amphibians and 53 reptiles (Appendix 5a and 5b). A further six species remain to be formally identified (Appendix 5c).

Plate 3 – Oritental Whipsnake (*Ahaetulla prasina*). Photo T. Martin.

Richness of herpetological groups is high considering the size of both the Buton forest reserves and the status of Buton as an offshore island. For example, of the 54 snake species (the best-documented group in the region) known to occur in the Sulawesi sub-region (de Lang & Vogel 2005) a total of 29 (53.7%) are known to occur here.

As with most other vertebrate groups, the herpetofauna community of the Buton forests displays a high incidence of endemism, with 34.7% of all detected species being endemic to the Wallacean biodiversity hotspot. This percentage will in probability rise after the six currently unidentified species in Appendix 5c are determined, as each of these is likely to be a hotspot endemic and all three are very possibly endemic to Buton island.

Of the known herpetofauna species, a total of three are known to be endemic to Buton: a skink species (*Eutropis grandis*) and two species of fossorial snake (*Calamaria butonensis & Calamaria longirostris*) (Appendix 2a). All these species were described from specimens taken in the reserve (Howard *et al*. 2007, Howard & Gillespie 2007) and are currently not known to occur anywhere outside the borders of the LFR.

Another notable endemic is the frog species *Rhacophorus georgii*. The species was first described in the early 20th century from an ambiguous type location on mainland Sulawesi

which has never been relocated. No more records of the species were made for the rest of the century, until it was rediscovered by an Operation Wallacea herpetology team in 2002. The species has been detected numerous times in the LFR since this date, although it remains a somewhat rare species, and to date the Reserve remains its only known locality (although suitable habitats exist in poorly-surveyed parts of mainland Sulawesi, such as Rawa Aopa National Park).

Two of the Reserve's reptiles are considered to be Vulnerable by the IUCN - the King Cobra (*Ophiophagus hannah*), and the South-East Asian Box Turtle (*Cuora amboinensis*), both of which occur at low densities in the Buton forests. However the Sulawesian herpetofauna remains very poorly studied – this is reflected by 70% of all species known to occur on Buton having an unknown or unassessed population trend status. Given projected rates of regional habitat loss, it is likely that the conservation status of many of these poorly-studied species is currently under-estimated, or that they are likely to become increasing threatened in the short-medium term future.

Section 5 – Freshwater fish

Assemblages of freshwater fish in the Buton forests were assessed in two research seasons run in 2000 and 2001. These surveys identified a total of 46 species in 17 families (Appendix 6a) along with a further 13 species which remain unidentified (Appendix 6b). A total of 29 of the identified species were detected inside the protected forest areas, along with six of the unidentified species. The remaining species were detected in rivers, ponds, paddy fields and brackish estuarine sites in close proximity to the forest reserve's borders. Species assemblages here are dominated by Gobiidae, which comprise 43.48% of all known fish species in the study area. Other notable groups include Eels, Gudgeons and Flagtails. Two families are represented only by exotic species introduced to the area – the Catfish (Clariidae) and Cichlids (Cichlidae).

Although freshwater fish generally display a high incidence of endemism in the Sulawesi region – 20-25% of all species known to occur here are endemic to the Wallacean hotspot (Tweedley et al. 2013) - endemism rates appear to be low on Buton. None of the fully identified species are regional endemics, and only a single as-yet-undetermined species of Halfbeak (*Nomorhamphus* sp) is thought by Tweedley *et al*. (2013) to represent a probable Wallacean endemic. If this identification is correct it would put the endemism rate at 2.17% across Buton as a whole, rising slightly to 3.45% within the borders of the protected forest areas. The reason for this low endemism appears to be the lack of any large, deep, lake systems on Buton – these being the habitats where most endemic species occur on the mainland (Tweedley *et al*. 2013).

Only two species of freshwater fish species occuring on Buton – *Anguilla celebesensis* and

Anguilla bicolor – are considered near-threatened by the IUCN (2017) although the taxon remains very poorly studied in the Wallacean region. Four species are explicitly designated as Data-deficient by the IUCN (Appendix 1), although only eight species (18.4% of the known assemblage) has had any kind of formal assessment conducted. The freshwater fish assemblages of the study area, while well-described, have been too poorly studied in a regional context to provide a detailed assessment of their conservation value, and this is an avenue of research that requires further attention.

Section 6 – Invertebrates

As with most tropical forest ecosystems the Buton forests supports a highly diverse invertebrate community. However, due to the difficulties of accurately identifying many Sulawesian invertebrate Orders, entomological work here has largely focussed on monitoring a single group on a long-term basis (butterflies), supplemented by smaller-scale work on Chalcidoidea Fig Wasps. Survey work has also recently started on two other groups – Termites and Dung Beetles – and in due course these new surveys should produce a comprehensive description of the community structure and diversity of these important groups.

To date, a total of 194 butterfly species from six families have been detected on Buton, 101 of which have been detected in forest habitats within the borders of the protected areas (Appendix 7). This is an impressively high number, representing 35% of the 557 butterfly species known to occur in the Sulawesi sub-region (Vane-Wright & de Jong 2003). The true total of butterflies in the Buton forests is also likely to be higher, as an important Lepidoptera family – the Hesperiidae – have not been monitored effectively in the area to date (see section 9 for further details).

The endemism rate of Butterflies in the area is also high; 47.4% of all species in the wider landscape are restricted to the Wallacean region – a total that rises to 55.1% in the forest habitats of the protected areas. This is the highest incidence of regional endemism of all taxa assessed to date by Operation Wallacea scientists. Also of notable importance is the presence of a large number of very locally endemic butterfly subspecies. While no butterfly species are locally endemic to South-east Sulawesi, no less than 30 subspecies are entirely restricted to this region, including 15 which are known only from Buton Island (Appendix 2b).

A single threatened species of butterfly is known to occur in the Buton forests – the Bonthain Tiger (*Parantica sulewattan*) which is considered to be Endangered (B1+2c) due to its small, fragmented, and declining global populations. It appears to be a rare species in the study area. Although no other species are currently acknowledged as threatened by the IUCN, the Wallacean Lepidoptera remains very poorly studied – the conservation status of 96.4% of all species occurring on Buton remains either unassessed or population trends remain unknown after assessment, and it is likely that the threats facing some of these poorly-known species

has either been overlooked or underestimated – a probability that will increase over time given the projections for habitat loss in the Sulawesi region.

After Butterflies, Fig Wasps (Chalcidoidea) are the best-known group of invertebrates in the Buton forests. Although this group has been studied in the context of theory-driven academic work conducted in 2009 and 2010 rather than long-running monitoring surveys, the group has been quite well described to a genus-level, although species-level identification has not been achieved for any samples taken from the study site. A total of 23 different genera from five families are currently known to occur in the Buton forests (Appendix 8a). None of these genera are endemic to the region, and without identification to low taxonomic levels it is not possible to determine species-level rates of endemism or species threat status.

Specimens from the other two groups for which monitoring was recently started – Dung Beetles and Termites - are currently being examined and species-level information will be provided in due course. To date, two species of Dung Beetle - *Gymnoplerus planus* and *Onthophagus cf. wallacei* - have been identified from samples taken in the Buton forests, the latter being a Wallacean endemic (Appendix 8b). A further seven species from the genus *Onthophagus* have also been found in the forests; work to determine the precise identity of these seven further species remains in progress. Termite work in the Buton forests is at a similar stage: two species have been identified (*Schedorhinotermes medioobscurus* and *Microcerotermes serrula*) with a further six termites identified to a genus level (Appendix 8c).

Section 7 – Botany

To date, botanical work in the Buton forests has focussed on tree species (with a particularly strong emphasis on palms), with some work of a more opportunistic nature having been completed on non-tree groups, most notably on ferns. To date, a total of 222 tree species from 45 families have been identified within the protected areas of the forest reserves (Appendix 9a and 9b). This high familial richness, with a fairly low number of species within each family and no species or family being ecologically predominant, is characteristic of Wallacean forests, and is in strong contrast to the Dipterocarp-dominated forests of Western Indonesia (Whitten *et al*. 1987, Corlett & Primack 2005).

In addition to the trees, a total 85 species of non-tree angiosperms from 32 families have been detected on Buton (Appendix 9c), along with a single Gymnosperm species (Appendix 9d) and 44 species of Fern and Fern-allies from 19 famililes (Appendix 9e).

In contrast to most Wallacean faunal groups, which possess high endemism but relatively low richness, the botanical assemblages of the Buton forests display the opposite pattern, with high richness but fairly low incidence of endemism. A total of 20 of the 222 trees species (8.97%) detected in the area are Wallacean endemics (Table 1) – a notable number but a substantially reduced endemic/non-endemic ratio compared to most faunal groups, and most

species have wide ranging distributions throughout the Oriental tropics, the Australasian tropics, or both.

Two species of tree detected in the Buton forests are considered to be threatened: the Vulnerable (A4cd) Amboina Pitch Tree (*Agathis dammara*), and the hardwood species *Madhuca betis,* also considered Vulnerable (A1cd). Both are threatened by the impact of logging and forest clearance on their global populations. The Queen Sago (*Cycas rumphii*) – a gymnosperm in the Cycadaceae family – and the Mangrove tree *Sonneratia ovata* are also considered Near-threatened due to future projections of habitat loss. As the conservation status of the vast majority of plants occurring on Buton remains unassessed, there could also be other species with an underestimated threat status.

As well as possessing rich species assemblages and a small number of endemic and threatened species, the flora of the Buton forests possess an extremely high conservation value for a multitude of other reasons. These include the presence of plants with important economic, social, medical, or domestic usage value (the 16 species of Rattans in the genus *Calamus* being amongst the most important). The large tree species of the forest reserves are also reservoirs of carbon sequestration and provide important habitats and feeding resources for the wider biodiversity of the forest. Of particular importance in this latter case are the 28 species of *ficus* figs, which represent a keystone feeding resource for a large proportion of Buton's frugivore-dominated bird community, as well as for many species of mammals and invertebrates (Kinnaird & O'Brien 2005).

Section 8 – Further work

Survey work conducted in the Buton forests since 1996 has built up a very detailed account of the study areas biodiversity and they now represent some of the best-described forest ecosystems anywhere in the Wallacea region. However, numerous further opportunities remain to build on the work thus far completed which could further improve the understanding of Buton's globally important biodiversity. This section of the report will address each broad taxonomical group examined by scientists in the Buton forests in turn, suggesting recommendations as to what further work or new survey protocols could improve the understanding of the community assemblages of these groups. These recommendations do not pertain to research possibilities unassociated with improving the knowledge of the Buton forests diversity, such as species-specific behavioural studies or theoretical academic research. While there is great scope for more of this type of work, such projects lie beyond the aims and scope of this report and will be discussed elsewhere.

1) Mammals. Most mammal groups have been well-studied in the Buton forests and, as it is a fairly species-depauperate group in the Wallacea region, it is unlikely that a large number of new species remain undiscovered in the area. Current survey protocols should be capable of

detecting new species in the groups most likely to yield new discoveries (small mammals and possibly bats). Perhaps the most important mammalian work to be conducted with a view to improving knowledge of the regions biodiversity value would be the identification of the small mammals which currently have an uncertain species status (Appendix 3c), and attempting to determine if some of the large fruit bat species known to roost on the periphery of the forests also utilise habitats within the boundaries of the protected areas.

2) Birds. The birds of Buton are well-studied, with details of local species assemblages existing in print (Martin *et al*. 2012). The species accumulation curves in Figure 3 indicate that the majority of species on the island have been discovered, but that there are in likelihood several species remaining to be detected on the island, especially in non-forest habitats. Undetected species are most likely to be seasonal migrants, cryptic nocturnal or understorey species and coastal shorebirds. However the currently-employed methodologies should be capable of eventually recording these species if they are present, and no fundamental changes or additions to the current monitoring program are recommended. Figure 3 also suggests that bird communities in the protected forest reserves are almost fully described.

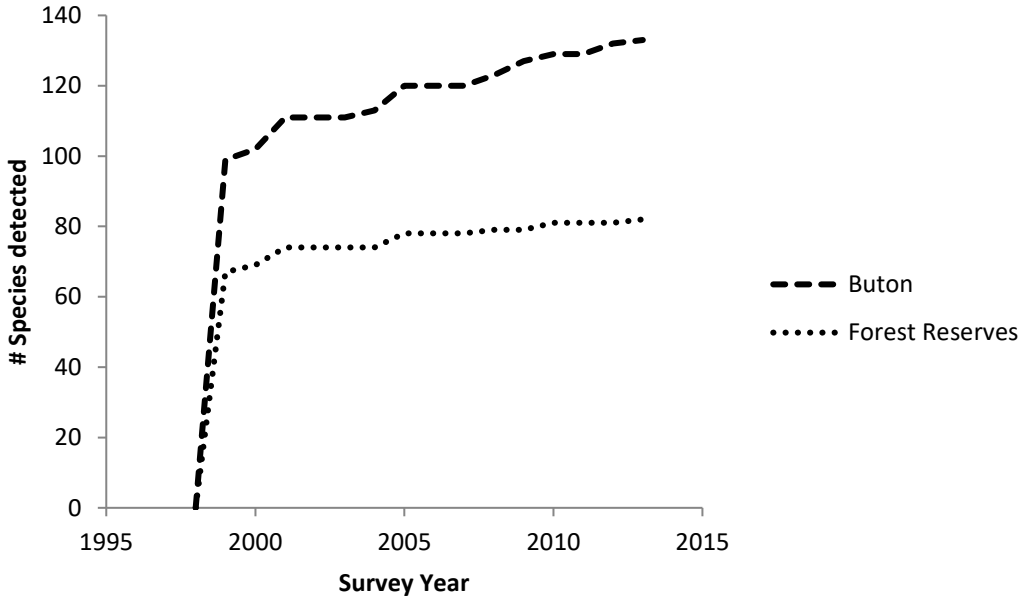

Figure 3 – Species accumulation curves displaying number of new bird species detected per survey year in Buton Island as a whole and for the forest reserves within Buton Island.

