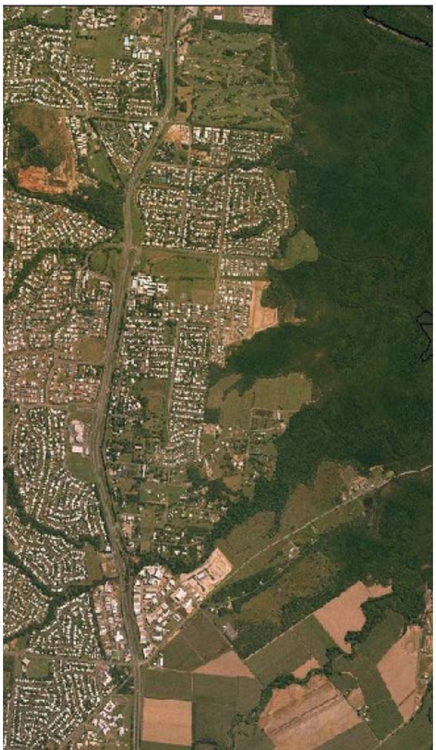
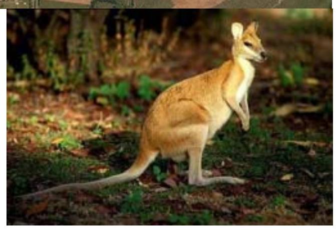
EcoSustainAbility

Agile Wallaby Survey
of the
White Rock Area





Undertaken for
Cairns Regional Council

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Version Notes

This version complete draft for Cairns Regional Council.

1 Introduction

1.1 Background

1.1.1 White Rock Wallabies

This report has been prepared for Cairns Regional Council by EcoSustainAbility following concerns at a substantial increase in Wallabies in the White Rock area. This has led to at least one incident involving human/wallaby interaction (with minor injury to a child).

This report presents the results of a survey of Wallabies in the White Rock area.

1.1.2 Northern Beaches Wildlife Strategy and Wallaby Survey

The techniques for the White Rock wallaby survey have been informed by previous work undertaken in the northern beaches area. In 2005/2006 a Wildlife Management Strategy was prepared for the Northern Beaches by the Rainforest Cooperative Research Centre (with the same project manager and primary author as this report). The Wildlife Management Strategy was tasked with addressing the effect of Wallabies on sugar cane production, a further detailed research program was proposed as "Stage 2" of the project. Further research was undertaken in 2007and 2008, funded by the Sugar Research and Development Corporation which provided a grant to the Barron River Farmers Group to undertake the project, "Development of an Integrated Wallaby Management Strategy". This was undertaken as a collaborative project between the growers and EcoSustainAbility.

1.1.3 Project Aim

The aim of the project was: *To gain a reasonable understanding of the population numbers and distribution of the Agile Wallaby population in the White Rock area*.

1.1.4 Study Team

The study team was Guy Chester (Project Manager and overall report author) and Jack Chester (field officer).

1.1.5 Acknowledgements

The project has been undertaken with the assistance of numerous Council officers in providing access to areas. Residents of the area put up spotlight surveys of their properties without too many complaints!

2 The Agile Wallaby (*Macropus agilis*)

2.1 Species Background

2.1.1 Conservation Status

The Agile Walklaby is listed as common under the (Queensland) *Nature Conservation Act*.

2.1.2 Description

The Agile Wallaby is a medium-sized, primarily grazing macropod, it is the most common macropodid in tropical coastal Australia. The species is sandy brown in colour with whitish underparts. It may have a median dark brown stripe between eyes and ears and a faint light buff cheek-stripe. There is a distinct light stripe on its thigh, and the edges of its ears and the tip of the tail are black.

2.2 Ecology

2.2.1 Habitat

The preferred habitat of the Agile Wallaby is along rivers and streams in open forest and the adjacent grasslands (Merchant, 1995). Stirrat (2003) investigated Agile Wallaby use of habitat near Darwin and found temporal and spatial variations in habitat use. During the day the wallabies rested in monsoon rainforest, dense thicket or under large trees. In the late afternoon they emerged and foraged close to cover until dusk when they moved into nocturnal foraging areas. In the dry season diurnal (daily) and crepuscular (moon phase) ranges over lapped very little with nocturnal range, but diurnal and crepuscular core ranges overlapped indicating that forest areas were used more often in the dry season than the wet season during the day and in the evenings. Overlap of diurnal and crepuscular ranges by nocturnal range was greatest in the wet season indicating that the wallabies stayed closer to forest areas when foraging at night in the wet season. Availability of food appeared to be the driving factor explaining seasonal differences in habitat use; a lack of food in the dry season leads wallabies to forage further from their resting sites, at night when temperatures are cooler and they are better protected from predators.

2.2.2 Diet

Agile Wallabies eat most native grasses and may dig 30 centimetres into the soil to obtain the roots of some plants (e.g., ribbon grass) (Merchant, 1995). Stirrat (2002) investigated the feeding ecology of the Agile Wallaby near Darwin and found that the wallabies were almost exclusively grazers in the wet season when the nitrogen content and in vitro digestibility of the herbage were high. Wallabies rarely browsed in the wet season. Dietary items preferred were grasses and legumes but the diet in the wet season consisted of non-leguminous forbs, which were most abundant in the study site. In the dry season, herbage quality was poor and wallabies broadened their diets to include foods such as leaf litter, fruits, flowers and roots, as well as green grasses and forbs when available. Therefore the Agile Wallaby has a flexible foraging strategy that enables a range of resources to be exploited in a highly seasonal environment where food shortages may be long and their duration unpredictable.

2.2.3 Reproductive Biology

The Agile Wallaby is not a seasonal breeder like its southern counterparts, it is rather opportunistic, and this species has a high fecundity compared with other tropical macropods. Reproduction is strongly dependent on the quantity and quality of food, and because there is a degree of environmental uncertainty in the tropics, driven by monsoonal flooding, and thus uncertainty in food quantity and quality (see Bolton et al., 1982 and Stirrat, 2002), this species has developed the ability to enter anoestrous (part of the reproductive cycle where breeding does not occur) during pregnancy and subsequently to give birth and suckle the young while anoestrous (i.e. maintain pregnancy in one side of the genital system while the other side becomes anoestrous), and the ability to return to breeding condition later while suckling. As a result, the Agile Wallaby is able to rear three young in two years. This reproductive trait is also shared with the inland red kangaroo (*Macropus rufus*) (Bolten et al., 1982, 1985).

