



6.1 d Cassowary Survey Apr. 2010 P. Buosi

**Supplementary Survey
(April 2010) for the Southern
Cassowary (*Casuarus
casuaris johnsonii*) at the
Proposed Ella Bay Integrated
Resort**

NRA Environmental Consultants



NATURAL RESOURCE ASSESSMENT AND MANAGEMENT



Our Ref: Apr10 Cassowary survey_cover letter_L01/PB:ks

25 October 2010

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Dear Rod

**RE: Supplementary Survey (April 2010) for the Southern Cassowary
(*Casuarus casuarus johnsonii*) at the Proposed Ella Bay Integrated Resort**

Satori Resorts Ella Bay Pty Ltd commissioned NRA Environmental Consultants to conduct field surveys to collect information on the abundance, distribution, sex ratio, age, class structure and movement pathways of Cassowaries living on or immediately adjacent to the proposed EBIRD site and access roads.

The first field survey was conducted in November 2009 and the results reported in NRA (2010). The results of the second survey, conducted in April 2010, are presented in the enclosed report.

If you have any questions about the information in the report, please contact me on 07 4771 6380.

Yours sincerely
NRA Environmental Consultants

PP

Peter Buosi
Principal Ecologist

Encl: *Supplementary Survey (April 2010) for the Southern Cassowary (Casuarus casuarus johnsonii) at the Proposed Ella Bay Integrated Resort*

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Key Words	Ella Bay; Southern Cassowary; Satori
Abstract	A Cassowary survey was undertaken at Ella Bay in April 2010. The information will inform management of the proposed Ella Bay Integrated Resort Development. The report provides data on the activity of 5 adult Cassowaries, 1 subadult Cassowary and 5 Cassowary chicks.

Quality Assurance					
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1. Introduction

In October 2009, NRA Environmental Consultants (NRA) reviewed survey and assessment work conducted on the Southern Cassowary (*Casuarius casuarius johnsonii*) (Moore 2006, 2007, 2009) for the proposed Ella Bay Integrated Resort Development (EBIRD). While the review concluded that there was sufficient and reliable information on the resident Southern Cassowary (hereafter referred to as Cassowary) for the impact assessment process to proceed, it was noted that the process would benefit from further information on the following (NRA 2009a).

- The abundance, distribution and movement pathways of the subadult population during ambient conditions.
- The distribution and movement pathways of adult Cassowaries during ambient conditions, especially around the coastal fringe and near potential impact areas (particularly proposed roads).
- The presence of female Cassowaries in and near the project area.
- Revised habitat assessment using a consistent and transparent methodology for all areas that includes consideration of any further field data.

In response, Satori commissioned NRA to conduct field surveys to collect information on the abundance, distribution, sex ratio, age, class structure and movement pathways of Cassowaries living on or immediately adjacent to the proposed EBIRD site and access roads (referred to as 'the study area' in this report) (**Figures 1a and 1b**). The information will further increase Satori's understanding of the Cassowary population around the proposed development area and inform management decisions regarding the species. Field survey timing is based on the recommended Cassowary monitoring program, which is to be reviewed annually (NRA 2009b). Surveys are currently planned to occur in the window periods of January–March, April–June and October–December, in order to coincide with key seasonal events. The first field survey was conducted in November 2009 and the results are reported in NRA (2010). The second field survey was conducted in April 2010 and is the subject of this report. The January–March survey was not conducted in 2010 as Satori staff were not available to assist.

The April survey was timed to coincide with the general period when adult birds begin moving around to find mates. NRA (2009b) and Moore (2009) recommended surveys during this period to help ascertain if additional adult Cassowaries temporarily move into the EBIRD area during this period.