3) Herpetofauna. As with birds, the herpetofauna of Buton has been well-studied, with a detailed account of its local community structure existing in print (Gillespie *et al*. 2005).

Currently used methodologies should be capable of detecting any remaining cryptic species. No changes or additions to the current survey protocols are recommended, although the identification of the as-yet undescribed species in Appendix 5c would be valuable.

4) Freshwater fish. A thorough survey of the freshwater fish of Buton has been completed and, while the results were gained over a fairly short two-season period rather than the long-running survey work being conducted on mammals, birds and herpetofauna, a solid understanding of the community structure of this group has been obtained and published (Tweedley *et al*. 2013). Further survey work on this group could very possibly yield more new species in the area, and perhaps help determine whether more of the known species occur within the borders of the forest reserves as well as in watercourses around their peripheries. If the resources became available to conduct more work on this group the data would no doubt be valuable. However, because a solid understanding of freshwater fish communities has already been achieved, because newly detected species are likely to be widely-spread generalist rather than endemics with high conservation value, and because this survey work requires highly specialised equipment and taxonomic knowledge, further work here should be regarded as a secondary priority compared to the more pressing attention required for the invertebrate and botanical surveys.

5) Invertebrates. Along with botanical work this is one of two areas where significant knowledge gaps exist in the understanding of the biodiversity of the Buton forests, and great potential exists to develop new survey protocols to address previously unstudied and under-studied groups.

Butterfly surveys have been conducted regularly since 1999, although in a somewhat less regulated and consistent manner than the mammal, bird and herpetofauna surveys. The understanding of butterfly communities on Buton is generally good, although further survey work using the currently employed methodologies would in likelihood detect more species and help determine whether a few more known species occur within the borders of the forest reserves as well as in non-forest habitats around their peripheries. There is one group of butterflies that requires significant further attention, though: the Hesperiidae (Skippers). Survey work to date has focussed on four of the main butterfly families – Papilionidae, Pieridae, Lycaenidae and Nymphalidae. A fifth family, the Riodinidae, is poorly represented in the Sulawesi region with just four species known to occur (Vane-Wright & de Jong 2003). The Hesperiidae, however, are very well-represented, with 87 species previously recorded on Sulawesi (Vane-Wright & de Jong 2003), although to date just two species have been recorded on Buton (Appendix 7). This is important, as it represents a major gap in the understanding of an otherwise well-surveyed group. Addressing this gap would be very valuable, allowing the richness of the butterfly communities in their entirety to be assessed here and compared with full community assessments made in other parts of the region, as well as the region as a whole. Hesperiidae are not, however, as straightforward to sample as

the other butterfly groups. Pollard walks, for example, are not a very effective methodology for this family due to their cryptic nature, low population densities and erratic flight patterns, and species in this family also do not respond well to the same bait types as used for other butterflies (Pollarad & Yates 1993). Surveying this family would therefore require a specialised methodology. One method employed successfully in other parts of the tropics – named the Ahrenholz technique - involves the use of toilet tissue sheets to attract Skippers (which resemble the bird droppings on which they feed) and then trapping them in a hand-net (Lamas & Robbins 1993). Hesperiidae species are also more difficult to identify in the field than other butterfly families; some would be probably be possible to identify in the field but others would probably need to be taken as specimens and identified post-season at an appropriate institution. This should not prove to be an insurmountable problem though: generally they are more straightforward to identify than other cryptic Lepidoptera i.e. moths (K. Willmott, *pers. comm.*), and their study should represent a higher priority than the moths as a successful survey of this family would result in a near-complete inventory of an important ecological taxa, rather that representing a start on a vast, technically-daunting new group. It is therefore recommended that a small-scale pilot study using the Ahrenholz technique (which remains poorly studied in South-East Asia) to survey Hesperiidae in the Buton forests be trialled in an upcoming season and, if results are successful in obtaining a significant sample size, that this technique be fully incorporated into butterfly surveys in subsequent seasons.

Of the other invertebrate groups for which survey work is at an early stage (Dung Beetles and Termites), a continuation of the current established methodologies should provide an increasingly full picture of their community diversity.

A large range of possibilities also exists for entirely new invertebrate surveys in the Buton forests, although the efficacy of each of these will depend on the ability to identify specimens post-season, a formidable obstacle given the lack of academic resources and taxonomic expertise for most Wallacean invertebrates.

One possibility lies in surveying dragonfly (Odonata) diversity. This is a fairly distinct group for which some reference material exists (primarily the work of Jan Van Tol), and for which establishing a river-based hand-netting survey protocol should be logistically feasible.

Another possibility could be an attempt to survey arachnid diversity in the Buton forests. If feasible, this would be a very useful study as they are a diverse group which act as good ecological indicators, and the group includes some highly distinctive regional endemics (such as Orb-weavers of the genus *Gasteracantha*). Survey work to assess arachnid diversity could also be conducted at the same locations as surveys for some other taxa, such as herpetofauna, contributing to the knowledge of how different taxa respond to environmental variables in different ways. There are, however, two prominent problems involved with surveying this group. Firstly, taxonomical knowledge of Sulawesian arachnids is very poor and it may prove difficult to find an institution willing and able to assist in identifying samples from Buton. Secondly, studies attempting to survey arachnid populations in a systematic manner in other parts of the tropics have sometimes been hampered by yields of very small sample sizes (T.

Creedy, *pers comm*), making survey effort inefficient and limiting the analytical potential of ecological datasets. It is therefore recommended that a short pilot study be conducted in an upcoming season to see if standardised survey methods can yield a useful number of arachnid samples. This survey work could take the form of checking a limited number of pitfall traps used for the herpetofauna surveys and performing vigorous, 15-minute plot searches (involving techniques such as beating and sweeping) in a 50m radius around these pitfall lines. If this would create disturbance problems for the herpetofauna monitoring, the plot search could be conducted a short distance away from the lines. It would probably be necessary for these early pilot studies to focus on the largest and most distinctive arachnid groups that would be the easiest to collect and identify – namely members of the Mygalomorphs, Opiliones, Scorpiones Orders and the Araneidae family. If the pilot study suggests that a standardised plot-search methodology can be effective for obtaining a significantly large and diverse arachnid sample, then the next steps towards implementing a full arachnid survey in the Buton forests could be taken (such as liaising with contacts possessing appropriate taxonomic expertise).

Plate 4 – Unidentified dragonfly species captured on Buton. Photo T. Martin.

6) Botany. The currently employed tree survey protocols in the Buton forests regularly detect new species and a continuation of these methods is recommended in order to build up an increasingly complete picture of the regions' tree diversity. This includes continued attention to the best described tree groups – figs and rattan palms – as new species of both are likely to be detected with continued survey effort (A. Powling, *pers comm*.).

As with invertebrates, a wide range of tentative possibilities exist for new or reinvigorated projects examining botanical richness in the Buton forests, the main limitation to the feasibility of each of these being the availability of resources and expertise to accurately identify specimens. Ferns are one group which certainly merits further attention, being fairly

easy to locate, sample and identify (relative to other botanical groups). A considerable amount of survey effort has been directly to this group in the past and a sizeable number of species have been identified (Appendix 9e) although no fern work has been conducted for several years. A reinvigoration of this project would be a strong recommendation, given that there are probably many species in the Buton forests which remain undetected and there is a pre-existing knowledge database to provide a foundation for further studies (A. Powling, *pers comm*.).

Orchids are another relatively well-studied group globally which remain completely unstudied in the study area. Organising a systematic Orchidaceae survey may be logistically possible, but there would be difficulties. Most Orchids in the Buton forests occur at canopy level, so any attempt at a comprehensive survey would need to incorporate the assistance and expertise of specialist canopy access teams. Collaborations with taxonomic experts in external institutions would also need to be achieved.

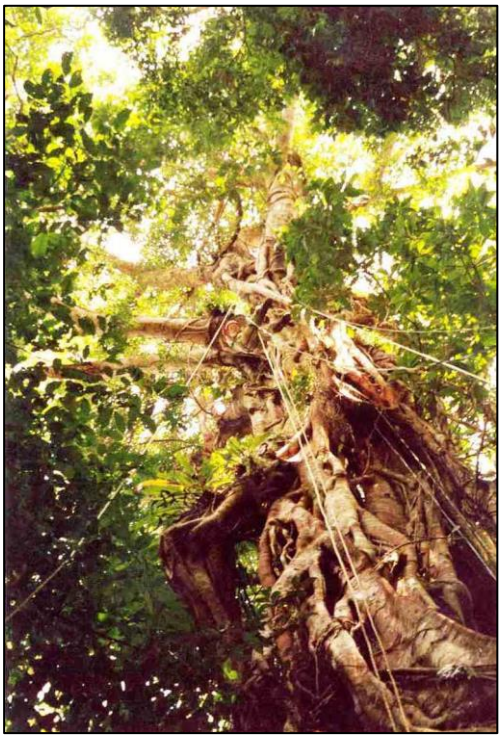

Plate 5 – Strangler Fig species (*Ficus* sp.) in the Lambusango Forest Reserve. Photo T. Martin.

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Appendix 1 – Species of conservation concern occurring on Buton Island

Table summarising threatened, near-threatened, and data-deficient species detected on Buton. Taxonomy and nomenclature for each group follow those described in Appendices 2-8. Species indicated * are also endemic to the Wallacean biodiversity hotspot (Myers *et al*. 2000). Species indicated ‡ are endemic to Indonesia. Threat status and population trends follow IUCN (2014).

Class	Common name	Latin name	IUCN Category	Population
Mammals	*Bear Cuscus	*Ailurops ursinus*	Vu	Decreasing
	*Small Sulawesi Cuscus	*Strigocuscus celebensis*	Vu	Decreasing
	*Lowland Anoa	*Bubalus depressicornis*	E	Decreasing
	*Sulawesi Wild Pig	*Sus celebensis*	NT	Decreasing
	*Timor Deer	*Cervus timorensis*	Vu	Decreasing
	*Booted Macaque	*Macaca ochreata*	Vu	Decreasing
	*Spectral Tarsier	*Tarsius spectrum*	Vu	Decreasing
	*Sulawesi Dwarf Squirrel	*Prosciurillus murinus*	DD	Unknown
	*Manado Fruit Bat	*Rousettus bidens*	Vu	Decreasing
	*Stripe-faced Fruit Bat	*Styloctenium wallacei*	NT	Decreasing
	*Sulawesi Harpy Fruit Bat	*Harpionycteris celebensis*	Vu	Decreasing
	Fierce Roundleaf Bat	*Hipposideros dinops*	DD	Decreasing
	Sulawesi Free-tailed Bat	*Mops sarasinorum*	DD	Unknown
Birds	Woolly-necked Stork	*Ciconia episcopus*	Vu	Decreasing
	Grey-headed Fish Eagle	*Ichthyophaga ichthyaetus*	NT	Decreasing
	Lesser Fish Eagle	*Icthyophaga humilis*	NT	Decreasing
	*Small Sparrowhawk	*Accipiter nanus*	NT	Decreasing
	‡Sunda Teal	*Anas gibberifrons*	NT	Stable
	*Blue-faced Rail	*Gymnocrex rosenbergii*	Vu	Decreasing
	*Maleo	*Macrocephalon maleo*	E	Decreasing
	Beach Thick-Knee	*Esacus magnirostris*	NT	Decreasing
	Grey-tailed Tattler	Tring brevipes	NT	Decreasing
	‡Yellow-crested Cockatoo	*Cacatua sulphurea*	CR	Decreasing
	*Pygmy Hanging Parrot	*Loriculus exilis*	NT	Decreasing
	*Ochre-bellied Hawk owl	*Ninox ochracea*	NT	Decreasing
	*Black-headed Kingfisher	*Actenoides capucinus*	NT	Decreasing
	*Knobbed Hornbill	*Aceros cassidix*	Vu	Decreasing
	*Sulawesi Hornbill	*Penelopides exarhatus*	Vu	Decreasing
	*Sulawesi Dwarf Kingfisher	*Ceyx fallax*	NT	Decreasing
	*Pied Cuckooshrike	*Coracina bicolor*	NT	Decreasing
	*Rufous-throated Flycatcher	*Ficedula rufigula*	NT	Decreasing
Herpetofauna	*Flying Frog sp.	*Rhacophorus edentulus*	DD	Unknown
	*Tuwa Flying Frog	*Rhacophorus georgii*	DD	Unknown
	*Boulenger's Water Snake	*Enhydris matannensis*	DD	Unknown
	‡Gunther’s Keelback	*Rhabdophis chrysargoides*	DD	Unknown
	King Cobra	*Ophiophagus Hannah*	Vu	Decreasing

	South-east Asian Box Turtle	*Cuora amboinensis*	Vu	Unknown
Fish	Celebes Longfin Eel	*Anguilla celebesensis*	NT	Unknown
	Indonesian Shortfin Eel	*Anguilla bicolor*	NT	Unknown
	Throat-spine Gudgeon	*Belobranchus belobranchus*	DD	Unknown
	Clinging Goby	*Sicyopterus micrurus*	DD	Unknown
	Goby sp.	*Sicyopterus ouwensi*	DD	Unknown
	Goby sp.	*Stiphodon semoni*	DD	Unknown
Butterflies	*Bonthain Tiger	*Parantica sulewattan*	E	Unknown
Plants	Amboina Pitch Tree	*Agathis dammara*	Vu	Decreasing
	Sapotaceae sp.	*Madhuca betis*	Vu	Unknown
	Mangrove Tree sp.	*Sonneratia ovate*	NT	Decreasing
	Queen Sago	*Cycas rumphii*	NT	Decreasing
Total –	**48 species**			

Appendix 2 – Species and sub-species occurring on Buton displaying very local endemism.