Reproduction is more successful on fertilised, nitrogenous pastures of farmland than on grasses of lower nutritive value; sexual maturity of both males and females is earlier, fecundity is higher and reproduction is often continuous in pastureland (Kirkpatrick and Johnson, 1969; Merchant, 1976; Bolten et al., 1982).

In native bushland, breeding in the dry season and at the onset of the wet season is optimal, this falls sharply during floods where foraging grounds are inundated and then increases again towards the end of the wet season (Bolten et al., 1985). Males are much larger than females, mean estimate of weight is 19 kg for males and 11 kg for females (Merchant, 1995). Females are estimated to begin breeding at 1.7 to 2.2 years of age, and this is dependent on the quality of habitat (Bolten et al., 1985). The mean gestation length is 30.5 days, mean pouch life is 209 days and annual fecundity has been estimated at 1.53 (Kirkpatrick and Johnson, 1969). The young suckles at foot until it is weaned at 10-12 months of age (Merchant, 1995).

The following are some key points concerning the Agile Wallaby:

- Adult weight (kg)
  - Male 19
  - Female 11
- Oestrus cycle length (days)
  - Gestation length (days) 30.5
  - Pouch life (days) 209
- Litter size 1
- Annual fecundity 1.53
- Age at breeding of female (years) 1.7 (on farmland)
- Age at weaning (months) 10-12

2.2.4 Behaviour

The Agile Wallaby has been reported as a solitary (Johnson, 1980) and a gregarious animal (Merchant, 1995). Nevertheless, this species does aggregate into both small (<10) and large groups (>10), although this may be temporary and related to sexual associations between male and female (Johnson, 1980) and resource-sharing. Blumstein et al. (2003) has suggested that Agile Wallabies may benefit from aggregating because in a group there is a reduced need for vigilance, which increases foraging time. According to Merchant (1995), Agile Wallabies are more nervous than other macropods, this disposition is often demonstrated by foot-thumping while the head is held high. The two most commonly observed behaviours are foraging and vigilance, which, from Stirrit's (2004) study near Darwin, comprise over 90% of the activity budget between 8pm and 7am.

Activity is significantly less during the day, particularly between 9am and 5pm when the animal rests in forest areas or cane lands, however this partitioning of active and inactive periods may be less pronounced in overcast weather. Grooming does not constitute a large part of the activity budget and was observed less often during the night and during the dry season. Resting and vigilance behaviour was also observed less in the dry season because of more time spent foraging and moving greater distances when forage quality was poor.

2.2.5 The Agile Wallaby as a Pest

With a highly flexible foraging strategy and high fecundity, in some areas growing populations of Agile Wallabies are foraging on a range of crops and pastures, which has resulted in the species being declared a pest. A number of strategies have been undertaken to reduce populations including poisoning in Western Australia and the Northern Territory, and shooting in Queensland (Merchant, 1995). In the Barron River delta and Marlin Coast of Cairns, a growing Agile Wallaby population is causing impacts on cane farms. At present small numbers are killed each year, however the Queensland Parks and Wildlife Service Damage Mitigation permitting system is not scientifically based on population dynamics. Other macropodid pest populations such as the red kangaroo are managed based on the principles of wildlife harvesting.

2.2.6 White Rock

In the White Rock area, anecdotal evidence suggests that there is a population of wallabies which are establishing in the southern White Rock area. It would appear that the population has grown rapidly in suitable habitat in rural-residential lands.

2.2.7 In the Barron River Delta and Marlin Coast Area

The Agile Wallaby has always been common throughout the Barron River delta and Marlin Coast, they move throughout various habitats ranging from grassland, woodland to open forest. They also (at least) visit mangrove areas and melaleuca areas. Populations have thrived in the cane lands in recent times, particularly since the phasing out of burning of cane crops before harvest. Mobs of Agile Wallabies have become isolated with increasing urban development (particularly to the north in the northern beaches suburban development) and in some cases there have been populations distressed as they lose connectivity to other areas of habitat as areas are fenced or developed. There is ongoing roadkill of Agile Wallabies throughout the Marlin Coast, primarily on the Captain Cook Highway and the main beach suburb access roads.

The predominant habitat for the Agile Wallaby is disturbed grasslands and sugar cane areas, although they also inhabit other forest areas. In terms of the key habitats identified in Chapter Three, the habitats most likely to be utilised by the Agile Wallaby include: *Acacia Open/Closed Forest, Mixed Woodland/Closed Forest, Sclerophyll Open Forest/Woodland, Casuarina Open/Closed Forest, Grassland Sedge, they have also been recorded in Samphire/Saltpan, Melaleuca Forest and Mangrove*.

The Barron River delta and Marlin Coast provides good habitat for a thriving population of the Agile Wallaby, which is common throughout its range on tropical coastal Australia and Papua New Guinea. As such the population has local significance only and is not threatened, although the population in the north (north of Reed Road) is likely to decline as urban development reduces available habitat.

3 Population

3.1 Introduction

This sections sets out current anecdotal evidence of recent population trends of Agile Wallabies, summaries available literature on Agile Wallaby abundance, outlines the methodology used for population surveys and the results of those surveys and based on this discusses the measured density and therefore likely population of Agile Wallabies in the area.

3.2 Agile Wallaby Abundance

3.2.1 Literature Review re Wallaby Populations

Griffiths *et al* (2005) report on known densities at a range of location in North Queensland and the Northern Territory. Densities for eucalypt woodland are 8, 17, 20 and 27 per square kilometre, densities for monsoon forest 62 and for eucalypt forest (next to flood plain) 190 per square kilometre. However at East Point Reserve, where the wallaby population grew rapidly, a maximum of 2100 per square kilometre (as opposed to a minimum of 187 per square kilometre before the population increase. These numbers show that large populations can thrive where the resources and lack of predators allows.

There is little published information on a minimum population density or total population level to ensure viability of the Agile Wallaby. However on the basis of anecdotal evidence of past populations it would appear that a population density of somewhere around 1000 for the Northern Beaches occurred prior to the recent population explosion. The Griffiths reported data of 8 per square kilometre for eucalypt woodland would appear a sustainable population (the data is from Litchfield National Park in the Northern Territory and there has been no noticeable population explosion or crash), this would result in a total population of 144 wallabies for the study area (far less than any anecdotal evidence for the Barron River delta (which is most likely much more productive for wallabies supporting a higher density).