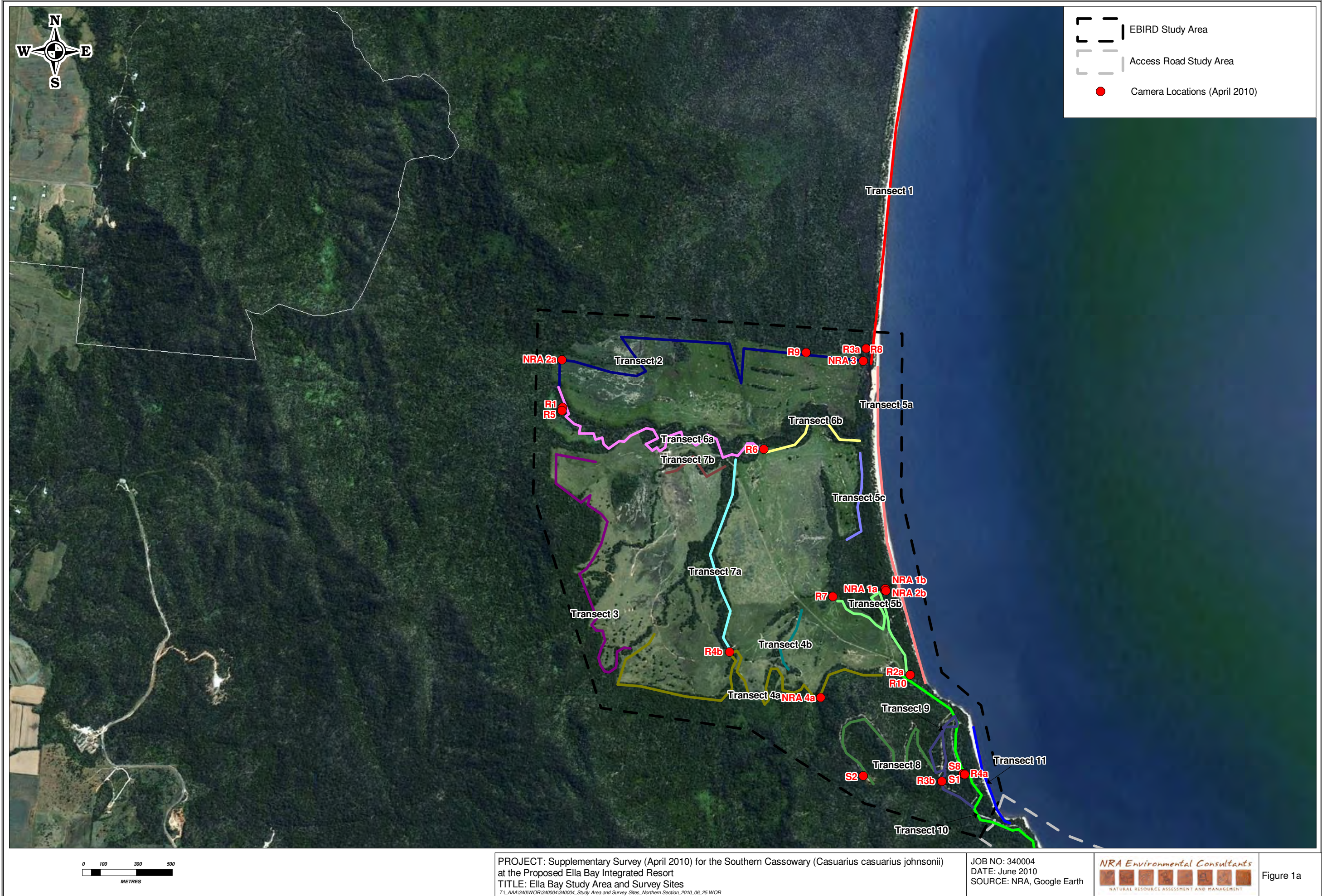
2. Approach

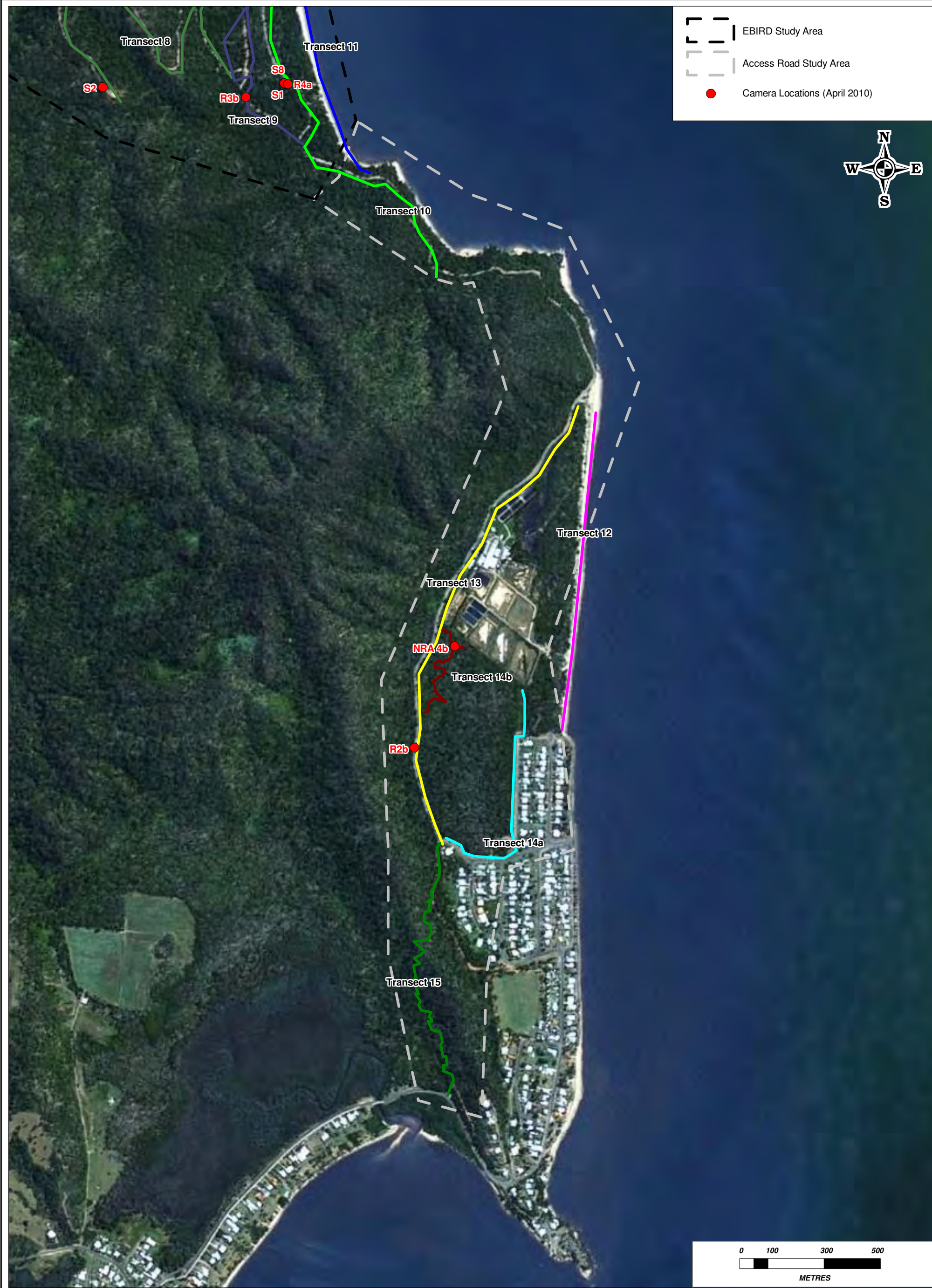
The methodology involved the collection and analysis of data obtained via searches for Cassowary sign (primarily scats, footprints and feathers) and from dedicated surveillance cameras. The survey periods and details of survey techniques are described below.