Tables summarising **a)** species endemic to the SE Sulawesi region, and **b)** sub-species endemic to the SE Sulawesi region which have been detected on Buton. Taxonomy and nomenclature for each group follow those described in Appendices 2-8. The endemism extent column indicates if a species or sub-species is endemic to SE Sulawesi as a whole, or just one or more of its offshore islands.

a)

Class	Common name	Latin name	Endemism extent
Mammals	Booted Macaque	*Macaca ochreata*	SE Sulawesi
Birds	Pale-bellied White-eye	*Zosterops consobrinorum*	SE Sulawesi
Herpetofauna	Skink sp.	*Eutropis grandis*	Buton
	Reed Snake sp.	*Calamaria longirostris*	Buton
	Reed Snake sp.	*Calamaria butonensis*	Buton
Total -	**5 species**		

b)

Class	Common name	Latin name	Endemism extent
Mammals	Booted Macaque	*Macaca ochreata brunnescens*	Muna & Buton
Birds	Yellow-billed Malkoha	*Phaenicophaeus calyorhynchus rufiloris*	Buton
Butterflies	Swift Peacock ssp.	*Papilio peranthus kransi*	Buton
	Tabitha's Swordtail ssp.	*Graphium dorcus butungensis*	Buton
	Pieridae ssp.	*Pareronia tritaea sarasinorum*	Buton, Kabaena, Muna

	Rosenberg's Painted Jezebel ssp.	*Delias rosenbergi munaensis*	Buton & Muna
	Pieridae ssp.	*Cepora celebensis kazuyoe*	Buton
	Pieridae ssp.	*Cepora fora milos*	Buton
	Zebra Blue ssp.	*Leptotes plinius zingis*	Buton
	Sulawesi Faun ssp.	*Faunis menado pleonasma*	SE Sulawesi
	Hewitson's Palmfly ssp.	*Elymnias hewitsoni atys*	SE Sulawesi
	Nymphalidae ssp.	*Elymnias hicetas butona*	Buton
	Great Wallacean ssp.	*Zethera incerta tenggara*	SE Sulawesi
	Nymphalidae ssp.	*Charaxes affinis butongensis*	Buton & Kabaena
	Wise Raja ssp.	*Charaxes solon brevis*	Buton
	Violet Lacewing ssp.	*Cethosia myrina vanbemmeleni*	Buton
	Erichson's Cruiser ssp.	*Vindula erota boetonensis*	Buton
	Nymphalidae ssp.	*Cupha arias muna*	Buton & Muna
	Nymphalidae ssp.	*Cupha maeonides butungensis*	Buton
	Celebes Sailer ssp.	*Neptis ida liliputa*	Buton, Kabaena, Muna
	Nymphalidae ssp.	*Lexias aeetes butongensis*	Buton & Kabaena
	Sulawesi Marquess ssp.	*Bassarona labotas pallesco*	Buton
	Nymphalidae ssp.	*Athyma libnites noctesco*	Buton, Kabaena, Muna
	Nymphalidae ssp.	*Moduza lymire munaensi*	Buton & Muna
	Paulinus Map ssp.	*Cyrestis paulinus kransi*	Buton & Wowoni
	Sulawesi Tabby ssp.	*Pseudergolis avesta nimbus*	Buton
	Wallace's Black Prince ssp.	*Rohana macar butongensis*	Buton
	Sulawesi White Emperor ssp.	*Helcyra celebensis semifusca*	Buton
	Sulawesi Blue Tiger ssp.	*Tirumala choaspes kroeseni*	Buton
	Common Tiger ssp.	*Danaus genutia telmissus*	Buton, Kabaena, Muna
	Long-branded Blue Crow ssp.	*Euploea algea tombugensis*	Buton, Kabaena, Muna
	Hewitson's Dwarf Crow ssp.	*Euploea hewitsonii reducta*	Buton, Kabaena, Muna
Total -	**32 species**		

Appendix 3 – Mammal diversity on Buton

Tables showing **a)** Non-volant mammals **b)** Chiroptera and **c)** currently undescribed mammal species on Buton. Taxonomy and nomenclature follow Duff & Lawson (2004). Species indicated † are considered threatened or near-threatened (IUCN). More details of these statuses are summarised in Appendix 1. Species indicated * are endemic to the Wallacean biodiversity hotspot (Myers *et al*. 2000). Species indicated ‡ are endemic to Indonesia. Species indicated (I) have been introduced to the study area. Threat status and population trends follow IUCN (2014). Species indicated X in the 'Reserve' column have been detected within the boundaries of protected forest reserves. Species unmarked in this column have only been detected in habitats adjacent to these protected areas.

a)

Order/Super-Order	Common name	Scientific name	Population	Reserve
Marsupialia	†*Bear Cuscus	*Ailurops ursinus*	Decreasing	X
	†*Small Sulawesi Cuscus	*Strigocuscus celebensis*	Decreasing	X
Artiodactyla	†*Lowland Anoa	*Bubalus depressicornis*	Decreasing	X
	†*Sulawesi Wild Pig	*Sus celebensis*	Decreasing	X
	†Timor Deer	*Cervus timorensis*	Decreasing	X
Carnivora	(I)Malay Civet	*Viverra tangalunga*	Stable	X
Primata	†*Booted Macaque	*Macaca ochreata*	Decreasing	X
	†*Spectral Tarsier	*Tarsius spectrum*	Decreasing	X
Rodentia	*Andrews' Shrew Rat	*Bunomys andrewsi*	Unknown	X
	*Hellwald's Spiny Rat	*Maxomys hellwaldii*	Decreasing	X
	*Sulawesi Giant Rat	*Paruromy dominator*	Stable	X
	Black rat	*Rattus rattus*	Stable	
	†*Sulawesi Dwarf Squirrel	*Proscirillus murinus*	Unknown	X
Total – 6 Orders / Super-orders	**13 species**			

b)

Family	Common name	Scientific name	Population	Reserve
Pteropodidae	Geoffroy's Rousette	*Rousettus amplexicaudatus*	Unknown	X
	*Sulawesi Rousette	*Rousettus celebensis*	Decreasing	X
	†*Manado Fruit Bat	*Rousettus bidens*	Decreasing	
	Black Flying Fox	*Pteropus alecto*	Stable	X
	*Signal-winged Acerodon	*Acerodon celebensis*	Unknown	
	†*Stripe-faced Fruit Bat	*Styloctenium wallacei*	Decreasing	X

	*Green Bare-backed Fruit Bat	*Dobsonia crenulata*	Stable	X
	†*Sulawesi Harpy Fruit Bat	*Harpionycteris celebensis*	Decreasing	
	Lesser Short-nosed Fruit Bat	*Cynopterus brachyotis*	Unknown	X
	Small Short-nosed Fruit Bat	*Cynopterus minutus*	Decreasing	
	Lesser Dawn Bat	*Eonycteris spelaea*	Unknown	
	Lesser Long-tongued Nectar Bat	*Macroglossus minimus*	Stable	X
	*Swift Fruit Bat	*Thoopterus nigrescens*	Unknown	X
	*Pallas' Tube-nosed Bat	*Nyctimene cephalotes*	Unknown	X
Emballonuridae	Dark Sheath-tailed Bat	*Mosia nigrescens*	Stable	X
	Lesser Sheath-tailed Bat	*Emballonura monticola*	Decreasing	X
Megadermatidae	Lesser False Vampire Bat	*Megaderma spasma*	Unknown	X
Rhinolophidae	‡Sulawesi Horseshoe Bat	*Rhinolophus celebensis*	Unknown	X
	Broad-eared Horseshoe Bat	*Rhinolophus euryotis*	Unknown	X
	Large-eared Horseshoe Bat	*Rhinolophus philippinensis*	Unknown	X
	Fawn Roundleaf Bat	*Hipposideros cervinus*	Unknown	X
	Ashy Roundleaf Bat	*Hipposideros cineraceus*	Unknown	X
	Diadem Roundleaf Bat	*Hipposideros diadema*	Unknown	X
	†Fierce Roundleaf Bat	*Hipposideros pelengensis*	Decreasing	X
	Cantor's Roundleaf Bat	*Hipposideros galeritus*	Unknown	X
Molossidae	Lesser Hairless Bat	*Cheiromeles parvidens*	Unknown	
	†Sulawesi Free-tailed Bat	*Mops sarasinorum*	Unknown	
Vespertilionidae	Javan Pipistrelle	*Pipistrellis javanicus*	Stable	X
	Greater Flat-headed bat	*Tylonycteris robustula*	Unknown	X
	Little Bent-winged Bat	*Miniopterus australis*	Stable	X
	Common Bent-winged Bat	*Miniopterus schreibersi*	Unknown	X
	Great Bent-winged Bat	*Miniopterus tristis*	Unknown	X
	Horsfield's Myotis	*Myotis horsfieldii*	Stable	X
	Small Black Myotis	*Myotis ater*	Stable	X
	Nepalese Whiskered Bat	*Myotis muricola*	Stable	X
	Large-footed Myotis	*Myotis adversus*	Unknown	X
	Flores Tube-nosed Bat	*Murina florium*	Unknown	X
	Hardwicke's Woolly Bat	*Kerivoula hardwickii*	Stable	X
	Papillose Woolly Bat	*Kerivoula papillosa*	Unknown	X
	Peters' Trumpet-eared Bat	*Kerivoula jagorii*	Stable	X
Total – 6 families	**40 species**			

c)

Order/Super-Order	**Common name**	**Latin name**	**Reserve**
Insectivora	'Brown Shrew'	Unknown	
	'White-footed Shrew'	Unknown	
	'Long-tailed Shrew'	Unknown	

Rodentia	Unknown Rat	*Rattus sp.*	
	'Tree mouse'	Unknown	
Total	**5 species**		

Appendix 4 – Bird diversity on Buton

Table showing bird species detected on Buton. Taxonomy and nomenclature follows Inskipp *et al*. (2001). Species indicated † are considered threatened or near-threatened (IUCN). More details of these statuses are summarised in Appendix 1. Species indicated * are endemic to the Wallacean biodiversity hotspot (Myers *et al*. 2000). Species indicated <M> are wintering or passage migrants. Species indicated ‡ are endemic to Indonesia. Threat status and population trends follow IUCN (2017). Species indicated X in the 'Reserve' column have been detected within the boundaries of protected forest reserves. Species unmarked in this column have only been detected in habitats adjacent to these protected areas.