Further to consideration of density is the home range of individuals. Stirrat (2003) found that the average home range sizes for Agile Wallabies are greater in the dry season than the wet, with ranges of 16.6 ha and 11.3 ha for male and female home ranges in the wet season and 24.6 and 15.3 respectively in the dry season. Wet season habitat preference was for open grassland, whereas in the dry season more use was made of forest areas for foraging.

3.2.2 Barron Delta Canelands

The current wallaby population on the Barron Delta canelands has been estimated to be 94 per square kilometre. Prior to this survey, cane farmers have considered that a density of at least 2.5 wallabies per hectare (on cane lands) was conservative.

In conclusion, based on densities in published literature, the current population of Agile Wallabies in the Barron River delta cane lands could to be at least 3000 based on known densities elsewhere, and perhaps as high as 8000 or even more. Based on recorded very high densities, an unconstrained population could reach over 30,000.

The survey technique adopted for assessing the abundance of Agile Wallabies in the Barron River delta Cane farms was a transect traversed by vehicle (15 km/h) using a spotlight. Eight 150 m wide sectors were selected comprising a total of 21.4 km.

The most wallabies counted in any one survey was 482 recorded on 8 December 2006, with the lowest being 16 on a cold July morning. The various sectors of the transect had vastly different densities of Agile Wallabies. The average density across the survey period and across the sectors was 0.94 wallabies per hectare (or 94/km^2).

The total area of cane fields in the study area is 1647 hectares which gives an estimated total of 1544 wallabies on cane lands. Within the study area there is 2791 ha of total potential habitat, not including mangroves, saltpans, river, beach and urban areas but including all other native forest and grassland. This gives an estimated population of 2617. However there are a number of confounding influences which, on balance, could mean this estimate is somewhat conservative.

3.3 Techniques for Monitoring Wallaby Abundance

3.3.1 Background

Reasons for monitoring wildlife abundance varies from testing the success of a management strategy to increase the abundance of a rare species or decrease the abundance of a pest species, to investigating the cause of a changing abundance, for example (Southwell, 1989). In the case of the Barron River delta Agile Wallaby population, which is considered a pest by cane farmers owing to its impact on cane production, monitoring is required to estimate abundance in order to introduce appropriate population controls and thereafter test the impact of such controls. This section reviews available techniques with the aim of recommending the most feasible strategy for the Barron River delta Agile Wallaby population.

3.3.2 Measures of Abundance

There are three ways in which abundance can be measured: as population size, when the population has a distinct boundary; as absolute density, i.e. the number of animals per unit area; and as a density index, i.e. some measurable correlate of absolute density (Southwell, 1989). Absolute density is generally the safer measure as it avoids the problems associated with any degree of population movement in or out of the area, and density indices are insufficient for calculation of safe harvesting rates (Mar, et al., 2001).

3.3.3 Techniques for Measuring Abundance

There are a number of techniques for measuring wildlife abundance. Southwell (1989) listed five main groups of techniques:

- Total counts, where every animal in the survey area is counted.
- Sample counts, where a large survey area inhibits a total count and some form of sampling is required.
- Mark-recapture methods, where a number of animals are marked on one occasion, and on the second occasion the proportion of these animals re-captured in a sample is used to estimate population size.
- Addition-removal methods, where a population is surveyed, and a linear index of density is obtained, before and after a known number of animals have been added or removed (non-selectively), the pre-manipulation size can be estimated.
- Catch-effort methods, where catch per unit effort of an exploited species is used to monitor the trend in abundance.

In measuring the abundance of the Barron River delta Agile Wallaby population, sample counts would be most appropriate. The primary reasons are that the survey area is too large to undertake total counts, the mark-recapture and addition-removal methods require a closed population, and conservation of the species is a major issue thereby requiring all relevant data before exploitation may be considered.

3.3.4 Sample counts

Direct sample counts as listed by Southwell (1989) include:

- Fixed-point counts, where the observer is stationed at a number of points throughout the survey area and counts the number of animals seen or heard within a defined time.
- Quadrate counts, where a number of quadrates of similar dimensions are searched until all animals within the boundaries have been counted.

- Transect counts:
  - Strip transects, where all animals within a specified distance from the transect are counted, and all animals beyond that distance are ignored.
  - Line transects, where all animals seen from the transect are counted, and distance and angle from observer to animal is recorded.

Southwell (1989) also discussed the indirect methods of faecal pellet counts where pellet accumulation per unit area and time is measured.

Fixed-point and quadrate counts are generally unsuitable for macropods because of their mobility and response to observers. Macropods tend to avoid the observer or move out of the quadrate before it has been searched, for example. Consequently, these methods have rarely been utilised for estimating macropod abundance (Southwell, 1989). Transect counts on the other hand are commonly utilised, and Australian state and federal wildlife authorities have established transect methodologies for monitoring harvested macropod populations, setting quotas and annual harvests (Pople and Grigg, 1999). Faecal pellet counts are often used to assess broad patterns of macropod habitat utilisation (Southwell, 1989), however in order to estimate absolute density pellet defecation rate must be known, which as recommended by Coulson and Raines (1985) needs to be determined for the population in question close to the time of survey. This is problematic given the temporal scale of monitoring, and furthermore sampling in cane field is undesirable due the dense vegetation and potential damage to the crop. Transect counts are therefore most appropriate for monitoring macropod abundance.

3.3.5 Transect Counts

Strip and line transect counts have a number of assumptions that must be met in order to accurately estimate density. Strip transect counts require that animals are accurately classified as in or out of the strip, and all animals within the strip are seen and counted. Line transect counts require accurate measures of distances and angles, and only those animals directly on the line must be counted. For both methods, animals must not move large distances toward or away from the transect line before being sighted, and animals must not be counted twice (Southwell, 1989).

Mode of travel along transects can be by aircraft, vehicle or foot. Much of the broad-scale surveys of macropods in the flat and sparsely vegetated interior of Australia are undertaken by aircraft. For reasons of safety and visibility (the area is under the cairns International Airport flight path), aerial surveys cannot be undertaken in the Barron River delta . The area is also too large to permit foot surveys as a feasible technique. Therefore, surveys would be best undertaken using a vehicle.

There are a number of factors which have a bearing on the validity of a transect count, and therefore need careful consideration. Southwell (1989) listed such factors as survey design, precision and sampling intensity, repeatability and accuracy.

