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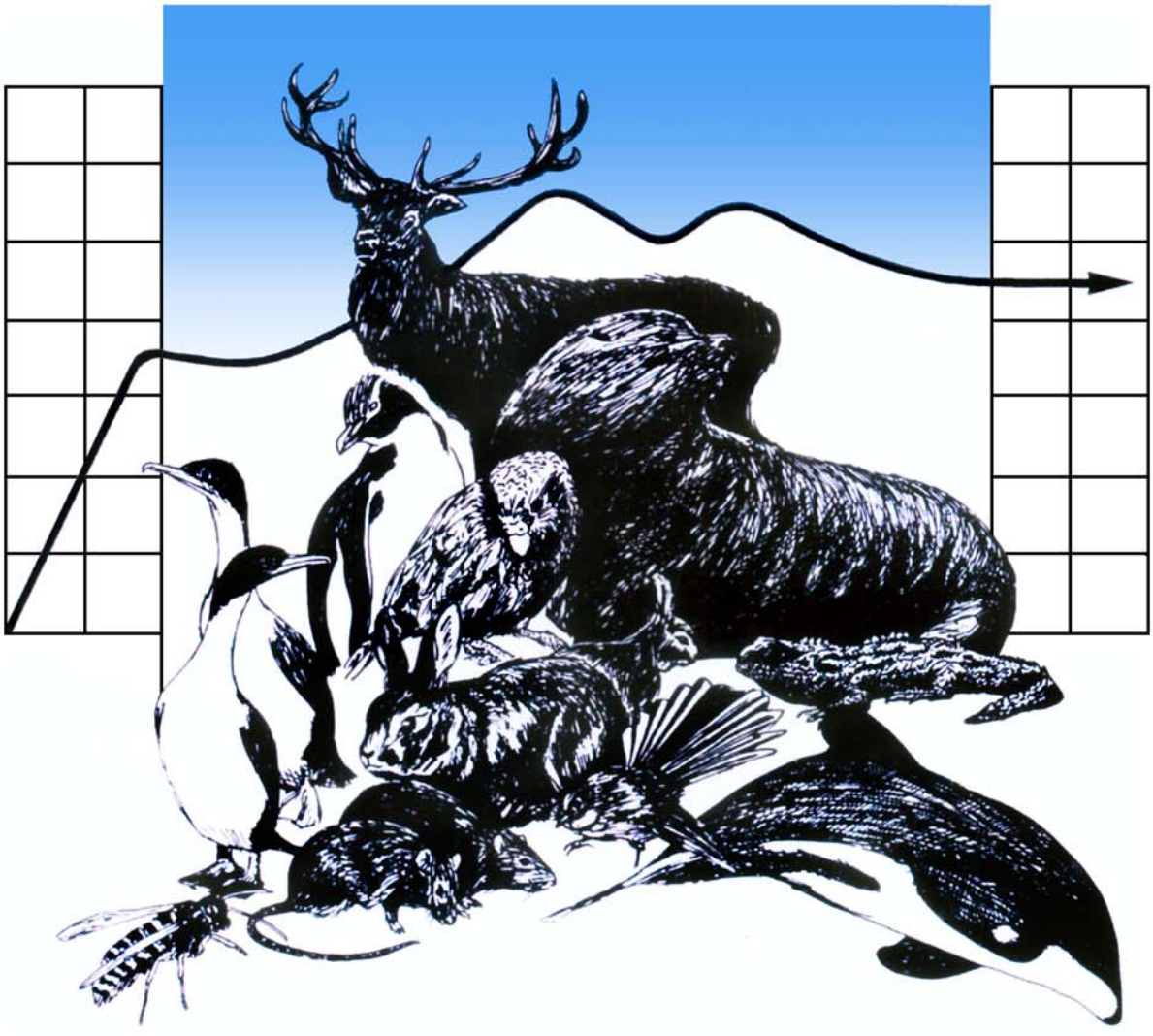

WILDLIFE MANAGEMENT

Assessment and conservation options for forest bird communities in the Independent State of Samoa

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1. ABSTRACT

In October and November 2008 a series of surveys were carried out at a study site in Solaua, in the Independent State of Samoa. The objectives of these studies were to assess the diversity of avian species in the area. They aimed to provide a species richness index for the site and to determine the time of day when detection probability was at its highest. An adapted three minute snap shot point count method outlined by Buckland et al., (2008) was employed to assess and record the variety of different avian species. 16 native avian species were detected during 20 three minute counts. This total included two species found on the IUCN redlist of endangered species. The results from these surveys were used to assess the suitability of the area as an internationally recognised Important Bird Area (IBA). To designate an area as an IBA a specific selection criteria must be met. IBAs and their place in the conservation of avian species in Samoa are discussed. Results from the time of day detection study supported literature on this subject and revealed that the peak time for optimal detection was in the period between 5:00pm and 7:00pm. Threats to biodiversity, notably avian species, in Samoa are also discussed and recommendations are made on how best to reduce these threats are discussed.

2. INTRODUCTION

Human activity, along with changes to the earth's climate, has been widely attributed to a rapid decline in much of our planet's biodiversity (Pimm et al. 1995; Watling 2000). Extinction, the ultimate change, is occurring at an increasing rate across an extensive range of terrestrial and aquatic habitats and must be addressed before it is too late (Steadman 1995). Pimm et al. (1995) reports human behaviour has influenced extinction rates of up to 1000 times greater than those experienced throughout earth's history. The overwhelming extent of this global crisis requires immediate and well directed attention to ensure more of the planets unique biodiversity is not lost. Due to the population decline and habitat destruction over such a broad scale, combined with the inadequate resources available to address them, decision makers must set priorities for the direction of conservation efforts. Identifying and isolating specific species or habitats that are most in need of these limited resources is a demanding task. As well as identifying the species or habitat, it is also imperative that the threats they face are also identified. Recognising areas that are facing such threats and are also rich in biodiversity will assist decision makers in distributing resources in the most productive and appropriate manner. In order to determine such areas accurate and reliable habitat and species assessments are essential.

The Independent State of Samoa, along with the other islands of the western-Polynesian group are home to some of the most diverse biodiversity found anywhere on earth (Watling 2001). Since human colonisation some 3000 years ago (Techera 2006) these islands have, however, also experienced some of the greatest losses in biodiversity seen anywhere on the planet (Watling 2000). For example, representing an astounding 20 percent worldwide reduction in the number of bird species, Steadman (1995) reports a loss of some 2000 bird species alone from this island group. In response to this and other alarming reports (Whittaker 2007) this group of pacific islands are widely recognised as areas of conservation concern.

Many avian species are relatively easy to census as they are generally well known, easy to locate compared with other taxonomic groups, and are easily recognisable (Bibby et al. 2000). Studies used to assess bird populations, therefore, are often used as indicator of the state of the environment in which they live (Bibby et al. 2000). Many surveying methods have been adapted and employed over the years to ensure accurate census are made and the data produced reliable. In order to make accurate estimations or assumptions about a habitat or species not all survey techniques are suited for different types of habitat (Sutherland et al. 2004).

The main objective of this report is to identify an area in the Independent State of Samoa as a possible area for avian conservation. I will also address some surveying techniques appropriate to assessing forest bird communities within this site.

This report will be divided into three main sections. In each section I will address the following aspects of assessing and protecting forest bird communities in Samoa.

1. RECOGNITION OF IBA: Identify and record an area of upland Upolu as a possible Important Bird Area (IBA) and justify this decision based on the IBA selection criteria.
2. SPECIES RICHNESS AND DETECTION SURVEYS: identify the methods use to assess species richness within the study site and use the findings to justify the decision to nominate the site as an IBA. Present finding of a time of day detection survey to identify highest detection times.
3. RECOMMENDATION FOR FUTURE CONSERVATION: Provide recommendations for future conservation efforts in regard to forest bird communities and other biodiversity in Samoa.

3. STUDY SITE

3.1 Samoa

The Independent State of Samoa, formally known as Western Samoa, lies in the south-west pacific between latitudes 13°25'S and 14°05'S, and longitudes 171°23'W and 172°48'W (Figure 1.).

Comprised of nine islands Samoa has a total land area of 2,935km^2. The two main larger islands, Savai'i (1,820km^2), and Upolu (1,100km^2) account for over 99 percent of the total land area. Seven smaller mainly uninhabited islands make up the rest of the Samoan land mass (Figure 2.)

With a 2004 population estimate of 184,984, Samoa has a population density of approximately 65 persons per kilometre (UN 2004). A vast majority of this population live in small family-orientated villages on or close to the coast of both islands (Figure 3.).