Family	**Common name**	**Latin name**	**Population**	**Reserve**
Oceanitidae	Wilson's Storm Petrel	*Oceanites oceanicus*	Stable	
Phalacrocoracidae	Little Pied Cormorant	*Phalacrocorax melanoleucos*	Unknown	
	Little Black Cormorant	*Phalacrocorax sulcirostris*	Unknown	
Ardeidae	Purple Heron	*Ardea purpurea*	Decreasing	
	White-faced Heron <M>	*Ardea novaehollandiae*	Unknown	
	Great-billed Heron	*Ardea sumatrana*	Decreasing	
	Great Egret	*Casmerodius alba*	Unknown	
	Intermediate Egret	*Mesophoyx intermedia*	Decreasing	
	Little Egret	*Egretta garzetta*	Increasing	
	Little Heron	*Butorides striatus*	Decreasing	
	Pacific Reef Egret	*Egretta sacra*	Stable	
	Cinnamon Bittern	*Ixobrychus cinnamomeus*	Stable	
	Black Bittern	*Dupetor flavicollis*	Decreasing	
Ciconiidae	†Woolly-necked Stork	*Ciconia episcopus*	Decreasing	X
Accipitridae	Osprey	*Pandion haliaetus*	Increasing	
	Jerdon's Baza	*Aviceda jerdoni*	Decreasing	X
	Barred Honey-Buzzard	*Pernis celebensis*	Decreasing	X
	Brahminy Kite	*Haliastur indus*	Decreasing	X
	White-bellied Sea Eagle	*Haliaeetus leucogaster*	Decreasing	
	†Grey-headed Fish Eagle	*Ichthyophaga ichthyaetus*	Decreasing	X
	†Lesser Fish Eagle	*Icthyophaga humilis*	Decreasing	
	*Sulawesi Serpent Eagle	*Spilornis rufipectus*	Stable	X
	Spotted Harrier	*Circus assimilis*	Stable	

	*Sulawesi Goshawk	*Accipiter griseiceps*	Decreasing	X
	†*Small Sparrowhawk	*Accipiter nanus*	Decreasing	
	*Vinous-breasted Sparrowhawk	*Accipiter rhodogaster*	Decreasing	
	*Spot-tailed Sparrowhawk	*Accipiter trinotatus*	Stable	X
	Black Eagle	*Ictinaetus malayensis*	Decreasing	X
	Rufous-bellied Eagle	*Hieraaetus kienerii*	Decreasing	
	*Sulawesi Hawk Eagle	*Spizaetus lanceolatus*	Decreasing	X
Falconidae	‡ Spotted Kestrel	*Falco moluccensis*	Increasing	
	Oriental Hobby	*Falco severus*	Decreasing	
Dendrocygnidae	Wandering Whistling-duck	*Dendrocygna arcuata*	Decreasing	
Anatidae	†‡ Sunda Teal	*Anas gibberifrons*	Stable	
Megapodiidae	Philippine Scrubfowl	*Megapodius cumingii*	Decreasing	X
	†*Maleo	*Macrocephalon maleo*	Decreasing	X
Phasianidae	Blue-breasted Quail	*Coturnix chinensis*	Stable	
	Red Junglefowl	*Gallus gallus*	Decreasing	X
Turnicidae	Barred Buttonquail	*Turnix suscitator*	Increasing	X
	Red-backed Buttonquail	*Turnix maculosa*	Decreasing	
Rallidae	Slaty-legged Crake	*Rallina eurizonoides*	Decreasing	X
	†*Blue-faced Rail	*Gymnocrex rosenbergii*	Decreasing	X
	Buff-banded Rail	*Gallirallus philippensis*	Stable	
	Barred Rail	*Gallirallus torquatus*	Unknown	
	*Isabelline Bush-hen	*Amaurornis isabellinus*	Unknown	
	White-breasted Waterhen	*Amaurornis phoenicurus*	Unknown	X
	Common Moorhen	*Gallinula chloropus*	Unknown	
Burhinidae	†Beach Thick-knee	*Esacus magnirostris*	Decreasing	
Glareolidae	Australian Pratincole	*Stiltia isabella*	Stable	
Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	Increasing	
Scolopacidae	Whimbrel <M>	*Numenius phaeopus*	Decreasing	
	Common Sandpiper <M>	*Actitis hypoleucos*	Decreasing	
	Wood Sandpiper <M>	*Tringa glareola*	Stable	
	†Grey-tailed Tattler <M>	*Tringa brevipes*	Decreasing	
	Common Redshank <M>	*Tringa totanus*	Unknown	
	Red-necked Phalarope <M>	*Phalaropus lobatus*	Decreasing	
Sternidae	Bridled Tern	*Sterna anaethetus*	Unknown	
	Whiskered Tern	*Chlidonias hybridus*	Stable	
Columbidae	Spotted Dove	*Streptopelia chinensis*	Increasing	X
	Brown Cuckoo Dove	*Macropygia amboinensis*	Stable	X
	*White-faced Cuckoo Dove	*Turacoena manadensis*	Stable	X

	Stephan's Dove	*Chalcophaps stephani*	Stable	X
	*Sulawesi Ground Dove	*Gallicolumba tristigmata*	Stable	X
	Pink-necked Green Pigeon	*Treron vernans*	Stable	
	‡Grey-cheeked Green Pigeon	*Treron griseicauda*	Stable	X
	Black-naped Fruit Dove	*Ptilinopus melanospila*	Stable	X
	Maroon-chinned Fruit Dove	*Ptilinopus subgularis*	Decreasing	X
	*White-bellied Imperial Pigeon	*Ducula forsteni*	Stable	X
	Green Imperial Pigeon	*Ducula aenea*	Stable	X
	Pied Imperial Pigeon	*Ducula bicolor*	Decreasing	
	*Silver-tipped Imperial Pigeon	*Ducula luctuosa*	Stable	X
Psittacidae	*Ornate Lorikeet	*Trichoglossus ornatus*	Decreasing	X
	†‡Yellow-crested Cockatoo	*Cacatua sulphurea*	Decreasing	X
	*Golden-mantled Racquet-tail	*Prioniturus platurus*	Stable	X
	Azure-rumped Parrot	*Tanygnathus sumatranus*	Stable	X
	* Sulawesi Hanging Parrot	*Loriculus stigmatus*	Stable	X
	†*Pygmy Hanging Parrot	*Loriculus exilis*	Decreasing	X
Cuculidae	*Sulawesi Hawk Cuckoo	*Hierococcyx crassirostris*	Stable	X
	Oriental Cuckoo <M>	*Cuculus saturates*	Stable	
	Plaintive Cuckoo	*Cacomantis merulinus*	Stable	X
	Rusty-breasted Cuckoo	*Cacomantis sepulcralis*	Stable	X
	Gould's Bronze Cuckoo	*Chrysococcx russatus*	Stable	
	Drongo Cuckoo	*Surniculus lugubris*	Decreasing	X
	Channel-billed Cuckoo	*Scythrops novaehollandiae*	Stable	
	*Black-billed Koel	*Eudynamys melanorhyncha*	Stable	X
	*Yellow-billed Malkoha	*Phaenicophaeus calyorhynchus*	Stable	X
Centropodidae	*Bay Coucal	*Centropus celebensis*	Stable	X
	Lesser Coucal	*Centropus bengalensis*	Increasing	
Tytonidae	*Sulawesi Owl	*Tyto rosenbergii*	Stable	X
Strigidae	*Sulawesi Scops owl	*Otus manadensis*	Stable	X
	†*Ochre-bellied Hawk owl	*Ninox ochracea*	Decreasing	X
	*Speckled Hawk Owl	*Ninox punctulata*	Stable	X
Caprimulgidae	Great eared Nightjar	*Eurostopodus macrotis*	Stable	
	*Sulawesi Nightjar	*Caprimulgus celebensis*	Decreasing	X
Apodidae	Glossy Swiftlet	*Collocalia esculenta*	Stable	X
	*Moluccan Swiftlet	*Collocallia infuscata*	Stable	
	Uniform Swiftlet	*Collocallia vanikorensis*	Stable	X
	Asian Palm Swift	*Cypsiurus balasiensis*	Stable	
Hemiprocnidae	Grey-rumped Tree-swift	*Hemiprocne longipennis*	Unknown	X
Halcyonidae	†*Black-headed Kingfisher	*Actenoides capucinus*	Decreasing	X
	*Black-billed Kingfisher	*Halcyon melanorhyncha*	Decreasing	
	Ruddy Kingfisher	*Halcyon coromanda*	Decreasing	X
	Collared Kingfisher	*Todiramphus chloris*	Decreasing	X

	Sacred Kingfisher <M>	*Todiramphus sancta*	Increasing	
Alcedinidae	†*Sulawesi Dwarf Kingfisher	*Ceyx fallax*	Decreasing	X
	Common Kingfisher	*Alcedo atthis*	Unknown	X
	Blue-eared Kingfisher	*Alcedo meninting*	Decreasing	X
Meropidae	Rainbow Bee-eater <M>	*Merops ornatus*	Stable	
Coraciidae	*Purple-winged Roller	*Coracias temminckii*	Stable	X
Bucerotidae	†*Sulawesi Hornbill	*Penelopides exarhatus*	Decreasing	X
	†*Knobbed Hornbill	*Aceros cassidix*	Decreasing	X
Picidae	*Sulawesi Pygmy Woodpecker	*Dendrocopos temminckii*	Stable	
	*Ashy Woodpecker	*Mulleripicus fulvus*	Stable	X
Pittidae	Elegant Pitta	*Pitta elegans*	Decreasing	X
	Red-bellied Pitta	*Pitta erythrogaster*	Decreasing	X
Hirundinidae	Barn Swallow <M>	*Hirundo rustica*	Decreasing	X
	Pacific Swallow	*Hirundo tahitica*	Increasing	X
Campephagidae	†*Pied Cuckooshrike	*Coracina bicolor*	Decreasing	X
	*White-rumped Cuckooshrike	*Coracina leucopygia*	Stable	X
	*Sulawesi Cicadabird	*Coracina morio*	Stable	X
	*White-rumped Triller	*Lalage leucopygialis*	Stable	
	‡White-shouldered Triller	*Lalage sueurii*	Increasing	
Dicruridae	Spangled Drongo	*Dicurus hottentottus*	Unknown	X
Oriolidae	Black-naped Oriole	*Oriolus chinensis*	Unknown	X
Corvidae	Slender-billed Crow	*Corvus enca*	Stable	X
	*Piping Crow	*Corvus typicus*	Stable	X
Timaliidae	*Sulawesi Babbler	*Trichastoma celebense*	Stable	X
Turdidae	†*Red-backed Thrush	*Zoothera erythronota*	Decreasing	X
	Pied Bushchat	*Saxicola caprata*	Stable	
Pardalotidae	Golden-bellied Gerygone	*Gerygone sulphurea*	Decreasing	
Cisticolidae	Zitting Cisticola	*Cisticola juncidis*	Increasing	
	Bright-headed Cisticola	*Cisticola exilis*	Increasing	
Muscicapidae	†*Rufous-throated Flycatcher	*Ficedula rufigula*	Decreasing	X
Monarchidae	Black-naped Monarch	*Hypothymis azurea*	Stable	X
Petroicidae	Citrine Canary Flycatcher	*Culicicapa helianthea*	Decreasing	X
Artamidae	White-breasted Woodswallow	*Artamus leucorynchus*	Stable	X

	*Ivory-breasted Woodswallow	*Artamus monarchus*	Unknown	X
Sturnidae	Short-tailed Starling	*Aplonis minor*	Decreasing	
	Asian Glossy Starling	*Aplonis panayensis*	Unknown	X
	*Sulawesi Myna	*Basilornis celebensis*	Unknown	X
	*White-necked Myna	*Streptocitta albicollis*	Decreasing	X
	*Finch-billed Myna	*Scissirostrum dubium*	Decreasing	X
Meliphagidae	Scarlet Myzomela	*Myzomela sanguinolenta*	Stable	X
Nectariniidae	Brown-throated Sunbird	*Anthreptes malacensis*	Stable	X
	Black Sunbird	*Nectarina aspasia*	Stable	X
	Olive-backed Sunbird	*Nectarina jugularis*	Stable	X
	Crimson Sunbird	*Aethopyga siparaja*	Stable	X
Dicaeidae	*Yellow-sided Flowerpecker	*Dicaeum aureolimbatum*	Stable	X
	*Grey-sided Flowerpecker	*Dicaeum celebicum*	Stable	X
Zosteropidae	‡Lemon-bellied White-eye	*Zosterops chloris*	Stable	X
	*Pale-bellied White-eye	*Zosterops consobrinorum*	Unknown	X
Passeridae	Eurasian Tree Sparrow	*Passer montanus*	Stable	
Estrildinidae	‡Black-faced Munia	*Lonchura molucca*	Stable	
	Scaly-breasted Munia	*Lonchura punctulata*	Stable	
	Black-headed Munia	*Lonchura malacca*	Stable	
	*Pale-headed Munia	*Lonchura pallida*	Stable	
Total – 53 Families	**157 species**			

Appendix 5 – Herpetofauna diversity on Buton

Tables showing **a)** Amphibians **b)** Reptiles and **c)** currently undescribed herpetofauna species detected on Buton. Taxonomy and nomenclature follow the composite sources applied in Gillespie *et al*. (2005). Species indicated † are considered threatened or near-threatened (IUCN). More details of these statuses are summarised in Appendix 1. Species indicated * are endemic to the Wallacean biodiversity hotspot (Myers *et al*. 2000). Species indicated ‡ are endemic to Indonesia. Threat status and population trends follow IUCN (2017). Species indicated X in the 'Reserve' column have been detected within the boundaries of protected forest reserves. Species unmarked in this column have only been detected in habitats adjacent to these protected areas.

a)

Family	Common name	Latin name	Abundance	Reserve
Microhylidae	Smooth-fingered Narrow-mouthed Frog	*Kaloula baleata*	Stable	X
Ranidae	Asian Brackish Frog	*Fejervarya cancrivora*	Increasing	
	Frog sp.	*Limnonectes grunniens*	Stable	X
	*Frog sp.	*Limnonectes modestus*	Stable	X
	*Frog sp.	*Hylarana celebensis*	Stable	
	Schlegel's Frog	*Rana chalconota*	Stable	
	*Mocquard's Frog	*Hylarana mocquardi*	Stable	X
Rhacophoridae	White-lipped Tree Frog	*Polypedates iskandari*	Stable	X
	†*Flying Frog sp.	*Rhacophorus edentulus*	Unknown	X
	†*Tuwa Flying Frog	*Rhacophorus georgii*	Unknown	X
Bufonidae	*Sulawesi Toad	*Ingerophrynus celebensis*	Stable	X
Total – 4 Families	**11 Species**			

b)

Family	Common name	Latin name	Population	Reserve?
Dibamidae	Blind Lizard sp.	*Dibamus novaeguinea*	Stable	X
Agamidae	Green Crested Lizard	*Broncochella cristatella*	Unknown	X
	*Flying Lizard sp.	*Draco beccarii*	Unknown	X
Gekkonidae	Flat-tailed House Gecko	*Cosymbotus platyurus*	Unknown	