Survey Design

Transects need to be randomly located to avoid biased inferences about abundance. This is often difficult logistically, however as long as transects are distributed independently of the distribution of animals being surveyed, sampling will be unbiased. Vehicle surveys do pose a problem in terms of randomness of transects in many situations. For the White Rock area the placement of transects needs to be assumed to be independent of the distribution of the Agile Wallabies being surveyed.

This fundamental assumption needs to be considered a limitation when estimating abundances.

Stratification of the survey area may be undertaken where distribution of the species is clumped in certain areas, to meet specific habitat requirements for example.

Precision and Sampling Intensity

Precision in estimation of abundance is important, particularly when the surveyed population is managed by ongoing culling because of the risk of a population crash due to a decreasing population size. However, there needs to be a balance between precision and effort.

Repeatability

Many factors can affect counts of macropods, Southwell (1989) listed time of day, temperature, cloud cover, vegetation density, strip width and height above ground. To negate the effects of these factors on countability and therefore increase the repeatability of transect counts, counting procedures need to be strictly standardised. For vehicle surveys, counts should be standardised for vehicle speed, observer position, time of the night/day, season and observer ability for example. Environmental conditions, such as lighting and weather conditions, are beyond the control of the observer, it is therefore suggested that where possible counting be undertaken only within a narrow range of environmental conditions. Surveys should also be undertaken at night; the Agile Wallaby is generally more active at night (Stirrit, 2004).

Southwell (1989) mentioned that countability of kangaroos may vary with density, for example when kangaroos aggregate at water holes during dry conditions they may be more difficult to count. This should not be a problem in the White Rock area where habitat requirements of Agile Wallabies are met year round (i.e. water and food abundance). For similar reasons, variable habitat utilisation should not affect repeatability of surveys.

Accuracy

It is difficult to test the accuracy of transect counts without doing a total population count. In the absence of a total count, line transect counts can return accurate density estimates in realistic situations according to previous studies (Southwell, 1989). However, this method can be problematic in areas that are densely vegetated and where animal density is high. Using a vehicle to traverse transects should moderate problems with high animal density through increasing the speed of the observer relative to that of the animals (Southwell, 1994). However, problems with densely vegetated areas, particularly mature cane fields, may affect accuracy, and further investigation is needed, a correction factor may need to be incorporated for example.

3.3.6 Conclusions re Transect Counts of Agile Wallabies in White Rock

The Agile Wallaby population in the White Rock Area should be surveyed at night when they are most active. Strip transect counts were undertaken with the spotlight beam used for sighting animals standardised to a 75-100m strip half-width. This satisfies the first assumption that animals are accurately classified as in or out of the strip. However the rural residential nature of the area, does mean that visibility if the whole transect is not possible, given the obstacles of buildings etc. an assumed overall transect width of 100m has been adopted.

Unfortunately, the survey area is not relatively homogenous and as discussed above does not allow good visibility of sighting all animals within the strip, thus the second assumption is somewhat problematic.

Strip transect sampling (with fixed-wing aircraft) has become an established method for the broad scale monitoring of harvested kangaroo populations, according to Pople and Grigg (1999). Strip transect sampling has also been successful for monitoring other mammals including African savanna mammals (Ogutu et al., 2006) and cetaceans (Barlow, 1995). Ogutu et al. (2006) said that "strip counts deserve serious consideration for surveys of species that occur at high densities and form large, loose agglomerations" (pg. 149), which applies to the Agile Wallaby.

Vehicle transect surveys are the most feasible mode of traversing transects in the survey area due to the size of the area, but also because it addresses the third assumption where animals must not move large distances toward or away from the transect line before being sighted. However, vehicles are not commonly used for estimating abundances due to the lack of randomness in transect placement. Vehicle usage can be justified in this situation due to the existence of numerous roads and tracks and therefore good access to the area, which enables "random" placement of transects. From Southwell (1989), other research using vehicles was for medium and small scale surveys of macropods, speed of the vehicle was mostly between 15 and 20 km hr^{-1} and strip half-width was mostly between 50 and 100m. Density is calculated from the transect counts by dividing the number of individuals counted by the sampled area. Refer to Buckland et al. (2004) for more detailed information.

3.4 Survey Techniques Adopted

3.4.1 Survey Techniques

After trials, two survey techniques were used:

1. Transect counts to enable density estimates.
2. Street surveys to assess overall distribution.

3.4.2 Transect Counts

The survey technique adopted for assessing the abundance of Agile Wallabies in the Whiterock area was an evening transect traversed by vehicle using a spotlight. Nine sectors were selected based on a broad coverage of the area, practicality for driving and ensuring a variety habitats (cane lands, residential, parkland, rural lands, rural residential etc.).

The vehicle traversed the sectors at about 15 km per hour, a speed sufficient to be able to see and count groups of wallabies before they scatter with the vehicles disturbance.

The transect is nominally 150m wide (75 m either side of the route), however it should be noted that the presence of fences, houses, vehicles, vegetation, sugar cane and adjoining native vegetation in some areas significantly reduces this distance. To attempt to standardise the distance (width of the transect), animals were counted up to 75m from either side of the route when there is good visibility, in areas where visibility was impaired on one side, animals up to 100+ metres out from the route were counted (thus achieving a roughly 150m wide transect as reliably as practicable). Despite this, a realistic survey width of the whole transects would be about 100m (taking into account obstacles).

The nine sectors had various lengths ranging from 1.8 to 4.3km long. Figure 1 shows the location of the transect sectors.

3.4.3 Street Surveys

Street surveys were adopted to gain a more complete understanding of the geographical spread of Wallabies throughout the area. There was some social impact with residents in the more urban areas of White Rock objecting to the spotlight survey. Consequently, a complete street survey was undertaken once and further street surveys focussed on the more likely areas.

3.4.4 Statistical Rigour

It must be noted that the rigour of the survey technique does present difficulty for any detailed statistical analysis. The sample size is small (number of surveys), the obstacles within transects adds complications and the unknown movement of the wallabies from one are to the next (between surveys) may all serve to confound the results. The survey technique will allow for repeatable surveys and gross population changes may be determined over time, however minor changes between surveys may not be detected.

4 Results

4.1.1 Transect Counts

The full results are included in a related spreadsheet. Table 1 shows the transect summary with Figure 2 depicting these results graphically by location.

There were no wallabies sighted in the Blackfellows, Swallows, Hopkins, Sheehey, Hollywood and Gold Course transects. Whilst the Blackfellows had mature cane, experience from Barron delta surveys is that wallabies would be expected to be seen if they were present in any numbers in the area.