The majority of land is family owned or is under customary ownership. Consequently most land use decisions remain in the hands of the land owners or family groups. This traditional style of landownership creates many issues related to the conservation of large areas of Samoa.

Samoa is a signatory to the Conservation on Biodiversity (Watling 2000) and consequently has eight different types of protected areas. These protected areas range from large national parks such as the 2,830 ha O Le Pupu-Pue National park on Upolu, through to smaller privately owned terrestrial reserves on both main islands.

3.2 Solaua

The study area, locally known as Solaua, is a privately owned farm located close to the village of Sauniatu on the island of Upolu (Figure 4.) Covering approximately 1500 acres, the study area consists of approximately 30 percent open pasture and 70 percent native and exotic forest (>1000 acres of forested area). Much of the forested area was destroyed during the cyclones of the early 1990's but significant regeneration has occurred and a number of native tree species are again flourishing here. The Fatumanava falls above the southern boundary of the farm feed into the Fatumanava River which then runs through the property and down to the Pacific Ocean on the northern coast.

Enforced by the land owners, hunting of any description is strictly prohibited within the property boundaries. The large area of dense forest, however, makes enforcement of this ban very difficult. Bullet shells are frequently found within the forested area around the perimeters of the farm. It is presumed these shells come from hunters from surrounding villages who are thought to poach pigeon, bats and other avian species (Von Reiche pers comm.). Poaching is a major threat to many of Samoa's avian species and will be discussed further in the following section.

4. BIODIVERSITY AND CAUSES OF DECLINE

Samoa is home to 48 native animal species, including 30 species of breeding land bird (33 percent endemic), three mammals and 15 reptiles (Watling 2000). It is also home to over 500 species of native plant, with a very high proportion of these (32 percent) endemic to Samoa (Whistler 1992). As outline in the introduction Samoa, and in fact many surrounding pacific island nations, are experiencing increasing rate of extinction of a range of their native species.

There are many factors which have been attributed to the decline in Samoan biodiversity. The most widely acknowledged threats include forest clearance, unregulated hunting, natural disasters, and the introduction of pest species (MNRE 2006, Watling 2000). In this section I will discuss these threats and address the influence they are having on Samoa's avian biodiversity.

4.1 Forest clearance

Unregulated forest clearance is widely recognised as the major factor in the decline of avian diversity in Samoa (MNRE 2006, Whistler 1992, Watling 2000). Comparisons of forest cover surveys completed in 1954 (Fox & Cumberland) and again in 1987 (ANZDEC) identified a 19 percent decrease in forest cover during this period (Figures 5 & 6).

Furthermore, Atherton (2004) notes that the decline in forest cover was also accompanied by a decline in the quality of forested habitat (MNRE 2006). Atherton (2004)

reported 32 percent of forest cover as open forest (less than 40 percent tree cover) and as little as 0.05 percent closed forest, the ideal habitat for many of Samoa's native birds (Watling 2000). 24 percent of forest cover was also identified as secondary re-growth and thus not suitable for supporting a large abundance of birds (Atherton 2004, in MNRE 2006). Although rates of deforestation are decreasing, largely due to the fact that most easily accessible timber has been cleared, the felling and logging of native timbers is an ongoing problem. Clearance of forested land for agriculture is also identified as a major cause of a decline in forest cover (Watling 2000).

Despite a mandate to phase out deforestation, developed through the Forests Policy in 1994, forest clearing remains a serious threat to the survival of much of Samoa's biodiversity (MNRE 2006). Legislation to address this threat is currently under development.

4.2 Natural disasters

Natural disasters have played a major role in the decline of forest cover, and quality, in Samoa. During the early 1990's, cyclones Ofa (1990) and Val (1991) hit Samoa causing wide spread devastation including a substantial desolation of native forests. Widely acknowledged as the most destructive cyclones in recent times Ofa and Val caused widespread damage to vast areas of the Samoa group (Elmqvist et al. 1994; Rearic 1990)

Cyclones Ofa and Val were jointly responsible for reducing Samoa's forest canopy cover from 100 percent to as little as 27 percent (Elmqvist et al. 1994). Consequently impact assessment on native wildlife carried out by Lovegrove et al. (1992) reported that 'populations of pigeons and fruit-doves were decimated' and indicated that they would take many years to recover. A substantial number of other native avian species, along with species from other taxonomic groups, such as native bats, were also decimated by the cyclones (Lovegrove et al. 1992). Locals report large numbers of avian and mammalian species 'crawling' from the devastated forested areas in search of food.

4.3 Hunting

Hunting and harvesting of many native Samoan birds and their eggs has also been identified as a major factor in the decline of such populations (MNRE 2006, Watling 2000). Before the cyclones of the early 1990's, it is reported that hundreds of pigeons were hunted for food every year. Beichle & Maelzer (1985) reported that an estimated 400 of the now endangered tooth-billed pigeons alone were hunted every year. In response to the devastation to avian populations caused by the cyclones, hunting of all pigeon species was prohibited under the 1993 Protection and Conservation of Wild Animals Regulations (MNRE 2006). The aim of this ban was to give the populations decimated by the cyclones an opportunity to recover. After further decimation of many avian populations by cyclone Heta in 1994, the Protection of Wildlife Regulations (PWR) was drafted and implemented. An extended ban on the hunting or harming of all pigeons was consequently introduced (MNRE 2006). The

protection of pigeons under this act remains in place today. Unfortunately this prohibition is widely ignored and poaching continued to be a significant problem (Techera 2006; Watling 2000). Community surveys completed in conjunction with the Manumea recovery project (2006) revealed that of the 221 people surveyed over half had eaten pigeon since the ban had been in place (MNRE 2006).

In recent years the hunting and harvesting of avian species has shifted from a needs basis to a customary rights issue (Watling 2000). Although there is no longer a need for subsistence or survival hunting and gathering in Samoa, many people continue to uphold their traditional rights to carry out these activities. Although widely recognised as an illegal practice, these rights are rarely disputed (Techera 2006).

4.4 Introduced species

The introduction of exotic pest species has also been attributed to a decline in many avian species populations (Bellingham & Davis 1988; MNRE 2006; Watling 2000). As in many countries around the world, introduced species play a significant role in the devastation of a range of native species notably through predation and competition for food and nesting sites (Bibby et al. 2000). Introduced mammals and birds are the main offenders impacting the health of native avian populations in Samoa.

4.4.1 Mammals

Prior to human colonisation there were no land mammals present on the islands of Samoa (Watling 2000). With the colonisation of humans also came the introduction of a range of predatory mammals including feral cats (*Felis catus)*, three species of rat including Ship rats (*Rattus rattus)*, Norway rats (*Rattus norvegicus)* and the Pacific rat (*Rattus exulans)*, and dogs (*Canis lupus familiaris)* (Bellingham & Davis 1988; Watling 2000). These predatory mammals had an immediate and significant impact on many avian species in Samoa. Most notably the impact was observed in the population decline of many species ground dwelling species (Watling 2000).

4.4.2 Birds

Along with the introduction of predatory mammals, exotic avian species are also having an impact on native bird populations (Watling 2000). Although the number of introduced avian species is not substantial, compared to other countries, the small numbers of introduced species have spread widely throughout the islands of Samoa. The most abundant of these are the Common Myna (*Acridotheres tristis*), Indian Myna (*Acridotheres tristis*) and the Red-Vented Bulbul (*Pycnonotus cater)* (Watling 2000). These aggressive pests are frequently observed harassing native avian species in competition for nesting space and food.

Mynas have also been observed chasing nesting birds away from nests, eating eggs and removing chicks (Doherty 2006).

It is of some relief for forest bid communities, however, that these species are not commonly distributed in untouched native forest. Preferring new and open habitats, such as those found around human dwellings, these birds are not currently considered a serious threat to avian species inhabiting native forests (Watling 2000). As human populations expand, however, and deforestation continues, so does the threat these pest pose to such native species (Watling 2000).

It should be noted, however, that mynas are considered such a significant threat that the Samoan government has introduced intensive extermination programmes in attempts to control them. Community involvement in these programmes is strongly encouraged and bounties are offered for the extermination of mynas.

4.5 Summary

There is no doubt that the avian biodiversity of Samoa face a number of immediate threats. Many of these threats, however, can be controlled by changes in human behaviours. Increased enforcement, and the development of more stringent laws and policies, in regards to deforestation and hunting will go some way to reducing the impact of such threats. The establishment of more national parks or designated conservation areas will also enable the protection many of Samoa's unique avian species. The development of protected sites will allow conservation managers greater control of dealing with threats such as introduced pests, hunting and deforestation (MNRE 2006). The continuation of current pest control programmes will also benefit native avian species while at the same time boost Samoa's economy by creating employment for its people and encouraging community involvement in conversation action.