	*Kabaena Bowfingered Gecko	*Cyrtodactylus jellesmae*	Unknown	X
	Tokay Gecko	*Gekko gecko*	Unknown	X
	Common Four-clawed Gecko	*Gehyra mutilata*	Unknown	
	Pacific Gecko	*Gehyra oceanica*	Unknown	X
	Common House Gecko	*Hemidactylus frenatus*	Stable	
	Common Dwarf Gecko	*Hemiphylodactylus typus*	Unknown	X
	Kuhl's Flying Gecko	*Ptychozoon kuhlii*	Unknown	X
Varanidae	Water Monitor	*Varanus salvator*	Unknown	X
Scincidae	Mangrove Skink	*Emoia atrocosta*	Unknown	
	Copper-tailed Skink	*Emoia cyanura*	Unknown	
	Common Sun Skink	*Eutropis multifasciata*	Unknown	X
	Rough Mabuya	*Eutropis rudis*	Unknown	X
	*Skink sp.	*Eutropis grandis*	Unknown	X
	Emerald Skink	*Lamprolepis smaragdinum*	Unknown	X
	Four-striped Lipinia	*Lipinia quadrivittata*	Unknown	X
	Bowring's Supple Skink	*Lygosoma bowringi*	Unknown	
	‡Skink sp.	*Sphenomorphus sarasinorum*	Unknown	X
	*Skink sp.	*Sphenomorphus tropidonotus*	Unknown	X
	Skink sp.	*Sphenomorphus variagatum*	Unknown	X
Acrochordidae	Wart Snake	*Acrochordus granulatus*	Stable	
Colubridae	Oriental Whipsnake	*Ahaetulla prasina*	Stable	X
	*Sulawesi Keelback	*Amphiesma celebica*	Unknown	X
	Mangrove Snake	*Boiga dendrophila*	Unknown	X
	Brown Treesnake	*Boiga irregularis*	Unknown	X
	*Brongersma's Reed Snake	*Calamaria brongersmai*	Unknown	X
	*Narrow-headed Reed Snake	*Calamaria nuchalis*	Unknown	X
	*Reed Snake sp.	*Calamaria butonensis*	Unknown	X
	*Reed Snake sp.	*Calamaria longirostris*	Unknown	X
	Dog-faced Water Snake	*Cerberus rhynchops*	Unknown	
	Paradise Tree Snake	*Chrysopelea paradisi*	Unknown	X
	Common Bronze-back	*Dendrelaphis pictus*	Unknown	X
	Reddish Ratsnake	*Coelognathus erythrurus*	Unknown	
	Celebes Ratsnake	*Elaphe jansenii*	Unknown	
	†*Boulenger's Water Snake	*Enhydris matannensis*	Unknown	
	Common Wolf Snake	*Lycodon aulicus*	Unknown	
	*Bleeker's Kukri Snake	*Oligodon waandersi*	Unknown	X
	Common Mock Viper	*Psammodynastes pulverulentus*	Unknown	X
	Speckle-bellied Keelback	*Rhabdophis chrysargos*	Unknown	X
	†‡Gunther's Keelback	*Rhabdophis chrysargoides*	Unknown	X
	Triangle Keelback	*Xenochrophis trianguligerus*	Increasing	X
Cylindrophiidae	*Black Pipe Snake	*Cylindrophis melanotus*	Unknown	X
Xenopeltidae	Sunbeam Snake	*Xenopeltis unicolor*	Stable	X

Crotalidae	Wagler's Pit Viper	*Tropidolaemus wagleri*	Stable	X
Elapidae	†King Cobra	*Ophiophagus hannah*	Decreasing	X
Pythnonidae	Reticulated Python	*Python reticulatus*	Unknown	X
Typhlopidae	*Deharveng's Blind Snake	*Cyclotyphlops deharvengi*	Unknown	X
	Brahminy Blind Snake	*Ramphotyphlops braminus*	Unknown	X
	Olive Blind Snake	*Ramphotyphlops olivaceus*	Unknown	
Bataguridae	†South-east Asian Box Turtle	*Cuora amboinensis*	Unknown	X
Total – 14 Families	**53 species**			

c)

Family	**Common name**	**Latin name**	**Reserve**
Microhylidae	Frog sp.	*Oreophryne sp.*	X
Rhacophoridae	Flying Frog sp.	*Rhacophorus sp.*	X
Scincidae	Skink sp.	*Sphenomorphus sp.1*	X
	Skink sp.	*Sphenomorphus sp.2*	X
	Skink sp.	*Sphenomorphus sp.3*	X
Colubridae	Reed Snake sp.	*Calamaria sp.*	X
Total – 4 Families	**6 Species**		

Appendix 6 – Freshwater fish diversity on Buton

Tables showing freshwater fish species detected on Buton. Taxonomy and nomenclature follow that employed by Tweedley *et al*. (2014). Common names follow those defined in Fishbase (2014). Species indicated † are considered threatened or near-threatened (IUCN). More details of these statuses are summarised in Appendix 1. Species indicated * are endemic to the Wallacean biodiversity hotspot (Myers *et al*. 2000). Species indicated (I) have been introduced to the study area. Threat status and population trends follow IUCN (2017). Species indicated X in the 'Reserve' column have been detected within the boundaries of protected forest reserves. Species unmarked in this column have only been detected in habitats adjacent to these protected areas.

a)

Family	Common name	Latin name	Population	Reserve
Anguillidae	Celebes Longfin Eel	*Anguilla celebesensis*	Unknown	X
	Indonesian Shortfin Eel	*Anguilla bicolor*	Unknown	
Moringuidae	Java Spaghetti Eel	*Moringua javanica*	Unknown	X
Muraenidae	Moray Eel sp.	*Thyrsoidea macrurus*	Unknown	X
	Indian Mud Moray	*Gymnothorax tile*	Unknown	
Ophichthidae	Snake-eel sp.	*Lamnostoma mindora*	Unknown	
Clariidae	(i) Catfish sp.	*Clarias teijsmanni*	Unknown	X
	(i) Philippine Catfish	*Clarias batrachus*	Unknown	X
Zenarchopteridae	Viviparous Halfbeak	*Zenarchopterus gilli*	Unknown	X
Aplocheilidae	Blue Panchax	*Aplocheilus panchax*	Unknown	X
Syngnathidae	Barhead Pipefish	*Microphis leiaspis*	Unknown	X
	Pipefish sp.	*Microphis mento*	Unknown	
Tetrarogidae	Wasp Fish sp.	*Tetraroge niger*	Unknown	
Ambassidae	Flag-tailed glass perchlet	*Ambassis miops*	Unknown	X
Carangidae	Brassy Trevally	*Caranx papuensis*	Unknown	X
Kuhliidae	Dark-margined Flagtail	*Kuhlia marginata*	Stable	X
	Rock Flagtail	*Kuhlia rupestris*	Stable	X
Cichlidae	(I) Nile Tilapia	*Oreochromis niloticus*	Unknown	

Eleotridae	Olive flathead Gudgeon	*Butis amboinensis*	Stable	X
	Northern Mud Gudgeon	*Ophiocara porocephala*	Stable	X
	Gudgeon sp.	*Ophieleotris aff. aporos*	Unknown	X
	Gudgeon sp.	*Eleotris aff. fusca-melanosoma*	Unknown	X
	†Throat-spine Gudgeon	*Belobranchus belobranchus*	Unknown	X
	Greenback Gauvina	*Bunaka gyrinoides*	Unknown	X
Gobiidae	Minute Mudskipper	*Periophthalmus minutus*	Unknown	X
	Barred Mudskipper	*Periophthalmus argentilineatus*	Unknown	
	†Clinging Goby	*Sicyopterus micrurus*	Unknown	X
	Goby sp.	*Sicyopterus macrostetholepis*	Stable	
	Goby sp.	*Sicyopterus microcephalus*	Unknown	
	†Goby sp.	*Sicyopterus ouwensi*	Unknown	
	Red-tailed Goby	*Sicyopterus gymnauchen*	Stable	
	Goby sp.	*Sicyopus zosterophorum*	Unknown	X
	Goby sp.	*Stiphodon elegans*	Stable	X
	†Goby sp.	*Stiphodon semoni*	Unknown	
	Goby sp.	*Waous aff. grammepomus-ocellatus*	Unknown	X
	Goby sp.	*Glossogobius aff. celebius-kokius*	Unknown	X
	Concave Goby	*Glossogobius concavifrons*	Unknown	X
	Bearded Flathead Goby	*Glossogobius bicirrhosus*	Unknown	X
	Goby sp.	*Glossogobius aff. obscurus-brunneus*	Unknown	X
	Speckled goby	*Redigobius bikolanus*	Stable	
	Goby sp.	*Schismatogobius bruynisi*	Unknown	X
	Bumblebee Fish	*Hypogymnogobius xanthomelus*	Unknown	
	Goby sp.	*Pseudogobiopsis oligactis*	Unknown	
	Goby sp.	*Stenogobius ophthalmoporus*	Unknown	
Rhyacichthyidae	Loach Goby	*Rhyacichthys aspro*	Unknown	X
Scatophagidae	Spotted Scat	*Scatophagus argus*	Unknown	X
Total – 17 Families	**46 Species**			

b)

Family	Common name	Latin name	Reserve
Muraenidae	Eel sp.	*Muraenidae* sp	
Cyprinidae	Carp sp.	*Rasbora* sp	
Mugilidae	Mullet sp.	*Mugil sp.*	X
Zenarchopteridae	*Halfbeak sp.	*Nomorhamphus sp*	X
Syngnathidae	Pipefish sp.	*Microphis sp*	X
	Pipefish sp.	*Doryicthys sp.*	
Tetrarogidae	Waspfish sp.	*Tetraroge sp.*	
Eleotridae	Sleeper Goby sp.	*Hypseleotris sp.*	X
Gobiidae	Goby sp.	*Redigobius sp.*	X
	Goby sp.	*Sicyopterus sp.*	X
	Goby sp.	*Lentipes sp.*	
	Goby sp.	*Stenogobius sp.*	
	Goby sp.	*Pseudogobiopsis sp.*	
Total – 8 Families	**13 Species**		

Appendix 7 – Butterfly diversity on Buton

Tables showing butterfly species on Buton. Taxonomy and nomenclature follow Vane-Wright & de Jong (2003). Species indicated † are considered threatened or near-threatened (IUCN). More details of these statuses are summarised in Appendix 1. Species indicated * are endemic to the Wallacean biodiversity hotspot (Myers *et al*. 2000). Species indicated ‡ are endemic to Indonesia. Threat status and population trends follow IUCN (2017). Species indicated X in the 'Reserve' column have been detected within the boundaries of protected forest reserves. Species unmarked in this column have only been detected in habitats adjacent to these protected areas.

Family	Common name	Latin name	Population	Reserve
Hesperiidae	Velvet Flat	*Celaenorrhinus ficulnea*	Unknown	X
	*Polygon Flat	*Odina chrysomelaena*	Unknown	
	Hesperiidae sp.	*Tagiades trebellius*	Unknown	X
	Hesperiidae sp.	*Hasora quadripunctata*	Unknown	
	*Straw-spotted Lancer	*Plastingia tessellata*	Unknown	
	Grey Coon	*Psolos fuligo*	Unknown	X
	Hooked Awling	*Choaspes hemixanthus*	Unknown	X
	Hesperiidae sp.	*Choaspes plateni*	Unknown	X
Papilionidae	Common Yellow Birdwing	*Troides helena*	Unknown	X
	*Rippon's Birdwing	*Troides hypolitus*	Unknown	X
	*Sulawesi Rose	*Pachliopta polyphontes*	Unknown	X
	*Sulawesi Blue Mormon	*Papilio ascalaphus*	Unknown	X
	*Blume's Peacock	*Papilio blumei*	Unknown	X
	Lime Swallowtail	*Papilio demoleus*	Unknown	
	*Sulawesi Banded Swallowtail	*Papilio gigon*	Unknown	X
	‡ Swift Peacock	*Papilio peranthus*	Unknown	X
	Common Mormon	*Papilio polytes*	Unknown	X
	*Sulawesi Red Helen	*Papilio sataspes*	Unknown	X
	Tailed Jay	*Graphium agamemnon*	Unknown	X
	*Lion Swordtail	*Graphium androcles*	Unknown	X
	*Wallacea Bluebottle	*Graphium anthedon*	Unknown	X
	Eastern Olive Triangle	*Graphium codrus*	Unknown	X
	‡Yellow Zebra	*Graphium deucalion*	Stable	X
	*Tabitha's Swordtail	*Graphium dorcus*	Unknown	X
	*Sulawesi Zebra	*Graphium encelades*	Unknown	X
	Great Jay	*Graphium eurypylus*	Unknown	
	*Meyer's Triangle	*Graphium meyeri*	Unknown	X
	*Monkey Swordtail	*Graphium rhesus*	(K)Unknown	