The results of the surveys are such that there is unlikely to be any wallabies in the golf Course, Hollywood park and Hopkins transect areas. Conclusive results are less certain for the Sheehey transect as there is high cover of grasses and shrubs which could conceal wallabies.

The three transects with wallabies regularly seen were Mission/Fretwell, Mercurio and Giffen. On these three transects, mean densities of 1062/km2, 57/km2 and 1601/km2 were observed. The mean total for these three surveys was 580 per survey.

Overall wallabies were seen as individuals, small “family groups” and larger mobs. In generall, it would appear that more isolated individuals were larger animals, whislt the mobs had a larger proportion of young and juveniles. The largest mobs seen were 122 on Giffen and 78 on Mission Fretwell (however larger mobs were seen during the street surveys although groups size was not recorded for the street surveys).

Figure 1: Study Area

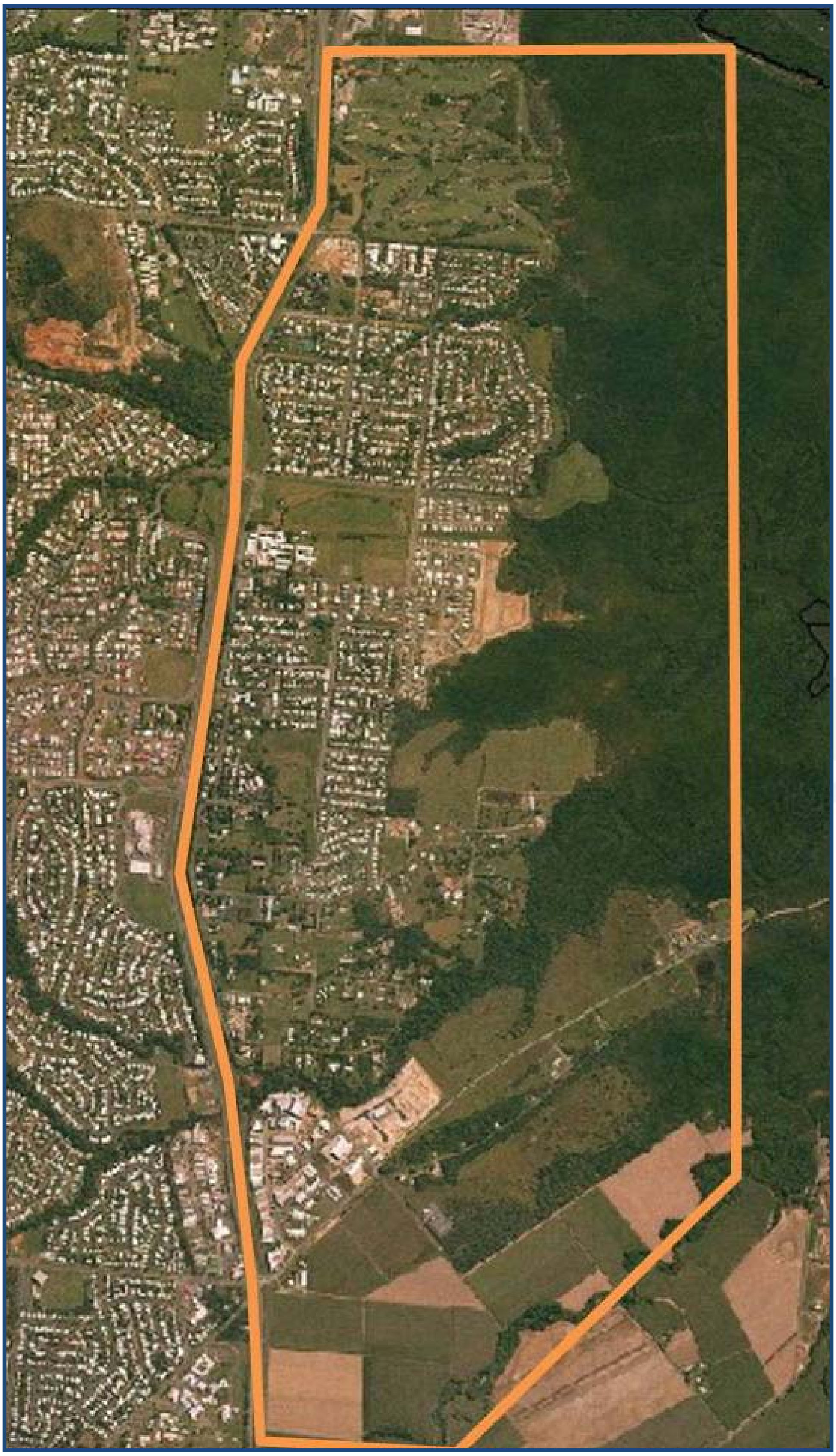

Figure 2: White Rock Wallaby Survey Transects (with Results Summary)