While extremely difficult to control, actions to prevent the potential devastation of threats such as natural disasters should also be considered. Maintaining healthy populations along with a wide range of suitable habitats for native species, will ensure the best chance of species survival if such events should occur.

As in many countries around the world, a partnership must be developed between conservation agencies, government organisations, NGO's and local communities to encourage all involved to take responsibility for their environment. Education programmes aimed at building positive conservation attitudes and practices, as well as public awareness, have proven to be excellent means of guaranteeing a healthy sustainable environment (Sutherland et al. 2004)

5. IMPORTANT BIRD AREAS (IBAs) AND THEIR PLACE IN PROTECTING SAMOA'S AVIAN BIODIVERSITY

5.1 IBAs

5.1.1 Introduction

The Important Bird Areas (IBA) scheme was designed by BirdLife International in 1981 with the aim of developing a network of sites to protect the world's avifauna (Masibalavu & Dutson 2006, O'Dea et al. 2006). IBAs are internationally recognised sites which primarily aim to encourage the protection and conservation of a target bird species. To achieve this aim, IBAs often focus on protecting or preserving the habitat in which the identified species lives (O'Dea et al. 2006). As of 2004, BirdLife International reports that over 7,500 sites in nearly 170 countries have been identified as IBAs.

5.1.2 Benefits of IBAs

Internationally recognised bird conservation areas such as IBAs provide a wide range of benefits both directly and indirectly for a range of taxonomic groups (Masabuluva & Dutson 2006). As outlined previously birds are often effective indicators of the health of an ecosystem and consequently the health other animal groups and plants within the same habitat. Although IBA are primarily designed to protect avifauna the conservation of these sites would also ensure the survival of a correspondently significant number of plants and animals (BirdLife International website, 2009).

As IBAs are internationally recognised areas of conservation interest they often attract attention from a diverse range of ornithologists, conservationists and experts from around the globe. This interest is often influential in the success of conservation programmes at both the IBA sites and in the surrounding community (Brooks et al. 2001). IBA also have the potential to become targets sites for eco-tourism ventures and further scientific studies and thus providing opportunities ultimately benefiting the landowner and the wider community. Governments and donor agencies also recognise the value of IBAs, and are therefore more inclined to support ventures though financial incentives and other means of assistance (Masabuluva & Dutson 2006).

As outlined, the designation of an area as an IBA does not only benefit the targeted avian species but also offer a wide range of benefits for sympatric avian species, other taxonomic groups, and the wider community.

5.2 Selecting areas as IBAs

In order for an area to be designated as IBA it must comply with a range of specific criteria. BirdLife International designed the following selection criteria to ensure global consistency and compatibility during the selection process.

To qualify as an IBA the site must included species from one or more of the following four categories:

1. globally threatened species;
2. restricted range species;
3. biome-restricted species
4. significant single or mixed-species congregations.

The specific criteria that the site must meet to qualify as an IBA for each category will be defined using an example in section 5.3

The selection of an area as an IBAs must be expert driven and have accurate and reliable data that confirms the specific criteria can be met (Masabuluva & Dutson 2006; O'Dea et al. 2006). This part of the selection process may be very time consuming if the area has not be surveyed in recent times or if sufficient data on the target species is not available. It is quite common, however, that as the area has been recognised as a potential IBA some information will have already been collected.

5.2.1 Size and boundaries

The size and boundaries of an IBA are most commonly determined by the ecological needs of the target species (Masabuluva & Dutson 2006). Natural features, land ownership, existing boundaries (such as forest edges, rivers or lakes) and existing protected areas are also considered when determining the potential boundaries of an IBA.

Selected IBA sites must be large enough to support a viable self-sustaining population of the species for which it was designated (Brooks et al. 2001; Masabuluva & Dutson 2006). It is also important, however, that the area of the IBA is not too great as to hamper the conservation efforts. A small area is much simpler to manage and is therefore more likely to achieve the goals set out by the conservation plan. The appropriate size of an IBA will fluctuate greatly depending on the terrain, vegetation type, and resources available. An IBA on a flat grass plain, for example, could be more easily managed than a mountainous forested area and could therefore be significantly larger.

5.3 Legal requirements of IBAs

In many countries, any conservation actions that may restrict people's access to their land will be met with heavy resistance (Masibalavu & Dutson 2006, MNRE 2006). This is especially true where customary rights play a significant role in the life of the community such as in many of the pacific islands (Techera 2006). It is, therefore, important to note that the designation of a

site as an IBA does not come with any legal obligations, and does not require the land-owners or other users to modify their behaviours. Ensuring involvement of the landowners and the local people in the protection of IBAs is of utmost importance.

5.4 Local communities and IBAs

IBA are not only designed to identify areas where successful bird conservation may take place but are also useful in gathering and providing information upon which governments, NGO's and communities may choose to act (Masibalavu & Dutson 2006). Globally, IBAs have played a significant role in encouraging people to take pride in their communities, and to take positive action to preserve their environment (Brooks et al. 2001). The IBA scheme strives to achieve this without imposing any negative effects on the local people's way of life (Brooks et al. 2001, Masibalavu & Dutson 2006).

6. ASSESING THE SUITABLITY OF AN IBA IN SOLAUA, UPLOU

6.1 Introduction

In the following section I will discuss the possibility of designating Solaua as a potential IBA. I will base my recommendation on data gathered while completing my research, in conjunction with data collected from previous studies in the area. I will also take into consideration the opinions and observations of experts and members of the local community when justifying my recommendation.

As outlined above there are certain criteria an area must meet before being designated as an IBA. In this section I will address each of the four categories and identify, using examples where possible, how the study site meets, or does not meet, the criteria for each category. I will also address other important factors that need to be considered when designating an area as an IBA.

6.2 Landowner and community support

As outlined previously, in order for an area to be developed as an IBA it is essential to ensure the landowner and the people of surrounding communities support the decision. As stated, any conservation action that is likely, or perceived to, impend the actions of people who use the land is likely to be met with heavy resistance. Meeting with local communities to clarify the intentions of designating an IBA is an important step in ensuring this partnership and understanding is established.

The land owner in this case, fully supports the idea of using the area to protect Samoa's native avian biodiversity. This support is demonstrated by the landowner's willingness to enforce a strict no hunting policy within the designated area. Plans to create a

possible eco-tourism venture on the study site also exhibit the landowner's enthusiasm to protect and conserve the area and its avifauna.

Discussions and consultation with members of local communities' surrounding the study site will need to be undertaken. A formal agreement or understanding between the landowner, these communities and other parties will need to be made to ensure all involved have the same expectations of the IBA.

6.3 Selection Criteria

6.3.1 Globally threatened species

Collard et al. (1994) defines a globally threatened species as any species that falls into the category of critically endangered, endangered or vulnerable on the IUCN Red List of Endangered species. To qualify as an IBA in this section the site must be known (or thought) to support species from one of the above categories (Masibalavu & Dutson 2006).

Many different species of pigeons and doves were sighted and recorded during the research period within the study area. The abundance of avian species present at this site indicates that the area is able to support a diverse and numerous varieties of avian species. The following endangered species are known (or thought) to be found with in the study area. Section 6.3.1 outlines the methods used to detect and record the species present within the study site.

6.3.1.1 **Ma'oma'o**

(Figure 7.)

The Ma'oma'o (Mao) is a large (28cm) olive-black coloured honeyeater with a very distinctive curved beak (Watling 2000). Once widespread and abundant across Savai'i, Upolu and much of Tutuila, American Samoa, the Mao is now restricted to fragmented areas of mature forest on Savai'i and Upolu. The last unconfirmed sighting the Mao on Tutuila was in 1977 (MNRE 2006 a, Watling 2000). According to Craig (2002) the Mao has not been sighted on Tutuila since. As no detailed studies of Mao populations have previously been carried out it is very difficult to identify changes in the abundance of this species (MNRE 2006 a). A comprehensive study designed to provide an assessment of the distribution of the Mao, in conjunction with Manumea surveys, was carried out in 2006. This survey revealed that Mao numbers were as low as 500 individuals (MNRE, 2006a).

Consequently, a recovery plan was written and implemented in 2006 with the aim to protect this unique endemic species from extinction. The low numbers of this species has been widely attributed to habitat destruction through deforestation (MNRE 2006a, Watling 2000) and to a lesser extent competition from introduced species (MNRE 2006a).

During the research period the Mao was spotted and recorded on at least four occasions within the study area. Conversations with local residents revealed that although the Mao was not common in the area, it was often seen and heard.

6.3.1.2 Manumea

(Figure 8.)