	Green Dragontail	*Lamproptera meges*	Unknown	X
Pieridae	Eastern Tree Yellow	*Gandaca butyrosa*	Unknown	
	Pieridae sp.	*Eurema alitha*	Stable	X
	Three-spot Grass Yellow	*Eurema blanda*	Unknown	X
	*Pieridae sp.	*Eurema celebensis*	Unknown	X
	Common Grass Yellow	*Eurema hecabe*	Unknown	X
	Pieridae sp.	*Eurema tominia*	Stable	X
	Lemon Emigrant	*Catopsilia pomona*	Unknown	X
	Orange Emigrant	*Catopsilia pyranthe*	(K)Unknown	
	Mottled Emigrant	*Catopsilia scylla*	Unknown	
	*Pieridae sp.	*Pareronia tritea*	Unknown	X
	Great Orangetip	*Hebomoia glaucippe*	Unknown	X
	The Psyche	*Leptosia nina*	(K)Unknown	
	*Rosenberg's Painted Jezebel	*Delias rosenbergi*	(K)Unknown	
	Common Albatross	*Appias albina*	(K)Unknown	
	*Pieridae sp.	*Appias aurosa*	(K)Unknown	
	*Pieridae sp.	*Appias hombroni*	Unknown	X
	Chocolate Albatross	*Appias lyncida*	Unknown	
	*Eastern Orange Albatross	*Appias zarinda*	Unknown	X
	Pieridae sp.	*Saletera panda*	Unknown	
	Caper White	*Belenois java*	Unknown	
	*Pieridae sp.	*Cepora celebensis*	(K)Unknown	
	*Pieridae sp.	*Cepora fora*	(K)Unknown	
	*Pieridae sp.	*Cepora timnatha*	Unknown	X
	*Pieridae sp.	*Aoa affinis*	Unknown	X
Lycaenidae	*Lycaenidae sp.	*Allotinus macassarensis*	(K)Unknown	
	*Lycaenidae sp.	*Allotinus major*	Unknown	X
	*Lycaenidae sp.	*Allotinus maximus*	(K)Unknown	
	*Lycaenidae sp.	*Logania obscura*	Unknown	X
	Lycaenidae sp.	*Miletus leos*	Unknown	X
	Apefly	*Spalgis epius*	(K)Unknown	
	Lycaenidae sp.	*Curetis tagalica*	Unknown	
	*Lycaenidae sp.	*Arhopala acetes*	(K)Unknown	
	*Lycaenidae sp.	*Arhopala argentea*	(K)Unknown	
	*Lycaenidae sp.	*Arhopala hercules*	Unknown	X
	Plain Plushblue	*Flos apidanus*	(K)Unknown	
	Scarce Silverstreak Blue	*Iraota rochana*	(K)Unknown	
	*Lycaenidae sp.	*Horaga selina*	(K)Unknown	
	Dark Posy	*Drupadia theda*	(K)Unknown	
	Common Silverline	*Spindasis vulcanus*	(K)Unknown	
	*Lycaenidae sp.	*Tajuria cyrillus*	(K)Unknown	
	*Chocolate Royal	*Remelana jangala*	Unknown	

	Common Tit	*Hypolycaena erylus*	(K)Unknown	
	Lycaenidae sp.	*Hypolycaena sipylus*	(K)Unknown	
	*Lycaenidae sp.	*Rapala dioetas*	(K)Unknown	
	*Lycaenidae sp.	*Rapala enipeus*	(K)Unknown	
	Slate Flash	*Rapala manea*	(K)Unknown	
	The Cornelian	*Deudorix epijarbas*	Unknown	
	White Lineblue	*Nacaduba angusta*	(K)Unknown	
	Rounded Six-line Blue	*Nacaduba berenice*	(K)Unknown	
	*Lycaenidae sp.	*Psychonotis piepersii*	Unknown	X
	Small Purple Lineblue	*Prosotas dubiosa*	(K)Unknown	
	Lycaenidae sp.	*Prosotas gracilis*	(K)Unknown	
	Common Lineblue	*Prosotas nora*	(K)Unknown	
	Marginated Lineblue	*Prosotas pia*	(K)Unknown	
	Felder's Lineblue	*Catopyrops ancyra*	(K)Unknown	
	*Lycaenidae sp.	*Caleta rhode*	(K)Unknown	
	Angled Pierrot	*Caleta caleta*	Stable	X
	*Lycaenidae sp.	*Caleta celebensis*	Unknown	X
	*Lycaenidae sp.	*Discolampa ilissus*	(K)Unknown	
	Lycaenidae sp.	*Jamides aratus*	Unknown	
	Dark Caerulean	*Jamides bochus*	(K)Unknown	
	Common Caerulean	*Jamides celeno*	(K)Unknown	
	Pale Caerulean	*Jamides cyta*	(K)Unknown	
	*Lycaenidae sp.	*Jamides festivus*	Unknown	X
	*Lycaenidae sp.	*Jamides philatus*	Unknown	X
	Forget-me-not	*Catochrysops strabo*	(K)Unknown	
	Long-tailed Blue	*Lampides boeticus*	Unknown	
	*Sulawesi Quaker	*Pithecops phoenix*	Unknown	X
	Zebra Blue	*Leptotes plinius*	(K)Unknown	
	Lesser Grass Blue	*Zizina Otis*	(K)Unknown	
	Tiny Grass Blue	*Zizula hylax*	(K)Unknown	
	Tailed Cupid	*Everes lacturnus*	(K)Unknown	
	The Malayan	*Megisba malaya*	Unknown	
	Common Hedge Blue	*Acytolepis puspa*	(K)Unknown	
	Gram Blue	*Euchrysops cnejus*	(K)Unknown	
Riodinidae	Plain Judy	*Abisara echerius*	Unknown	X
Nymphalidae	*Sulawesi Faun	*Faunis menado*	Unknown	X
	The Palmking	*Amathusia phidippus*	Unknown	X
	*Honrath's Palmking	*Amathusia virgate*	Unknown	X
	*Platen's Kohinoor	*Amathuxidia platen*	Unknown	X
	*Nymphalidae sp.	*Discophora bambusae*	Unknown	
	*Common Celebean	*Bletogona mycalesis*	Unknown	
	Common Evening Brown	*Melanitis leda*	Unknown	X

	Dark Evening Brown	*Melanitis phedima*	Unknown	X
	*Nymphalidae sp.	*Melanitis velutina*	Unknown	X
	*Hewitson's Palmfly	*Elymnias hewitsoni*	Unknown	X
	*Nymphalidae sp.	*Elymnias hicetas*	Unknown	X
	*Great Wallacean	*Zethera incerta*	Unknown	
	Bamboo Tree-brown	*Lethe europa*	Unknown	X
	*Sulawesi Jungle Brown	*Orsotriaena jopas*	Unknown	X
	Smooth-eye Bush-brown	*Orsotriaena medus*	(K)Unknown	
	Horsfield's Bush-brown	*Mycalesis horsfieldi*	Unknown	
	*Itys Bush Brown	*Mycalesis itys*	Stable	X
	Common Bush Brown	*Mycalesis janardana*	Unknown	X
	Dingy Bush Brown	*Mycalesis perseus*	Unknown	
	*Nymphalidae sp.	*Lohora opthalmica*	Unknown	X
	*Nymphalidae sp.	*Lohora physcon*	Unknown	X
	*Nymphalidae sp.	*Acrophtalmia leuce*	Unknown	X
	*Nymphalidae sp.	*Ypthima nynias*	Unknown	X
	*Nymphalidae sp.	*Ypthima loryma*	(K)Unknown	
	Nymphalidae sp.	*Ypthima norma*	(K)Unknown	
	*Nymphalidae sp.	*Charaxes affinis*	Unknown	
	*Green Raja	*Charaxes nitebis*	Unknown	
	Wise Raja	*Charaxes solon*	Unknown	X
	Eastern Mountain Coster	*Acraea moluccana*	Unknown	X
	Red Lacewing	*Cethosia biblis*	Unknown	X
	*Violet Lacewing	*Cethosia myrina*	Unknown	X
	Nymphalidae sp.	*Terinos taxiles*	Unknown	X
	Erichson's Cruiser	*Vindula dejone*	Unknown	X
	Common Cruiser	*Vindula erota*	Unknown	X
	Nymphalidae sp.	*Cupha arias*	Unknown	X
	*Nymphalidae sp.	*Cupha maeonides*	Unknown	X
	*Nymphalidae sp.	*Cirrochroa semiramis*	Unknown	X
	The Vagrant	*Vagrans sinha*	Unknown	X
	Small Leopard	*Phalanta alcippe*	Unknown	X
	Common Leopard	*Phalanta phalantha*	(K)Unknown	
	*Nymphalidae sp.	*Pantoporia antara*	Unknown	X
	*Nymphalidae sp.	*Lasippa neriphus*	Stable	X
	*Celebes Sailer	*Neptis celebica*	Unknown	X
	*Nymphalidae sp.	*Neptis ida*	Unknown	X
	*Nymphalidae sp.	*Lexias aeetes*	Unknown	X
	*Sulawesi Gaudy Baron	*Euthalia amanda*	Unknown	X
	Redspot Duke	*Dophla evelina*	Unknown	X
	*Sulawesi Marquess	*Bassarona labotas*	(K)Unknown	
	*Nymphalidae sp.	*Tarattia lysania*	Unknown	X
	*Nymphalidae sp.	*Athyma libnites*	Unknown	X
	*Nymphalidae sp.	*Moduza lycone*	Unknown	X

	*Nymphalidae sp.	*Moduza lymire*	Unknown	X
	*Nymphalidae sp.	*Lamasia lyncides*	Unknown	
	*Sulawesi Sergeant	*Tacola eulimene*	Unknown	X
	Angled Castor	*Ariadne ariadne*	Unknown	X
	*Holland's Castor	*Ariadne merionoides*	Unknown	X
	Wavy Maplet	*Chersonesia rahria*	Unknown	X
	‡Paulinus Map	*Cyrestis paulinus*	Unknown	X
	*Nymphalidae sp.	*Cyrestis strigata*	Unknown	X
	*Nymphalidae sp.	*Cyrestis thyonneus*	(K)Unknown	
	*Sulawesi Tabby	*Pseudergolis avesta*	Unknown	X
	Constable Butterfly	*Dichorragia nesimachus*	Unknown	X
	Nymphalidae sp.	*Symbrenthia hippoclus*	Unknown	X
	Peacock Pansy	*Junonia almana*	Stable	X
	Grey Pansy	*Junonuia atlites*	Unknown	X
	Northern Argus	*Junonia erigone*	Unknown	
	Chocolate Argus	*Junonia hedonia*	Unknown	X
	Australian Lurcher	*Yoma sabina*	Unknown	X
	The Wizard	*Rhinopalpa polynice*	Unknown	X
	Malayan Egg-fly	*Hypolimnas anomala*	Unknown	X
	Great Egg-fly	*Hypolimnas bolina*	Unknown	
	*Nymphalidae sp.	*Hypolimnas diomea*	Unknown	
	Australian Leafwing	*Doleschallia polibete*	Unknown	
	*Wallace's Black Prince	*Rohana macar*	Unknown	X
	*Sulawesi White Emperor	*Helcyra celebensis*	Unknown	
	*Eastern Yellow Glassy Tiger	*Parantica cleona*	Unknown	X
	*Manado Tiger	*Parantica menadensis*	Unknown	X
	†*Bonthain Tiger	*Parantica sulewattan*	Unknown	X
	Young Tiger	*Ideopsis juventa*	Unknown	X
	‡Blanchard's Wood Nymph	*Ideopsis vitrea*	Unknown	X
	*Sulawesi Blue Tiger	*Tirumala choaspes*	Unknown	X
	Common Tiger	*Danaus genutia*	Unknown	X
	Long-branded Blue Crow	*Euploea algea*	Unknown	X
	*Sulawesi Striped Blue Crow	*Euploea configurata*	Unknown	
	*Vanoort's Crow	*Euploea eupator*	Unknown	X
	*Hewitson's Dwarf Crow	*Euploea hewitsonii*	Unknown	X
	Redtenbacher's Crow	*Euploea redtenbacheri*	Unknown	X
	Two-brand Crow	*Euploea sylvester*	(K)Unknown	
	*Westwood's King Crow	*Euploea westwoodii*	Unknown	X
	*Blanchard's Ghost	*Idea blanchardii*	Unknown	X
Total – 6 Families	**194 Species**			

Appendix 8 – Diversity of other invertebrates on Buton

Tables showing **a)** Hymenoptera genera on Buton, **b)** Coleoptera species and generea Hymenoptera genera on Buton, and **c)** Isoptera species and generea on Buton. Species indicated † are considered threatened or near-threatened (IUCN). More details of these statuses are summarised in Appendix 1. Species indicated * are endemic to the Wallacean biodiversity hotspot (Myers *et al*. 2000). Threat status and population trends follow IUCN (2017). Species indicated X in the 'Reserve' column have been detected within the boundaries of protected forest reserves. Species unmarked in this column have only been detected in habitats adjacent to these protected areas.

a)