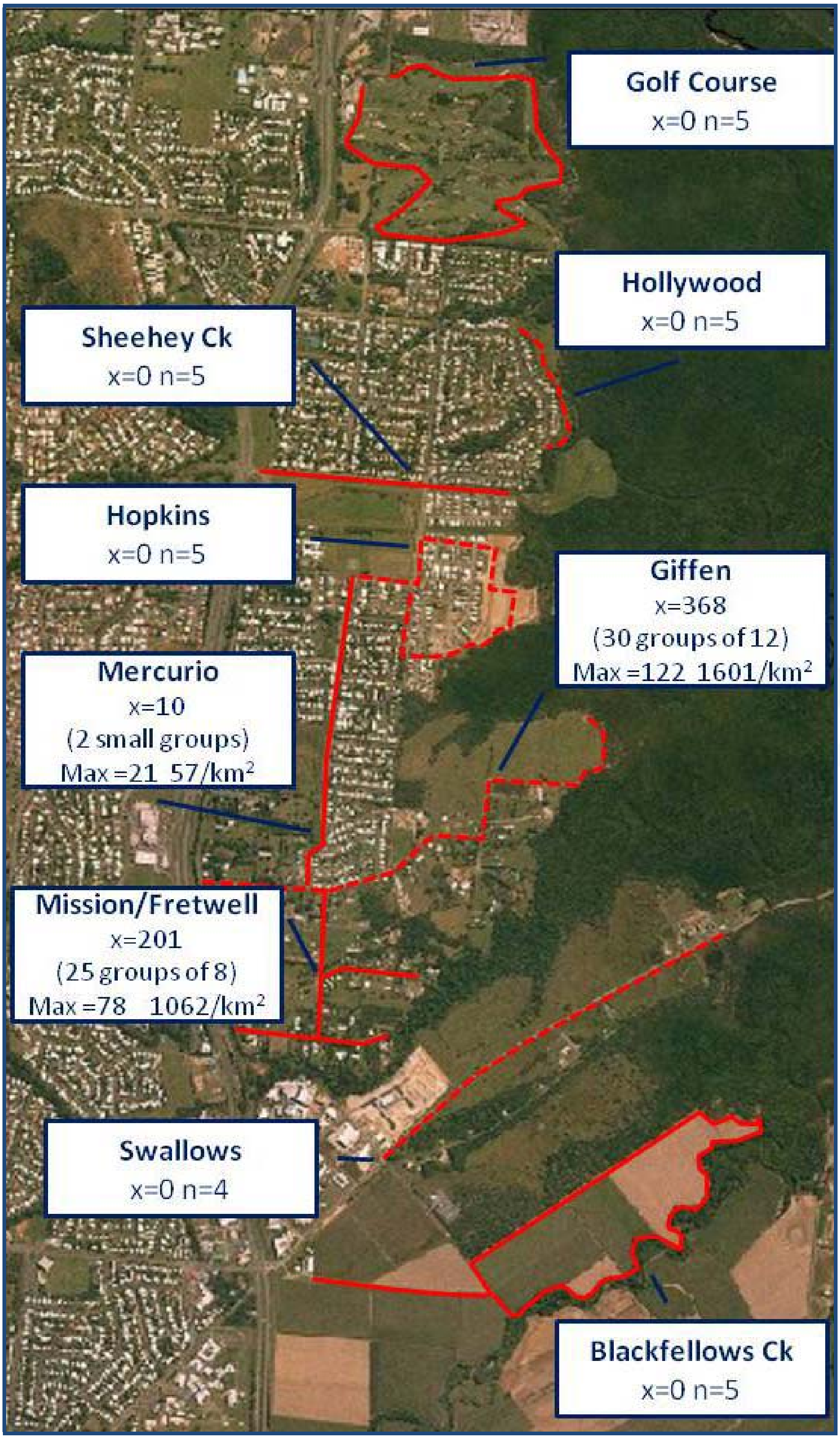

Figure 3: White Rock Street Surveys (with Wallaby Distribution Results)