The Manumea, or tooth-billed pigeon, is a large colourful pigeon approximately 34-38 cm long (MNRE 2006; Steadman 2006; Watling 2004). Like the Mao, the Manumea was once widespread and abundant in Samoa and its offshore islands but is now largely restricted to fragmented areas of its previous range. Surveys conducted from October 2005 to November 2006 recorded the presence of Manumea in isolated patches on both Savai'i (six areas) and Upolu (four areas) (MNRE, 2006). In addition the Manumea has been heard or seen at Uafato (MNRE 2006) and Nu'utele (Beichle 1991; MNRE 2006). Unlike the Mao, previous studies of population distributions have been undertaken and consequently estimations of population declines can be made. Figures nine and ten indicate sightings of the Manumea from the periods 1974-2000 (Figure 9.) and again from a survey completed in 2005-2006 (Figure 10.).

Ulf Beichle, a pacific island avian specialist studying the Manumea, provided the best estimations of numbers reporting the population to be between 4,800 -7,200 individuals in the early 1980's (Beichle 1991). Beichle goes on to estimate that numbers had dropped to as "low as a couple of hundred" in 2006 but cites the need for more comprehensive surveys to provide precise figures (MNRE, 2006). These estimates have contributed to the Manumea's classification as 'endangered' on the IUCN Redlist of Endangered Species. A recovery plan has been consequently written and implemented for this species.

Although the Manumea was neither sighted nor heard during the research period it is likely that this species may inhabit the study area. The abundance of Maota, *Dysoxylum maota,* a fruiting member of the mahogany family, an acknowledged source of food for the Manumea, (MNRE 2006; Watling 2000), together with reports of historical sightings from member of the community and experts, confirm the likelihood that this species is still in the area.

6.3.2 Restricted range species

A restricted range species is defined by Stattersfield et al. (1998) as a species which has a geographical range of less than 50,000km^2. All endemic birds on islands with a land area of less than 50,000km^2 will, as a result, fit into this category. Both the Mao and the Manumea, as indicated above, are endemic to the islands of Samoa.

In order to qualify as an IBA in this category, however, more accurate numbers of these endangered populations would be needed. Masibalavu and Dutson (2006) state than in order for an area to qualify as an IBA in this category it must hold at least five percent of the population of any identified range-restricted species.

6.3.3 Biome-restricted assemblages

Brooks et al. (2001) defines a biome-restricted assemblage as a category referring to a species (regardless of range size) that is endemic to a particular biome i.e.; forests, shrub land, deserts.

In order to qualify as an IBA in this category the avian species identified must inhabit, and be able to only inhabit, a single biome. As a majority of the islands in the western pacific share the same biome (forests) it is not appropriate to include pacific island birds in this category. Masibalavu & Dutson (2006) support this by stating that areas in the Fijian or other Pacific Islands can not qualify as an IBA in this category.

6.3.4 Congregations

Congregations of species are defined here by Sutherland et al (2004) as a large group, or congregation of birds of any single species. This section is a quite complex and is consequently divided up into four parts.

6.3.4.1 Water birds

This section refers to congregations of an individual species of water bird with numbers greater than or equal to one per cent of the global population. Significant population of water birds were not recorded or sighted during the research period. Indications from local people reveal that it is unlikely that these criteria could be met in Solaua. It should be noted, however, that at least one pair of native Pacific Black Ducks (*Anas superciliosa)* were regularly sighted within the study area. It is unlikely, however, that there would be sufficient numbers of this species to meet the criteria for a water bird congregation. Comprehensive surveys of the area focusing specifically on water bird species may, however, reveal larger populations.

6.3.4.2 Seabirds

The second part of this category refers to congregations of an individual seabird species in numbers greater than or equal to one percent of the global population (Masabuluva & Dutson 2006). As with water bird species no substantial numbers of sea birds were identified during the study period. It should, however, be noted that a small number of unidentified seabird species were sighted flying high overhead and entering the forested area near the boundary of the study area. Identification of these birds was difficult due the distance from the observer and to the inaccessibility to the area where they appeared to have landed. More comprehensive survey may reveal nesting or breeding sites of certain species of sea bird though it is unlikely in any great numbers.

6.3.4.3 Large congregations

To qualify as an IBA in the third part of this category the designated area must support ≥20,000 water birds or ≥10,000 pairs of sea birds on a regular basis (Masabuluva & Dutson 2006). As mentioned above there have been no sightings or records of significant populations

of water or sea birds in the study area. It is unlikely that the area would qualify as an IBA in this category.

6.3.4.4 Migratory birds

The final part of this category, part four, refers to the presence of migratory birds at bottle neck sites. Thresholds for individual species are defined depending on the species present.

As there is no recorded presence of migratory birds at this site, this section does not apply to study area. Masabuluva & Dutson (2006) support this observation by stating that this section of the IBA selection criteria does not apply to any of the pacific islands in the western-Polynesian group.

6.4 Conclusion

Enthusiastic support from the landowners, ornithologists and other experts in the area indicate this area could be a possible site of an IBA. The landowners' willingness to formally identify the area as an IBA and to protect the habitat of a number of native avian species indicates a solid foundation for forming an IBA at this site.

Based on the categories of globally threatened and restricted range species it is also suitable to recommend Solaua as an ideal site for Samoa's first IBA. As outlined, the benefits of implementing IBA would be significant, not only for the targeted species, the Mao and the Manumea, but for a range of other birds, plants and other taxonomic groups such as native bats. The implementation of an IBA in the heart of Upolu would also encourage other landowners and members of the community to become involved in the conservation of their community. Designating the area as an IBA would also provide opportunities for more comprehensive studies on Mao and Manumea populations. The need for these studies is outlined in the respective recovery plans. The implementation of an IBA in this area could also provide an area where bird watchers and tourists could enjoy some of Samoa's unique biodiversity.

In summary, there would be many benefits for the avian population, other taxonomic groups and the wider community in designating Solaua as Samoa's first official IBA. It is highly recommended, therefore, that this area be seriously considered for this scheme.

7. SPECIES RICHNESS AND DETECTION SURVEYS

7.1 INTRODUCTION

Assessing the species richness of an area is paramount when determining the most appropriate conservation action to take (Sutherland et al. 2004). Species richness here is defined by Gotelli et al. (2001) as a fundamental measurement of community and regional

diversity. Quantifying species richness has gained increasing importance over recent time as data collected from such studies is often used in designing conservation programmes (Herzog et al. 2002). There are many different methods available to assess the species richness of an area (Bibby et al. 2000) but not all methods are suitable for each habitat. There are many considerations that need to be addressed when determining the most suitable surveying method for the selected habitat.

To assess the diversity of avian species with in the study site in Solaua I employed the three minute snap shot point count method as outline in Buckland et al. (2008). This method was selected due to its simplicity. This method also offers a reliable and quick assessment of avian species. This method, as opposed to line transects for example, allows researchers to take this time at each point and detect a majority of species present in the area. As the habitat being surveyed consisted of thick undergrowth under a dense canopy it was necessary to take time at each count station to ensure all species present were detected. Detection by sight was often very difficult and knowledge of calls was invaluable.

As in all survey methods aiming to achieve the highest rate of detection is paramount in providing reliable and accurate data (Bibby et al. 2000; Sutherland et al. 2004). In order to achieve this high level of detection certain aspects of surveys must be considered. The time of day surveys are undertaken plays a huge role in the number of avian species detected. In order to assess the most appropriate time of day to assess species richness a survey was carried out over a five day period.

In this section I will outline factors that need to be considered to ensure accurate species richness assessments are made. I will go on to discuss the methods used to undertake a species richness survey in Solaua and present the results of this research. I will also discuss the methods used to assess the most appropriate time of day for detection surveys and present the findings of this study.

7.2 ENSURING ACCURATE SURVEYS

Accurate and comprehensive avian surveys can be labour intensive and extremely time consuming (Sutherland et al. 2004). In order for surveys to be through and precise many consideration must be taken into account. Bibby et al. (2000) identifies the following factors as important when conducting avian surveys.

7.2.1 Prior knowledge and expectations

It is of utmost importance to become familiar with the species that are likely to be found in the area. Species guide books or charts are often available and are invaluable tools when attempting to identify avian species. It is also important to become familiar with the restricted range species (Stattersfield et al. 1998) and threatened species that may be in the area, as detection of these is an essential part of gathering accurate information.

7.2.2 Learning the birds

There is no substitute for being able to immediately identify most birds by sight or sound with confidence and accuracy (Bibby et al. 2000). Studying bird guides and listening to sound recording of calls, where available, can be a time consuming process but is critical in accurate identification of many species. Prior to beginning the study it is invaluable to spend time with an expert to learn to identify the avian species in the area.