Family	Common name	Latin name	Population	Reserve
Agaonidae	Fig Wasp sp.	*Ceratosolen sp.*	Unknown	X
	Fig Wasp sp.	*Platyneura sp.*	Unknown	X
	Fig Wasp sp.	*Waterstoniella sp.*	Unknown	X
	Fig Wasp sp.	*Pleistodontes sp.*	Unknown	X
	Fig Wasp sp.	*Eukoebelea sp.*	Unknown	X
	Fig Wasp sp.	*Eupristina sp.*	Unknown	X
	Fig Wasp sp.	*Dolichoris sp.*	Unknown	X
	Fig Wasp sp.	*Platyscapa sp.*	Unknown	X
	Fig Wasp sp.	*Kradibia sp.*	Unknown	X
Eurytomidae	Fig Wasp sp.	*Sycophila sp.*	Unknown	X
Pteromalidae	Fig Wasp sp.	*Philotrypesis sp.*	Unknown	X
	Fig Wasp sp.	*Sycoscapter sp.*	Unknown	X
	Fig Wasp sp.	*Apocrypta sp.*	Unknown	X
	Fig Wasp sp.	*Arachonia sp.*	Unknown	X
	Fig Wasp sp.	*Diaziella sp.*	Unknown	X
	Fig Wasp sp.	*Watshamiella sp.*	Unknown	X
	Fig Wasp sp.	*Herodotia sp.*	Unknown	X
	Fig Wasp sp.	*Meselatus sp.*	Unknown	X
	Fig Wasp sp.	*Lipothymus sp.*	Unknown	X
	Fig Wasp sp.	*Otitesella sp.*	Unknown	X
	Fig Wasp sp.	*Arachonia sp.*	Unknown	X
Torymidae	Fig Wasp sp.	*Megastigmus sp.*	Unknown	X
Braconidae	Fig Wasp sp.	*Ficobracon sp.*	Unknown	X
Total – 5 Families	**Genera – 23**			

b)

Family	Common name	Latin name	Population	Reserve
Scarabaeidae	Dung Beetle sp.	*Gymnoplerus planus*	Unknown	X
	*Dung Beetle sp.	*Onthophagus cf. wallacei*	Unknown	X
	Dung Beetle sp.	*Onthophagus sp.*	Unknown	X
	Dung Beetle sp.	*Onthophagus sp.*	Unknown	X
	Dung Beetle sp.	*Onthophagus sp.*	Unknown	X
	Dung Beetle sp.	*Onthophagus sp.*	Unknown	X
	Dung Beetle sp.	*Onthophagus sp.*	Unknown	X
	Dung Beetle sp.	*Onthophagus sp.*	Unknown	X
	Dung Beetle sp.	*Onthophagus sp.*	Unknown	X
Total – 1 Family	**9 Species**			

c)

Family	Common name	Latin name	Population	Reserve
Rhinotermitidae	Termite sp.	*Schedorhinotermes medioobscurus*	Unknown	X
Termitidae	Termite sp.	*Odontotermes sp.*	Unknown	X
	Termite sp.	*Microcerotermes serrula*	Unknown	X
Nasutitermitinae	Termite sp	*Hospitalitermes sp.*	Unknown	X
	Termite sp.	*Lacessititermes sp.*	Unknown	X
	Termite sp.	*Nasutitermes sp.*	Unknown	X
	Termite sp.	*Bulbitermes sp.*	Unknown	X
	Termite sp.	*Bulbitermes sp.*	Unknown	X
Total – 3 Family	**8 Species**			

Appendix 9 – Botanical diversity of the Buton Forests

Tables showing **a)** Non-palm tree species, **b)** Palm species, **c**) other Angiosperm species **d)** Gymnosperm species, and **e)** Fern and Fern-allied species detected in the Buton Forests. Taxonomy and nomenclature follow that employed by Kew Gardens (2014) for non-palms and Powling (2007) for palms. Species indicated † are considered threatened or near-threatened (IUCN). More details of these statuses are summarised in Appendix 1. Species indicated * are endemic to the Wallacean biodiversity hotspot (Myers *et al*. 2000). Species indicated ‡ are endemic to Indonesia. Species indicated (I) have been introduced to the study area. Threat status and population trends follow IUCN (2017).

a)

Family	Indonesian name	Latin name	Population
Araucariaceae	†N/A	*Agathis dammara*	Decreasing
Gnetaceae	Kangkuse	*Gnetum gnemon*	Unknown
Annonaceae	(I)Koba	*Cananga odorata*	Unknown
	Beleko	*Polyalthia lateriflora*	Unknown
	Guara	*Mitrephora diversifolia*	Unknown
	Lalolea	*Xylopia sp.*	Unknown
Lauraceae	Sahu	*Alseodaphne borneensis*	Unknown
	*Kulilawa	*Cinnamomum culilaban*	Unknown
	Wasa	*Litsea cordata*	Unknown
	Futeo	*Endiandra rubescens*	Unknown
Myristicaceae	(?)N/A	*Myristica koordersii*	Unknown
	Saukorea	*Myristica malaccensis*	Unknown
	Garu	*Gymnacranthera forbesii*	Unknown
	(?)Towincu	*Gymnacranthera paniculata*	Unknown
Anacardiaceae	Kaboruboru	*Koordersiodendron pinnatum*	Unknown
	Tibosu (1)	*Semecarpus heterophylla*	Unknown
	Tibosu (2)	*Semecarpus perrottetii*	Unknown
	Tibosu (3)	*Semecarpus sp.*	Unknown
	Kafofo merah	*Buchanania sessilifolia*	Unknown
	Kafofo	*Buchanania arborescens*	Unknown
	Mangga hutan	*Buchanania sp.*	Unknown
	Rau	*Dracontomelon mangiferum*	Unknown
	Olo	*Spondias pinnata*	Unknown
Apocynaceae	‡Kahembehembe	*Tabernaemontana sphaerocarpa*	Unknown
	Gumpanga	*Alstonia scholaris*	Unknown
	Kangkura	*Alstonia spectabilis*	Unknown

	Tipulu	*Wrightia calycina*	Unknown
Asparagaceae	N/A	*Dracaena angustifolia*	Decreasing
Bignoniaceae	Ewuewu	*Radermachera gigantea*	Unknown
	Mandemandea	*Oroxylon indicum*	Unknown
Bombacaceae	Kawukawu	*Bombax ceiba*	Unknown
Burseraceae	Bolo	*Santiria laevigata*	Unknown
	Onoli	*Canarium asperum*	Unknown
Calophyllaceae	N/A	*Calophyllum inophyllum*	Unknown
	N/A	*Calophyllum soulattri*	Unknown
Casuarinaceae	N/A	*Gymnostoma sumatranum*	Unknown
Clusiaceae	Menawo	*Garcinia parvifolia*	Unknown
	(?)Kabulabulawa	*Cratoxylon clandestinum*	Unknown
Combretaceae	N/A	*Terminalia copelandii*	Unknown
Datiscaceae	Bolongita	*Tetrameles nudiflora*	Unknown
Dilleniaceae	(?)Bigi	*Dillenia serrate*	Unknown
	Kabigibigi	*Tetracera sp.*	Unknown
Ebenaceae	Kongkue	*Diospyros lanceifolia*	Unknown
	N/A	*Diospyros malabarica*	Unknown
Elaeocarpaceae	Sausorabi	*Elaeocarpus sphaericus*	Unknown
Euphorbiaceae	Bulante	*Macaranga triloba*	Unknown
	Lapi	*Macaranga tanarius*	Unknown
	Kamomea	*Macaranga hispida*	Unknown
	(I)N/A	*Macaranga cf. grandifolia*	Unknown
	N/A	*Mallotus floribundus*	Unknown
	N/A	*Phyllanthus niruri*	Unknown
	Gironda	*Bridelia stipularis*	Unknown
	Kaindea	*Baccaurea javanica*	Unknown
	Tambawa	*Antidesma sp.*	Unknown
	Koteo	*Drypetes longifolia*	Unknown
	Ulea	*Drypetes microphylla*	Unknown
	Kia	*Drypetes sp.*	Unknown
	Beau	*Aleurites moluccana*	Unknown
	Masihonda	*Cephalomappa sp.*	Unknown
	Saukolope	*Croton argyratus*	Unknown
	N/A	*Cleistanthus myrianthus*	Unknown
Fabaceae	Alibesi	*Albizia lebbeck*	Unknown
	Welalo	*Archidendron fagifolium*	Unknown
	Gumampora	*Sphatolobus sp.*	Unknown

	Sampalu	*Tamarindus indica*	Unknown
	Roda	*Erythrina subumbrans*	Unknown
	N/A	*Erythrina variegate*	Stable
	Ipi	*Intsia palembanica*	Unknown
	Behuhu	*Cassia siamea*	Unknown
	(I)N/A	*Senna alata*	Unknown
Fagaceae	*Ngasa	*Castanopsis buruana*	Unknown
	Kapoluli	*Lithocarpus celebicus*	Unknown
Flacourtiaceae	Tolasa	*Homalium caryophyllaceum*	Unknown
	Umba	*Homalium foetidum*	Unknown
Lecythidaceae	(?)Kalumente	*Planchonella nitida*	Unknown
	Kambau	*Planchonia valida*	Unknown
	N/A	*Barringtonia pendula*	Unknown
	Moni	*Barringtonia racemosa*	Unknown
	N/A	*Intsia palembanica*	Unknown
	N/A	*Inocarpus fagiferus*	Unknown
	(?)Wataubi	*Hydenanthus excelsus*	Unknown
	Kambau	*Radermachera gigantea*	Unknown
Leeacea	(?)Parigirigi	*Leea spinosa*	Unknown
Lythraceae	Lombau	*Lagerstroemia floribunda*	Unknown
	N/A	*Duabanga moluccana*	Unknown
Malvaceae	Bontu	*Hibiscus tiliaceus*	Unknown
	N/A	*Microcos paniculata*	Unknown
	N/A	*Urena lobata*	Unknown
Meliaceae	Wongkau	*Aglaia sp.*	Unknown
	Urufi	*Aglaia odoratissima*	Unknown
	†Rorio	*Aglaia silvestris*	Unknown
	(?)N/A	*Chisocheton kingie*	Unknown
	Ketapi	*Sandoricum koetjape*	Unknown
	Kasenongapa	*Dysoxylum parasiticum*	Unknown
	N/A	*Dysoxylum arborescens*	Unknown
	N/A	*Xylocarpus granatum*	Decreasing
	(I)Maranti	*Swietenia sp.*	Unknown
	(I)Bebuno	*Lansium domesticum*	Unknown
Moraceae	Tangku	*Ficus racemosa*	Unknown
	N/A	*Ficus adenosperma*	Unknown
	(?)N/A	*Ficus botryocarpa*	Unknown
	N/A	*Ficus benjamina*	Unknown
	N/A	*Ficus caulocarpa*	Unknown
	N/A	*Ficus cordatula*	Unknown
	N/A	*Ficus congesta*	Unknown
	N/A	*Ficus crassiramea*	Unknown
	N/A	*Ficus drupacea*	Unknown
	N/A	*Ficus glandifera*	Unknown

	N/A	*Ficus gul*	Unknown
	N/A	*Ficus heteropleura*	Unknown
	N/A	*Ficus hispida*	Unknown
	N/A	*Ficus lawesii*	Unknown
	N/A	*Ficus microcarpa*	Unknown
	N/A	*Ficus nervosa*	Unknown
	(?)N/A	*Ficus riedelli*	Unknown
	N/A	*Ficus septica*	Unknown
	N/A	*Ficus sumatrana*	Unknown
	N/A	*Ficus virgate*	Unknown
	N/A	*Ficus virens*	Unknown
	Kawajawaja	*Ficus copiosa*	Unknown
	Dowidowi	*Ficus ribes*	Unknown
	Ea	*Ficus variegate*	Unknown
	Kamela	*Ficus tinctoria*	Unknown
	Padamata	*Ficus involucrate*	Unknown
	Wuhaa	*Ficus subulata*	Unknown
	Padai	*Ficus magnoliifolia*	Unknown
	Kimbou	*Artocarpus elasticus*	Unknown
	Nangka hutan	*Artocarpus heterophyllus*	Unknown
	Kukubi	*Antiaris toxicaria*	Unknown
	Rombo	*Broussonetia papyrifera*	Unknown
Myrtaceae	(?)Ampo	*Syzygium spicatum*	Unknown
	(?)Jambu jambu	*Syzygium zollingerianum*	Unknown
	Urufi putih	*Syzygium zeylanicum*	Unknown
	(I)Buah malaka	*Psidium guajava*	Unknown
	(?)Ete	*Rapanea hasseltii*	Unknown
	Tombo	*Eugenia domestica*	Unknown
	Tamatamate	*Rhodamnia cinerea*	Unknown
	N/A	*Xanthostemon petiolatus*	Unknown
Oleaceae	N/A	*Chionanthus montanus*	Unknown
Oxalidaceae	N/A	*Averrhoa carambola*	Unknown
Proteaceae	(?)Kalimente	*Macadamia hildebrandtii*	Unknown
Rhizophoraceae	N/A	*Bruguiera gymnorhiza*	Decreasing
	N/A	*Rhizophora apiculata*	Decreasing
	N/A	*Rhizophora mucronata*	Decreasing
	†N/A	*Sonneratia ovate*	Decreasing
Rubiaceae	Bangkali kuning	*Anthocephalus macrophyllus*	Unknown
	N/A	*Borreria laevicaulis*	Unknown
	Hobehi	*Neonauclea calycina*	Unknown
	*N/A	*Neonauclea cf. havilandii*	Unknown
	N/A	*Neolamarckia cadamba*	Unknown
	Kosilu	*Nauclea orientalis*	Unknown
	Tongkila	*Nauclea sp.*	Unknown
	*Kambonganga	*Timonius celebicus*	Unknown
	Kakentakenta	*Hymenodiction excelsum*	Unknown