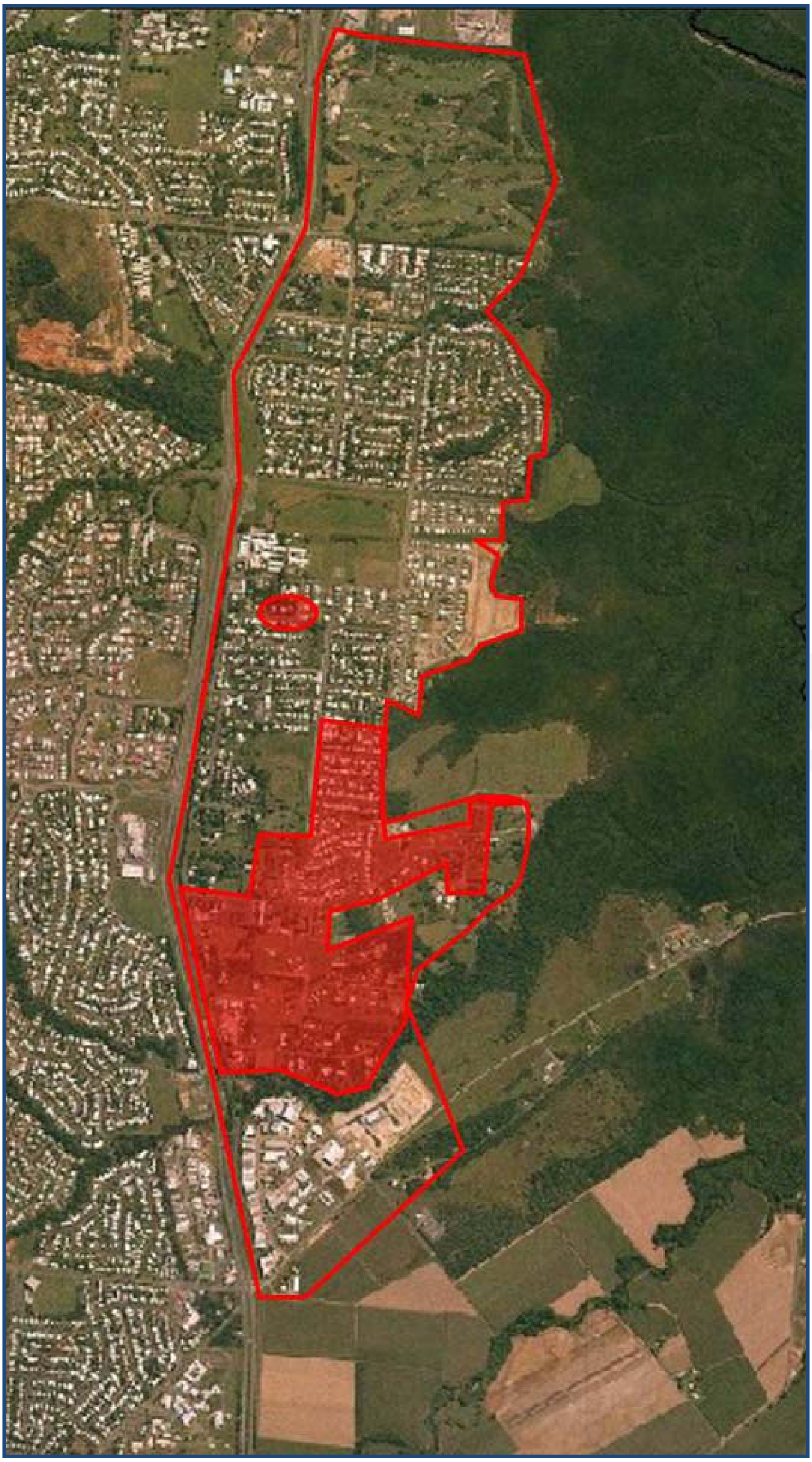

Figure 4: Detailed Street Survey Results

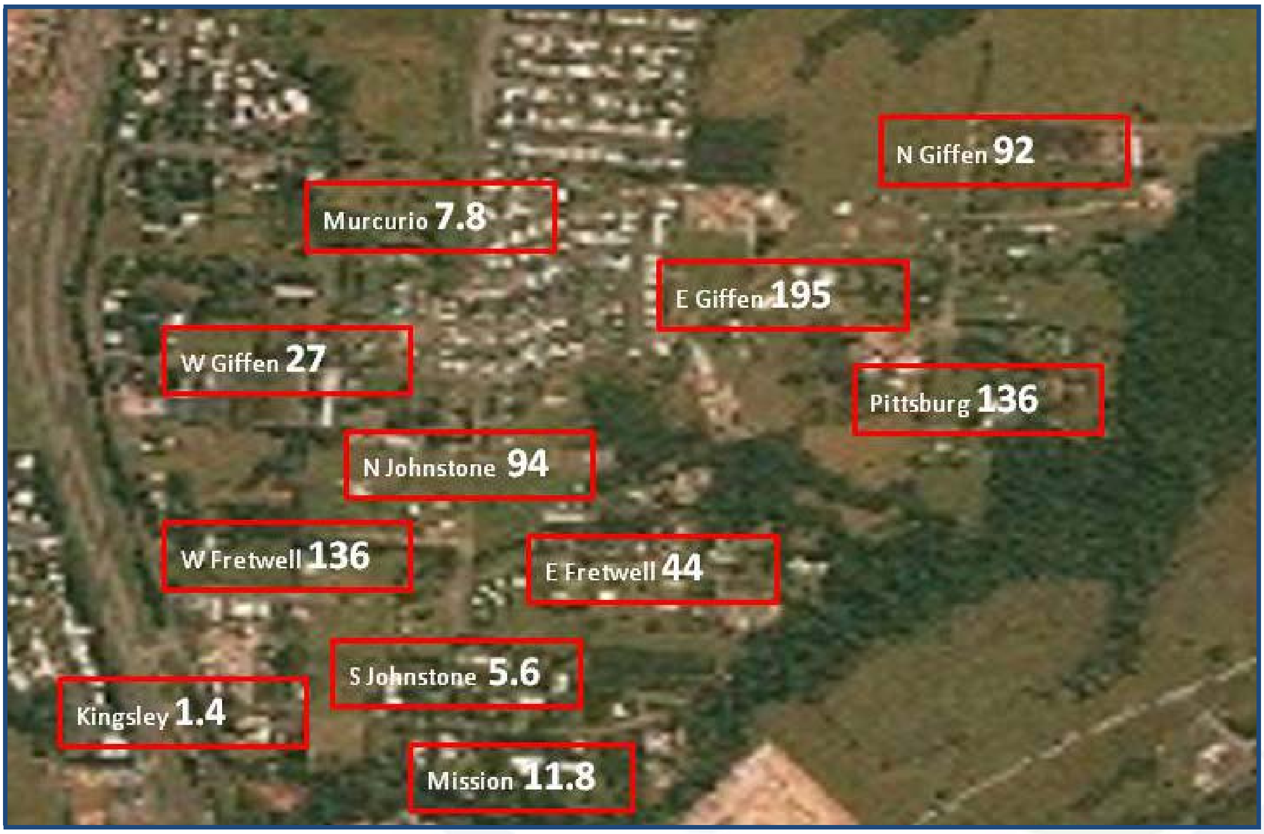

Figure 5: White Rock Wallaby Distribution

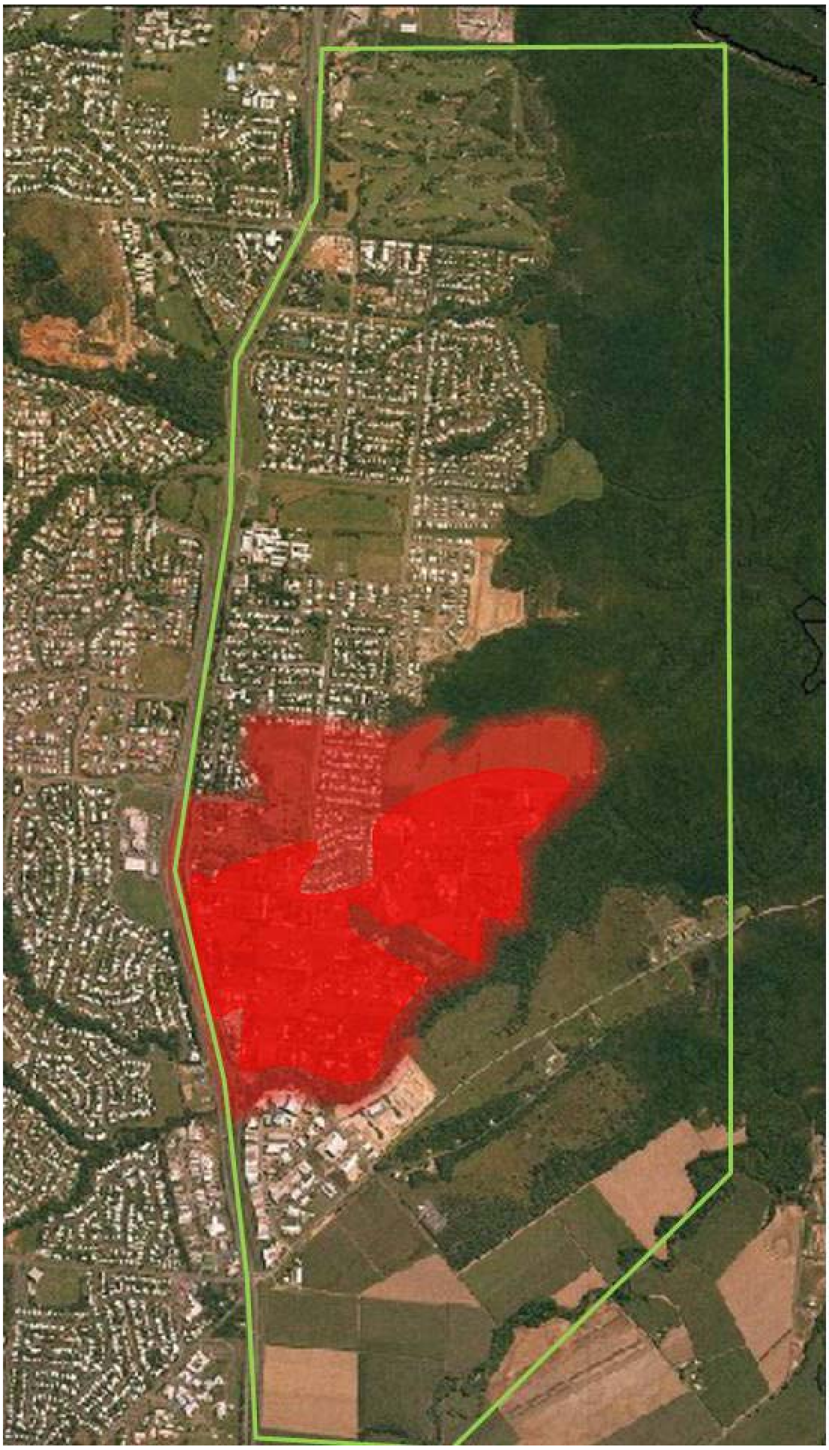

Table 1: Transect Survey Results

	Mean	km	Density per km^2	Max Mob	Mean # Groups	Mean Group Size
Sector						
Blackfellows	0	4.9	0	0		
Swallows	0	3.5	0	0		
Mission/Fretwell	201	1.9	1062	78	25	8
Giffen	368	2.3	1601	122	30	12
Mercurio	10	1.7	57	21	1.5	6
Hopkins	0	2.4	0			
Sheehey	0	1.0	0			
Hollywood	0	5.5	0			
Golf Course	0	3.3	0			
Total	**301**					

4.1.2 Street Surveys

Table 2 records the results for streets in which wallabies were seen. In addition, there were two wallabies seen in Whitten St, two in Denver and one in Rafferty on the 8 April survey. Figure 3 shows the area of the street surveys which repeatedly recorded wallabies and Figure 4 shows the mean results for the southern White Rock streets.

The highest number seen on any one night was 953, with the mean of five surveys being 755. The largest numbers were seen in the Giffin/Mission/Fretwell areas, with Pittsburg St at the eastern end of Giffin Road having a large mob seen regularly on one property.

Table 2: Street Survey Results

Date	**8/04/2010**	**9/04/2010**	**11/04/2010**	**13/04/2010**	**18/04/2010**	***Mean***
Temp (^{0}C)	*25*	*22*	*25*	*27*	*24*	
Mission	22	9	12	5	11	*11.8*
Kingsley Cl	4	2	0	0	1	*1.4*
Johnstone (Mission-Fretwell)	20	3	0	3	2	*5.6*
Fretwell East	26	46	78	30	40	*44*
Fretwell West	59	48	209	235	131	*136.4*
Johnstone (Fretwell-Giffin)	33	90	111	87	147	*93.6*
Giffin East	162	166	203	189	255	*195*
Pitsburg	130	64	204	254	30	*136.4*
Greenacres/End Giffin	91	138	104	56	70	*91.8*
Giffin West	15	29	26	26	37	*26.6*
Harlequin	6	3	0	10	3	*4.4*
Mercurio	13	14	6	4	2	*7.8*
Total	*581*	*612*	*953*	*899*	*729*	***754.8***

4.1.3 Observations

During the surveys there were a number of observations made:

- There are areas which have the food, water and shelter which could be expected to support wallabies which do not currently have any, there is the potential for these areas to support substantial wallaby populations should they migrate into these areas (such as the golf Course, Hollywood Park, Sheehey Road and others.
- The wallabies on the Barron delta have developed a lifestyle based around the resources of a cane paddock, feeding on the green pick and young cane when paddocks have emnerging cane and then creating lounge rooms and eating the leaves and sucking on the stalks of mature cane. The wallabies in the White Rock area appear not to have adopted this behaviour, however there is the potential, in which case there could be a substantial population in the cane fields south of Swallows Road.
- There are many very young wallabies, and many quite small females with young in or just out of pouch. By no means quantifiable data, however, there would appear to have been recently high fecundity and an ongoing population explosion could be happening. Of course the drier season of the winter months may restrict survival of young and this may not eventuate, hovwer the population exhibited an age structure which was not “normal” based on the experience of the Barron delta surveys.