7.2.3 Indigenous and local knowledge

Along with expert's knowledge, the knowledge of local people is also a very useful source of information. Although these people may not be formally schooled in the skills of bird identification, their experience and local knowledge is invaluable. This is especially true in areas where the species is hunted or has other traditional values. Using local people to guide researchers to areas where specific species have been recently spotted ensures a majority of species will be detected.

7.2.4 Time of day and season

Detection of some species may vary depending on the time of day or season. If it is unknown when a certain species breeds or nests it may be difficult to determine weather or not this species is present within the study area. Ideally, surveys would be completed thought the year in different season and at a range of different time during the day.

To determine the most appropriate time of day for the detection of Samoan birds, a study was undertaken recording the number of detections in response to different times. This study will be described in section 6.3.2.

7.2.5 Micro habitats

In species rich areas many birds occupy their own distinctive habitat also referred to as micro habitats (Bibby et al. 2000). It is important, therefore, that the ranges of micro habitats, within the study area are thoroughly surveyed to ensure as many species as possible are detected.

7.2.6 Altitude

The altitude of the study site will have a significant influence on the species present in the area. In order to detect as many different species as possible a range of survey points at different altitudes must be used.

7.2.7 Fruits and flowers

Many species are attracted to localised resources such as fruiting or flowering trees. These areas are often the best placing for detecting large umbers of different species and should be identified prior to beginning any survey. Taking advantage of local knowledge to locate these areas in invaluable.

7.2.8 Vantage points

Selecting a suitable vantage point for detection surveys is critical. Many species of bird are difficult to detect from the ground, especially canopy dwelling species. It is therefore imperative that a suitable point is selected so detection probability of these species is increased.

7.2.9 Summary

As outline by Bibby et al. (2000) there are a number of factor that must be addressed in order to complete an accurate species richness survey within the identified habitat. In the following section I will outline the methods used to ensure that a comprehensive species richness survey was conducted for the study area.

7.3 METHOD

In this section I will outline the methods of the two different surveys that were undertaken during the research period. The first survey was designed to determine the number of different avian species found within the study area (species richness). The second survey aimed to identify the time of day when detection probabilities of these avian species were at their highest.

7.3.1 Species richness survey

To ensure an accurate and comprehensive species index of the study area a snap shot point count method as outlined in Buckland et al. (2008) was employed. This method involves a group of researcher travelling to a designated site and identifying all birds present in the surrounding area at a point in time. Due to time constraints and the number of points requiring surveys, a time limit at each point was necessary. Ideally this time constraint would not exist and more time could be spent at each point. It is possible that this would result in a larger number of species being identified. This concern was addressed, however, by completing duplicate counts at each point. Employing this method allowed the research team to cover a wide area of study site, while at the same time provide an accurate assessment of the species found at each point.

Each site was selected based on habitat structure, local and expert knowledge of bird occurrence, and the presence of fruiting or flowering vegetation. Accessibility to selected

areas was also an influencing factor in determining the most appropriate sites. To increase the chance of detection of a diverse range of species, 20 counts were undertaken at ten different sites during the study period. These counts were undertaken by a team of researchers including the author, and three local guides. Employing local guides with their knowledge of native birds ensured all species present could be identified.

Using an adapted five minute bird count recording sheet (appendix 1.) all birds in the area were recorded at each site. Although unnecessary for this survey, records of count times and whether conditions were also kept.

7.3.2 Time of day detection

In an attempt to identify the most productive time of day for detecting forest bird species within the study area a five day survey was carried out. The single site for this survey was selected in response to the large number of detection at the selected point during the species richness survey.

The study was conducted over five non consecutive days during the study period. A five minute bird count method, as outline in Dawson and Bull (1975), was employed to identify the number of individual birds present at one hour intervals from 6:00am through to 7:00pm. Observations of the number of birds present, irrelevant of species, were made during each five minute period and recorded in a field notebook. Averages of these figures, including standard deviation and confidence intervals, were then used to determine the most productive time of day to detect avian species.

7.4 RESULTS

7.4.1 Species richness

A total of 158 individual native birds were sighted and recorded during the survey period. A total of 16 different species were recorded. This total includes four sightings of the Mao, two sightings of Tu'aimeo, and the sighting of a single Fiaui. The Mao, endangered, and the Tu’aimeo, vulnerable, are both listed on the IUCN Red List of endangered species, and the Fiaui is listed as of conservation concern in Samoa (Watling 2000). The abundance of other more common native species indicates the area has the potential to support a large number of native birds. Figure 11 displays the number of detections for all native birds encountered during the species richness surveys.

7.4.2 Time of day detection

A total of 640 detections were made throughout the five days. Of these 640 detections and substantial percentage were made in the hours surrounding dawn and dusk. 374 detections, accounting for 59 percent of the total detections, were made within the six count

periods around dusk and dawn. Compare this with the 266 detections made in the remaining eight periods. The lowest average number of detections (4.6, SD 1.14) occurred in the mid afternoon, 2:00pm, when maximum daily temperatures were often reached (Watling 2000). The highest average number of detections (17.2 SD 1.92), occurred during the 5:00pm count. It should be noted that that the low levels of detection in the first and last time periods could be attributed to a lack of effective light at these times. Figure 12 displays the average number of detections for each time period.

7.5 DISCUSSION

7.5.1 Species richness

As outlined by the results of this survey, the study area is home to a wide range of native avian species. This is encouraging for ornithologist and conservationist in the region as it identifies the area as a potential site for future research or for the protection of a diverse range of species.

Due to the limited number of counts completed, and the fact that the counts were undertaken within a confined time period, it is also likely that not all avian species present in the area were detected. In order for a full species richness survey to be completed it would require a great deal more time and observer effort. As an accurate account of species richness is paramount to planning effective conservation programmes (Gotelli et al. 2001; Sutherland et al 2004), it is recommended that further more comprehensive surveys be carried out. Due to the number and severity of threats Samoan avifauna is facing, however, this area should be immediately considered as an area of conservation importance. The detection of rare and endangered species such as the Mao and the Tu'aimeo should be an indication of the potential of this site to support a range of unique species. As outlined in section 5.4 the designation of this site as an area of conservation importance will not only benefit a wide range of bird species, but also other taxonomic groups and the wider community.

7.5.2 Time of day detection

In order to increase the accuracy and reliability of this time of day detection analysis an extended study period would be required. Due to time constraints of this project, this was not possible. The conclusions made from this survey, however, are strongly supported by the literature and by expert opinion. Watling (2000) reports sightings of forest bird species in the pacific islands are often higher in the early mornings and again in the evenings in relation to the movement of birds leaving and returning to their roosts. Atherton (pers comm.) also predicted the greatest probability of detection around these times.

Based on the findings of this survey, with support from relevant literature and expert opinion, it is recommended that further detection surveys scheduled to be undertaken in this

area be completed within these times where possible. Completing surveys at these times will ultimately lead to the highest possible rate of detection. Achieving this will allow conservation managers to accurately assess the conservation needs of the area and take the most appropriate action.

8. RECOMMENDATIONS

Throughout this report many threats have been identified and possible solutions to these threats have been discussed. It is of utmost importance that these are taken seriously and action is taken to reduce the severity of such threats. In order to reduce the decline in populations of forest bird communities in Samoa the following actions to minimise these risks should be considered.

8.1 Deforestation

As it is widely acknowledged as one of the most serious threats to avian biodiversity in Samoa, immediate action needs to be taken to reduce this threat. It is up to government officials, in cooperation with landowners to develop, implement and enforce stringent laws or policies regulating the clearance of forested areas. Designating protected areas where deforestation is prohibited would provide an excellent starting point to address this threat. The need for timber and areas of land for agricultural purposes must be weighed up against the need to protect Samoa's unique biodiversity.

8.2 Hunting and harvesting

With increased enforcement the currently laws and policies should be adequate to address this problem. An increase in public awareness about the severity of this threat may also go some way to halting the decline of avian population in the future. It must be made clear to local people that current practices, traditional or not, are not sustainable and changes must be made in order to ensure the survival of these hunted species.

8.3 Introduced pests

Current initiatives to eradicate mynas and consequently reduce the threat they pose is an excellent step in ensuring these pest do not present a severe risk to native avian populations in the future. It is encouraged that these programmes should continue or be extended. Comprehensive research into the impact rats and feral cats are having on avian populations should also be carried out and appropriate action should be taken.