	(?)Bangkudu	*Morinda tomentosa*	Unknown
	(?) N/A	*Pavetta montana*	N/A
	(?)Tanggologolo	*Plectronia didyma*	Unknown
Sabiaceae	(?)Kabuko	*Meliosma nitida*	Unknown
Sapindaceae	Kabisubisu	*Erioglossum rubiginosum*	Unknown
	Kase	*Pometia pinnata*	Unknown
	Kasisimbu	*Dimocarpus dentatus*	Unknown
	N/A	*Lepisanthes tetraphylla*	Unknown
	N/A	*Schleichera oleosa*	Unknown
Sapotaceae	Taimanu	*Palaquium obovatum*	Unknown
	(?)Kalengka	*Palaquium obtusifolium*	Unknown
	Uris	*Chrysophyllum lanceolatum*	Unknown
	†Sulewe	*Madhuca betis*	Unknown
Sterculiaceae	Bau	*Pterospermum diversifolium*	Unknown
	Wagili	*Pterospermum celebicum*	Unknown
	Tokolu	*Kleinhovia hospital*	Unknown
	(?)Kakoho	*Pterocymbium javanicum*	Unknown
	(?)Kalakalau	*Sterculia longifolia*	Unknown
	Saukoleka	*Sterculia macrophylla*	Unknown
	Saribongko	*Heritiera trifoliolata*	Unknown
	Nuhu	*Heritiera littoralis*	Decreasing
Thymelaceae	Kanamunamu	*Phaleria sp.*	Unknown
	Sisiwa	*Phaleria capitata*	Unknown
	Padulaose	*Gonystylus brunnescens*	Unknown
Tiliaceae	Kobamfu	*Grewia koordersiana*	Unknown
	Kaapuapu	*Grewia glabra*	Unknown
	(?)Bulusese	*Colona scabra*	Unknown
Ulmaceae	Kagiligili	*Celtis philippinensis*	Unknown
Urticaceae	(?)Benako	*Villebrunea rubescens*	Unknown
	(?)Silato	*Dendrocnide microstigma*	Unknown
	(?) N/A	*Dendrocnide oblanceolata*	Unknown
	N/A	*Dendrocnide sinuate*	Unknown
	N/A	*Dendrocnide stimulans*	Unknown
	N/A	*Poikilospermum suaveolens*	Unknown
Verbenaceae	(?)Rogo	*Premna foetida*	Unknown
	Wola	*Vitex cofassus*	Unknown
	Tompira	*Vitex pubescens*	Unknown
	Kulimonifi	*Callicarpa longifolia*	Unknown
	(?)Pani	*Clerodendrum kaemfeni*	Unknown
Total – 44 Families	**193 Species**		

b)

Family	Common name	Latin name	Population
Arecaceae	Palm sp.	*Alocasia cf. balgooyi*	
	(I) Areca Palm	*Areca catechu*	Unknown
	*Palm sp.	*Areca vestiaria*	Unknown
	(I) Sugar Palm	*Arenga pinnata*	Unknown
	Clustering Fishtail Palm	*Caryota mitis*	Unknown
	(I) Coconut Palm	*Cocos nucifera*	Unknown
	*Palm sp.	*Hydriastele selebica*	Unknown
	*Palm sp.	*Licuala celebica*	Unknown
	Footstall Palm	*Livistona rotundifolius*	Unknown
	Nypa Palm	*Nypa fruticans*	Unknown
	Palm sp.	*Oncosperma horridum*	Unknown
	*Palm sp.	*Pinanga rumphiana*	Unknown
	*Rattan sp.	*Calamus koordersianus*	Unknown
	*Rattan sp.	*Calamus leiocaulis*	Unknown
	*Rattan sp.	*Calamus leptostachys*	Unknown
	*Rattan sp.	*Calamus macrosphaerion*	Unknown
	*Rattan sp.	*Calamus minahassae*	Unknown
	Rattan sp.	*Calamus mindorensis*	Unknown
	Rattan sp.	*Calamus ornatus*	Unknown
	*Rattan sp.	*Calamus pachystachys*	Unknown
	*Rattan sp.	*Calamus paucijugus*	Unknown
	*Rattan sp.	*Calamus pedicellatus*	Unknown
	*Rattan sp.	*Calamus robinsonianus*	Unknown
	Rattan sp.	*Calamus siphonospathus*	Unknown
	*Rattan sp.	*Calamus suaveolens*	Unknown
	Rattan sp.	*Calamus subinermis*	Unknown
	Rattan sp.	*Calamus symphysipus*	Unknown
	*Rattan sp.	*Calamus zollingeri*	Unknown
	*Rattan sp.	*Daemonorops robusta*	Unknown
Total – 1 Family	**28 Species**		

c)

Family	Common name	Latin name	Population
Piperaceae	N/A	*Piper abbreviatum*	Unknown
	*N/A	*Piper amboinense*	Unknown
	N/A	*Piper betle*	Unknown
	N/A	*Piper caninum*	Unknown
	*N/A	*Piper cf. bantamense*	Unknown
	N/A	*Piper fragile*	Unknown

Amaryllidaceae	N/A	*Crinum asiaticum*	Unknown
Acanthaceae	N/A	*Acanthus ebracteatus*	Decreasing
	N/A	*Andrographis paniculata*	Unknown
Balanophoraceae	N/A	*Balanophora fungosa*	Unknown
Balsaminaceae	N/A	*Impatiens platypetala*	Unknown
Capparaceae	N/A	*Crateva religiosa*	Unknown
Commelinaceae	N/A	*Commelina diffusa*	Stable
Compositae	N/A	*Ageratum conyzoides*	Unknown
	N/A	*Blumea balsamifera*	Unknown
	N/A	*Emilia sonchifolia*	Unknown
	N/A	*Erechtites valerianifolius*	Unknown
	N/A	*Erigeron sumatrensis*	Unknown
	N/A	*Eupatorium odoratum*	Unknown
	N/A	*Gynura procumbens*	Unknown
	N/A	*Pluchea indica*	Unknown
	N/A	*Synedrella nodiflora*	Unknown
	N/A	*Tridax procumbens*	Unknown
	N/A	*Vernonia cinerea*	Unknown
Convolvulaceae	N/A	*Ipomoea aquatic*	Unknown
	N/A	*Ipomoea hederifolia*	Unknown
	N/A	*Ipomoea pes-caprae*	Unknown
	N/A	*Merremia peltata*	Unknown
Cucurbitaceae	N/A	*Gymnopatalum cochinchinense*	Unknown
Cyperaceae	N/A	*Cyperus kyllingia*	Unknown
Dioscoreaceae	N/A	*Dioscorea cf. pyrifolia*	Unknown
	N/A	*Dioscorea hispida*	Unknown
Flagellariaceae	N/A	*Flagellaria indica*	Unknown
Goodeniaceae	N/A	*Scaevola sericea*	Unknown
Gnetaceae	N/A	*Gnetum gnemon*	Unknown
Graminae	N/A	*Apluda mutica*	Unknown
	N/A	*Cenchrus brownie*	Unknown
	N/A	*Coix lacryma-jobi*	Unknown
	N/A	*Cynodon dactylon*	Unknown
	N/A	*Dactyloctenium aegyptium*	Unknown
	N/A	*Digitaria ciliaris*	Unknown
	N/A	*Eleusine indica*	Increasing
	N/A	*Eragrostis tenella*	Unknown

	N/A	*Imperata cylindrical*	Unknown
	N/A	*Oplismenus compositus*	Unknown
	N/A	*Polytrias amaura*	Unknown
	(I) N/A	*Saccharum spontaneum*	Stable
	N/A	*Setaria palmifolia*	Unknown
	N/A	*Sorghum propinquum*	Unknown
Hernandiaceae	N/A	*Hernandia ovigera*	Unknown
Icacinaceae	N/A	*Iodes cirrhosa*	Unknown
	N/A	*Phytocrene hirsute*	Unknown
Lamiaceae	Pagoda Flower	*Clerodendrum paniculatum*	Unknown
	(I)Knobweed	*Hyptis capitata*	Unknown
	(I)N/A	*Lantana camara*	Unknown
	N/A	*Premna serratifolia*	Unknown
	N/A	*Stachytarpheta jamaicensis*	Unknown
	N/A	*Vitex cofassus*	Unknown
Leguminosae	N/A	*Clitoria ternatea*	Unknown
	N/A	*Cynometra cauliflora*	Unknown
	N/A	*Flemingia strobilifera*	Unknown
	N/A	*Mimosa pudica*	Stable
	N/A	*Mucuna pruriens*	Unknown
	N/A	*Vigna marina*	Unknown
Loganiaceae	N/A	*Strychnos axillaris*	Unknown
Marantaceae	N/A	*Donax canniformis*	Unknown
Melastomataceae	N/A	*Melastoma malabathricum*	Unknown
Menispermaceae	N/A	*Arcangelisia flava*	Unknown
	(?)N/A	*Pycnarrhena tumefacta*	Unknown
	N/A	*Tinospora crispa*	Unknown
Orchidaceae	N/A	*Bulbophyllum flabellum-veneris*	Unknown
	N/A	*Calanthe millikenii*	Unknown
	N/A	*Trichoglottis geminate*	Unknown
Pandanaceae	(?)N/A	*Freycinetia cf. devriesi*	Unknown
	N/A	*Freycinetia cf. funicularis*	Unknown
	N/A	*Pandanus cf.borneensis*	Unknown
Passifloraceae	(I)Bush Passionfruit	*Passiflora foetida*	Unknown
Ranunculaceae	N/A	*Naravelia laurifolia*	Unknown
Rubiaceae	N/A	*Myrmecodia tuberosa*	Unknown
	N/A	*Myrmeconauclea cf. stipulacea*	Unknown
	N/A	*Hydnophytum formicarum*	Unknown

Salicaceae	N/A	*Homalium foetidum*	Unknown
Solanaceae	N/A	*Solanum ferox*	Unknown
Vitaceae	N/A	*Tetrastigma cf. pedunculare*	Unknown
	N/A	*Tetrastigma lanceolarium*	Unknown
Total – 32 families	**85 Species**		

d)

Family	**Common name**	**Latin name**	**Population**
Cycadaceae	†Queen Sago	*Cycas rumphii*	Decreasing

e)

Family	**Common name**	**Latin name**	**Population**
Lycopodiaceae	N/A	*Lycopodium cernua*	Unknown
	N/A	*Huperzia phlegmaria*	Unknown
Selaginaceae	N/A	*Selaginella plana*	Unknown
Marattiaceae	King Fern	*Angiopteris evecta*	Unknown
Ophioglossaceae	N/A	*Ophioglossum pendulum*	Unknown
Aspleniaceae	N/A	*Asplenium longissimum*	Unknown
	N/A	*Asplenium macrophyllum*	Unknown
	N/A	*Asplenium nidus*	Unknown
Blechnaceae	N/A	*Stenochlaena palustris*	Unknown
Cyatheaceae	N/A	*Cyathea cf. roroka*	Unknown
	N/A	*Cyathea cf. elmeri*	Unknown
	N/A	*Cyathea contaminans*	Unknown
	N/A	*Cyathea moluccana*	Unknown
Davalliaceae	Deersfoot Fern	*Davallia denticulata*	Unknown

Dennstaedtiaceae	Common Bracken	*Pteridium aquilinum*	Unknown
Dryopteridiaceae	N/A	*Teratophyllum aculeatum*	Unknown
Gleicheniaceae	N/A	*Dicranopteris linearis*	Unknown
	N/A	*Sticherus truncate*	Unknown
Lindsaeaceae	N/A	*Lindsaea lucida*	Unknown
Lomariopsidaceae	N/A	*Nephrolepis biserrata*	Unknown
	N/A	*Nephrolepis hirsutula*	Unknown
Lygodiaceae	N/A	*Lygodium circinnatum*	Unknown
Polypodiaceae	N/A	*Drynaria quercifolia*	Unknown
	N/A	*Drynaria sparsisora*	Unknown
	N/A	*Microsorum membranifolium*	Unknown
	N/A	*Microsorum punctatum*	Unknown
	N/A	*Phymatosorus scolopendria*	Unknown
	N/A	*Pyrrosia longifolia*	Unknown
	N/A	*Pyrrosia piloselloides*	Unknown
Pteridaceae	Golden Leather Fern	*Acrostichum aureum*	Stable
	N/A	*Adiantum malesianum*	Unknown
	N/A	*Pteris ensiformis*	Unknown
	N/A	*Pteris moluccana*	Unknown
	N/A	*Pteris tripartita*	Unknown
	N/A	*Pteris vittata*	Increasing
Schizaceae	N/A	*Schizaea dichotoma*	Unknown
	N/A	*Schizaea digitata*	Unknown
Tectariaceae	N/A	*Pleocnemia irregularis*	Unknown
	N/A	*Pteridrys syrmatica*	Unknown
	N/A	*Stenosemia aurita*	Unknown
	N/A	*Tectaria crenata*	Unknown
Thelypteridaceae	N/A	*Cyclosorus callosus*	Unknown
	N/A	*Cyclosorus heterocarpus*	Unknown
	N/A	*Cyclosorus subpubescens*	Unknown
Woodsiaceae	N/A	*Diplazium sp.*	Unknown
Total – 20 Families	**Species – 45**		