- More isolated individuals tend to be medium to larger animals which are most likely males moving away from a mob with a dominant male. These males may be somewhat more aggressive which could exacerbate the risks of adverse interactions with people.
- Dogs appear to “control” the distribution of wallabies. Some properties with free roaming dogs had very low densities of wallabies, yet appeared to offer similar pasture to other properties with high numbers. Conversely, where dogs were well secured behind fences, wallabies were unconcernedly grazing metres away from the dogs, despite their vigourous barking brought on by the survey spotlight and vehicle movement.
- Fences are a major issue, with fences controlling the distribution of wallabies. The movement of individuals and groups is controlled by the location of barrier fences, whiclt other fences may be easily traversed. Whislt Agile Wallabies have been onserved in other surveys to be able to jump to well over 1.5+ metres, it would appear that a 1.2 metre high fence (of chain wire or similar construction), is sufficient to create a virtual barrier.
- Pasture type appears to affect distribution, with some paddocks being unused in most surveys despite having good grass cover, it may not be as palatable. No correlation has been made, howver it would be a worthy area of investigation.

4.2 Abundance

4.2.1 Estimated Population

It would appear that the southern White Rock area has a population of at least 1000 wallabies, most likely to be up to 2000 (given the surveys do not cover the whole area of the concentrated population). In the Barron delta, an overall population of around 2600 is estimated with a density of $94/km^2$, whereas in the southern White Rock area, a much more concentrated population of up to 2000 gives a density of in the order of 1000 per km^2!

The Walaby population is concentrated on the Giffin-Mission Road area (see Figure 5).

Given that there are many areas of seemingly suitable habitat, there is the potential for the population to expand geographically and for the overall population to grow substantially.

5 Conclusions

There is a population of Agile Wallabies in the southern White Rock area. Total numbers are at least 1000 and could be as high as 2000. The population has a high proportion of young and very young females breeding, this leads to a conclusion that the population is undergoing a period of high fecundity and further population growth could occur if not limited by resources, disease or predation.

There are many areas of suitable habitat for wallabies to the north and south of the current population and should the present population start to spread out, substantial growth in numbers could occur in these presently unutilised areas of habitat.

A more quantitative assessment of the age structure of the population could be worthwhile to determine the above conclusions re potential for population growth. It may be worthwhile repeating surverys later in the year to follow up on changes in the distribution and abundance.

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