8.4 Recognition of IBA

Designating Solaua as an IBA would be an excellent foundation in the protection of a range of native avian species. An IBA in upland Uplou would provide an ideal site, not only for the protection of native species but also as a site where further research could be carried out. It would also provide an area where local communities could take an active role in conserving their countries unique biodiversity. The results of the species richness surveys carried out in this project support the proposal to identify Solaua as an important bird conservation area or IBA

8.5 Community awareness

It is imperative that the local people of Samoa become aware of the threats native biodiversity in their community face. Undertaking extensive public awareness programmes that reach all levels of society will ensure that people begin to take responsibility for their own actions and reduce the threats they pose to the environmental and it inhabitants. Public awareness will also encourage local people to become actively involved in conservation efforts in their communities.

9. SUMMARY

In summary there are many ways in which government agencies, NGO's and people of the communities of Samoa can help preserve their unique biodiversity. It is of utmost importance that well guided action involving all levels of society is taken immediately before the impact of these threats becomes irreversible. The options for change are available, it is up to the people of Samoa to take action.

10. FIGURES

Figure 1. Location of the Independent State of Samoa in the Pacific Ocean

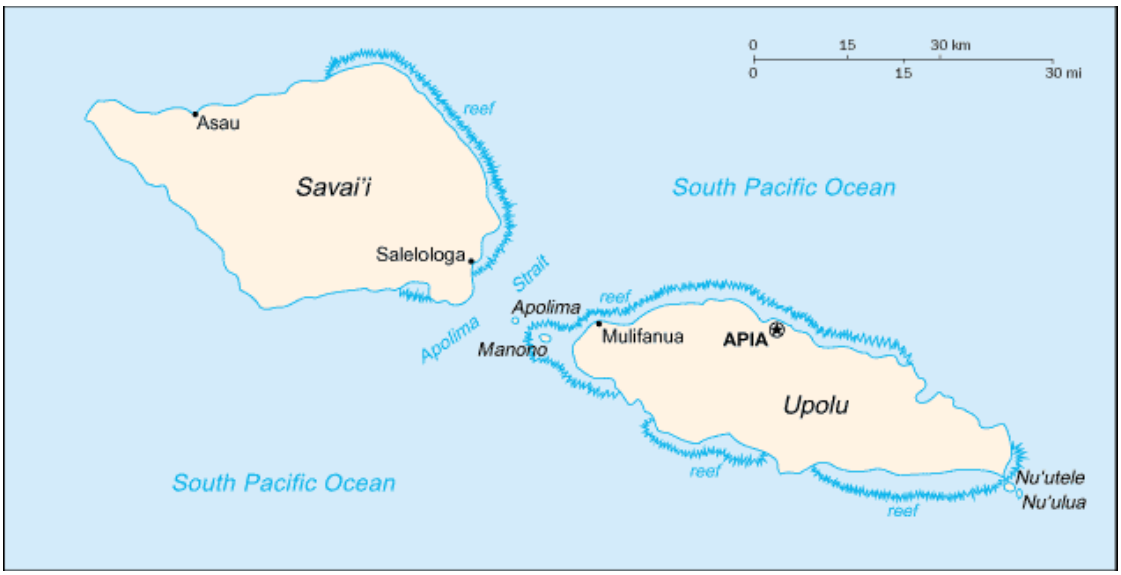

Figure 2. Map showing the islands of the Independent State of Samoa

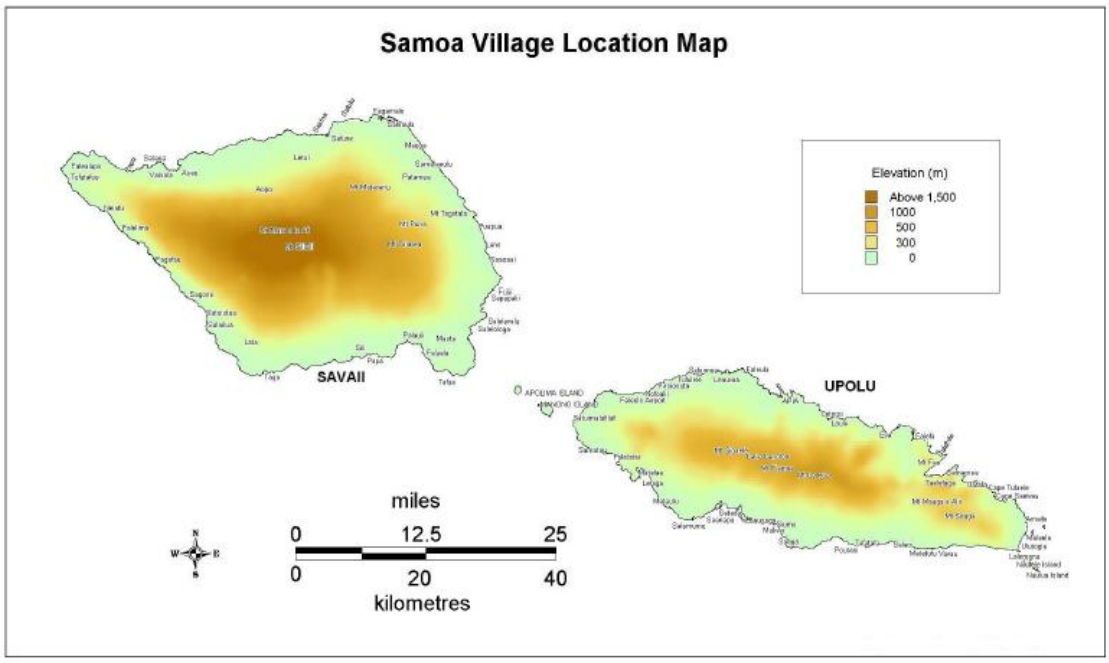

Figure 3.Location of Samoan villages around the coasts of both main islands.

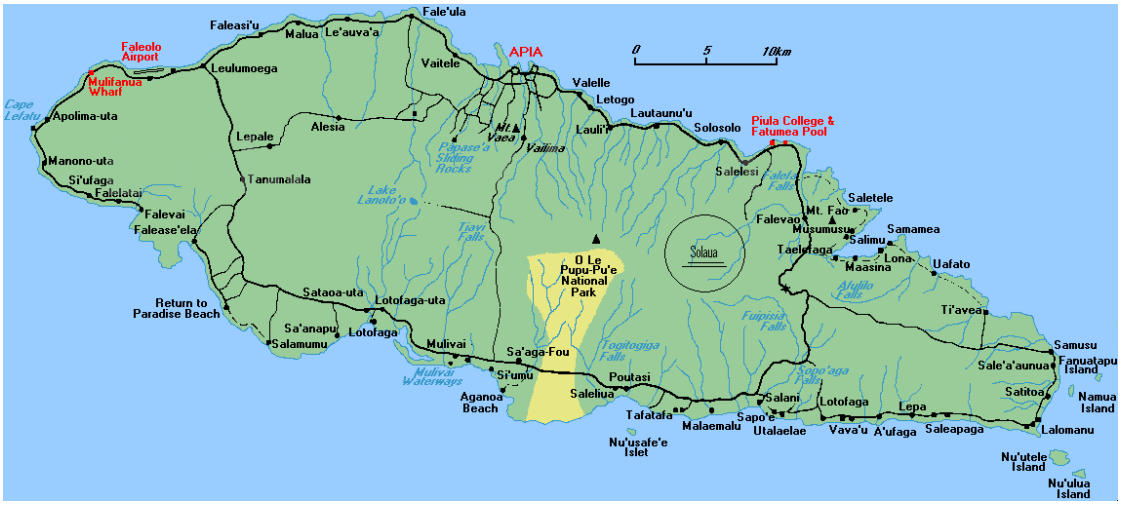

Figure 4. Map showing location of Solaua on the island of Upolu, Samoa

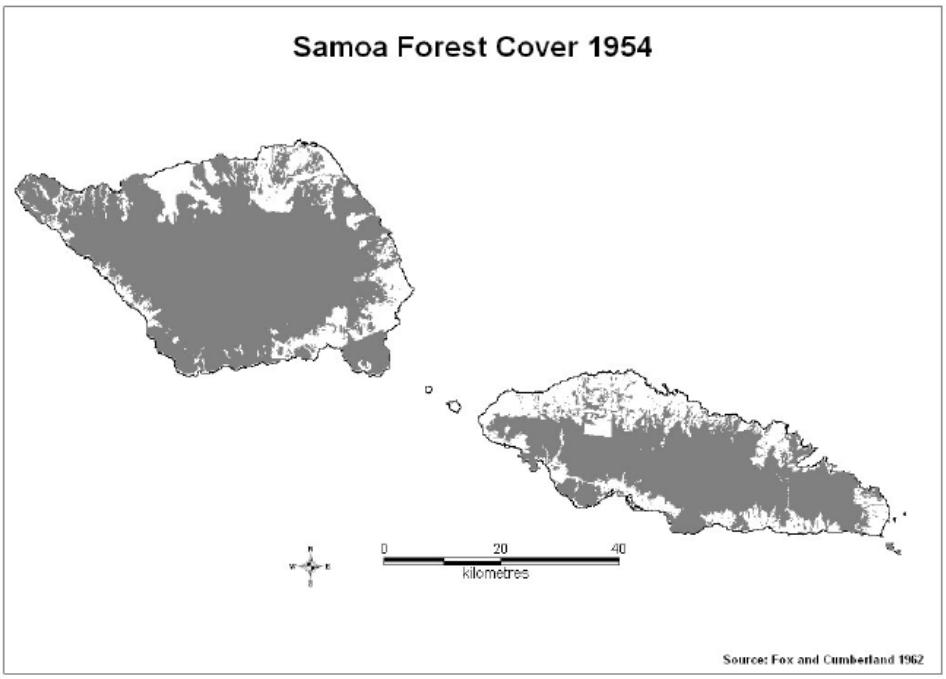

Figure 5. Map of Samoan islands showing forest cover in 1954

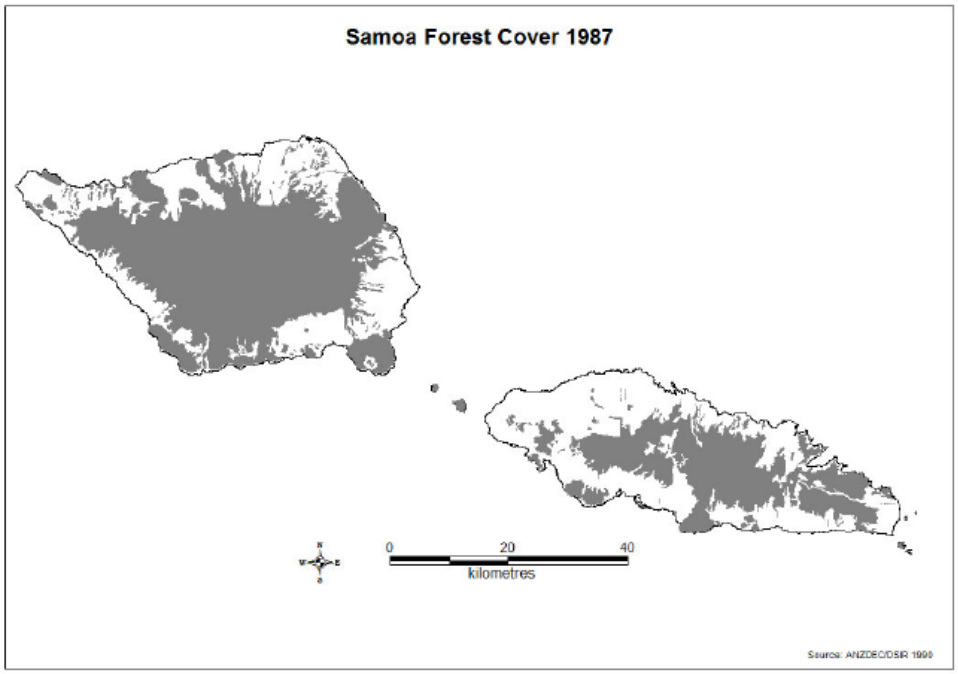

Figure 6. Map of Samoan islands showing forest cover in 1987

Figure 7. Mao (*Gymnomyza samoensis)* a vulnerable Samoan forest bird species

Figure 8. Manumea (*Didunculus strigirostris*) an endangered Samoan forest bird

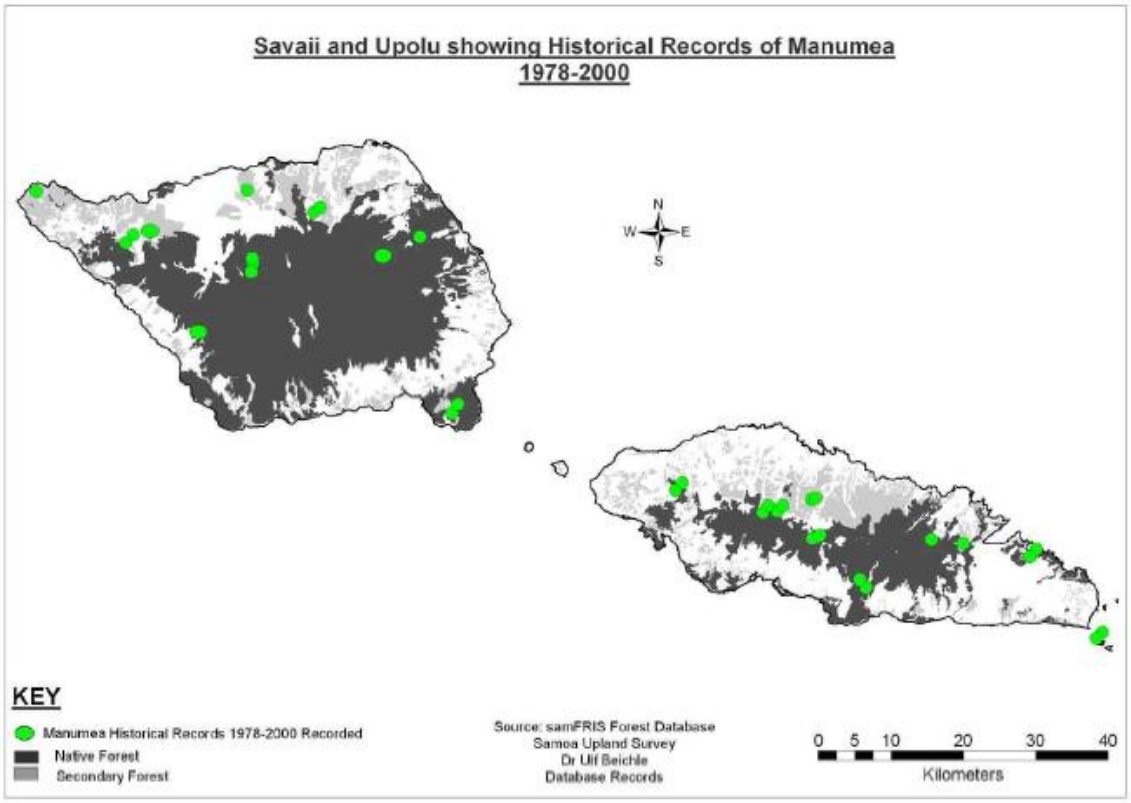

Figure 9. Map of Samoan islands showing where Manumea was detected during surveys from 1978-2000

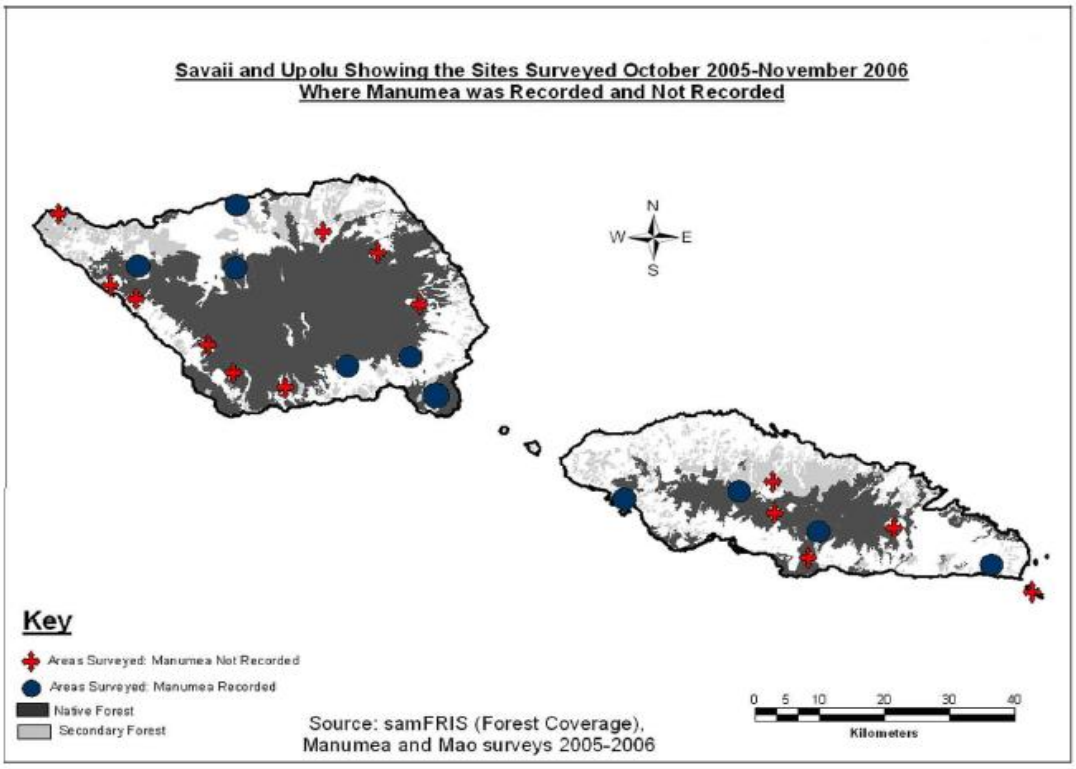

Figure 10. Map of Samoan islands showing where Manumea was and was not detected in 2005/2006 surveys

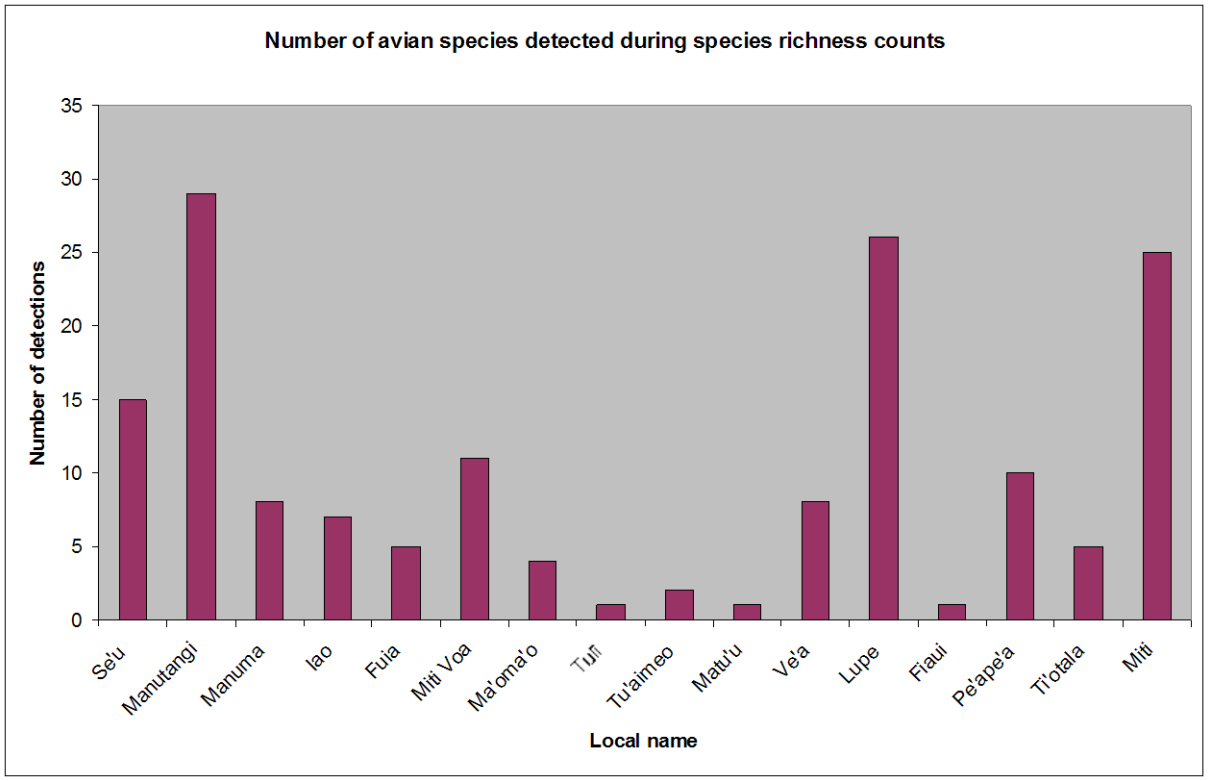

Figure 11. Graph displaying the number of different avian species detected in the species richness survey

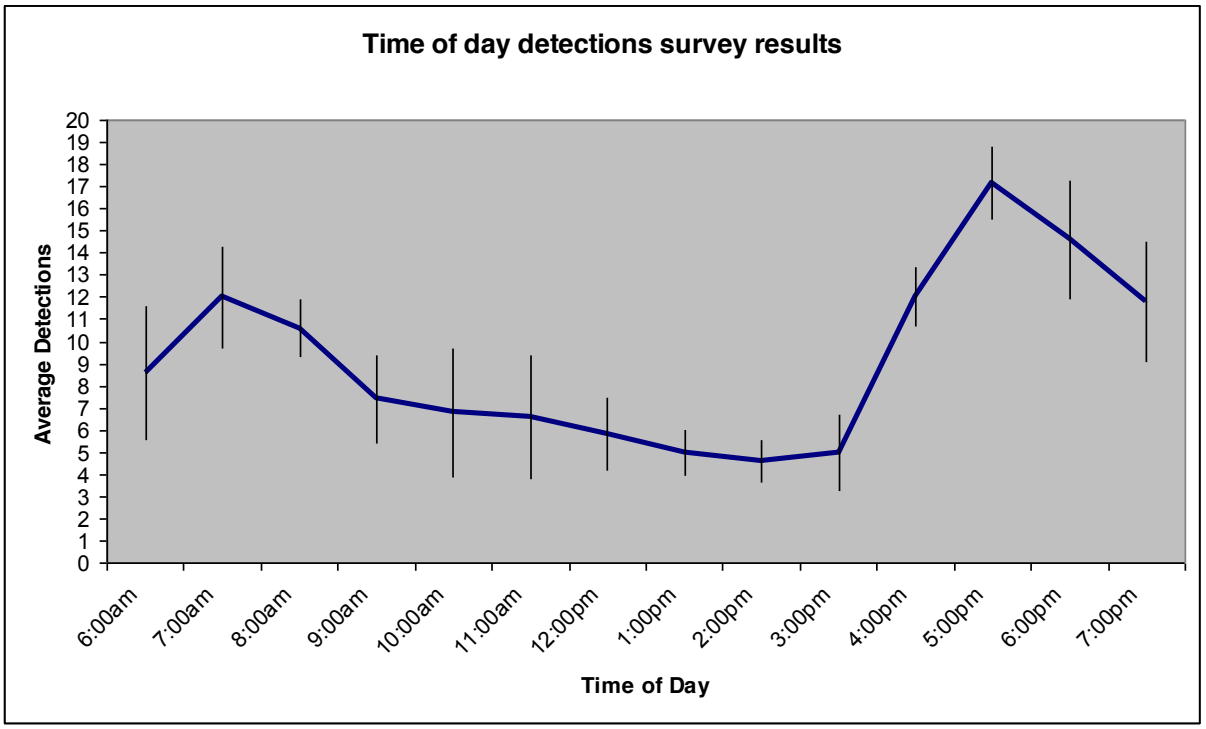

Figure 12. Graph showing the number of average detection at each period during the time of day detection survey

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13. APPENDIX

Observer		Date		General location		Specific location	

Start time (24 hour)						
Temperature (1-6)						
Wind (0-3)						
Other noise (0-2)						
Sun (minutes)						
Precipitation type (N,M,R,H,S)						
Precipitation value (0-5)						

Species	Seen	Heard	Seen	Heard	Seen	Heard	Seen	Heard	Seen	Heard	Total

Sun (0-5) Record approximate duration, in minutes, of bright sun on the canopy immediately overhead			***Seen and Heard*** Birds that are first heard should be entered under **H** (even if they are later seen), birds that are first seen should be entered under **S**. Adding H and S should give the total number of birds observed	
Time 24 hour clock, at the beginning of each count			***Unbounded*** Counts are unbounded	
Temperature **1** freezing < 0°C **2** cold 0-5 °C **3** cool 6-10 °C **4** mild 11-15 °C **5** warm 16-22 °C **6** hot > 22 °C	***Wind*** The average for each five-minute count on a modified Beaufort scale: **0** Leaves still or move without noise (Beaufort 0 and 1) **1** Leaves rustle (Beaufort 2) **2** Leaves and branches in constant motion (Beaufort 3 and 4) **3** Branches or trees sway (Beaufort 5, 6 and 7)	***Noise*** Other than wind the average for the five minutes **0** not important **1** moderate **2** loud	***Precipitation type*** Average for each count N None M Mist R Rain H Hail S Snow	***Precipitation value*** 0 None 1 Dripping foliage 2 Drizzle 3 Light 4 Moderate 5 Heavy

Appendix 1. Blank recording form for the species richness survey