- **Field survey.** A field survey was undertaken between 13 and 17 April 2010 by Peter Buosi (NRA), with assistance from Satori staff members Adrian Hogg, Brian Hogg and Steve Garrad. The survey involved daily searches for Cassowaries and their signs (primarily scats, footprints and feathers) along designated transects. Survey transects are shown on **Figures 1a and 1b** and described in **Table 1**. Differences between transects used in the April 2010 and November 2009 surveys are also described in **Table 1**. Data on Cassowaries and their sign were recorded in accordance with the categories described in **Table 2**.
- **Surveillance cameras.** Surveillance cameras were also used to collect Cassowary data. Camera locations are shown on **Figures 1a and 1b**, with the period of deployment (survey effort) shown in **Table 3**. In summary, survey cameras were deployed in the month prior to the survey, during the survey week and week following the survey. Many camera locations differ slightly to that used in November 2009. The optimal location for cameras is being refined based on site-specific experience. Camera survey effort was greater during the current survey compared with the November 2009 survey.

Satori staff routinely record Cassowary photos captured on surveillance cameras and opportunistic sightings of Cassowaries. This data was also reviewed during the preparation of this report and helped inform the analysis.

The population analysis described in this report is based on data collected during the above described field survey and by Satori staff between March and April 2010.





PROJECT: Supplementary Survey (April 2010) for the Southern Cassowary (*Casuarus casuarius johnsonii*)
at the Proposed Ella Bay Integrated Resort
TITLE: Ella Bay Study Area and Survey Sites
T:_AAA\3401\WOR\340004\340004_Study Area and Survey Sites_Southern Section_2010_06_25.WOR

JOB NO: 340004
DATE: June 2010
SOURCE: NRA, Google Earth



Figure 1b

Table 1: Description of survey transects used during the April 2010 Cassowary survey at Ella Bay

Transect Number	Transect Length (km)	Description	Variation From November 2009
1	3	Beach and foredune commencing at north-east corner of clearing and terminating at a headland 3 km to the north.	
2	2.5	Forest edge along northern boundary of clearing.	Many sections were under water, which reduces the quality and detectability of Cassowary sign.
3	3.3	Forest edge along western boundary of clearing.	The grass along the forest edge was higher and denser than in November 2009, which reduced detectability of Cassowary sign. Greater time was spent surveying just inside this forest edge in April 2010.
4	3.2	Forest edge along southern boundary of clearing.	As per Transect 3.
5a to 5c	3.3	Random meanders along beach and foredune communities commencing at north-east corner of clearing and terminating at south-east corner of clearing.	The central portion of forest was inaccessible due to water levels. Greater effort (than November 2009 survey) was devoted to surveying the western edge of this forest block (Transects 5b and 5c).
6a	1.8	Upstream section of east-west creek. Effort concentrated along northern forest edge.	The stream channel was not surveyed in April 2010 due to water levels. The channel was surveyed in November 2009.
6b	0.7	Downstream section of east-west creek. Effort focused on forest edge along northern and southern side of creek. The presence of crocodiles prevented a survey along creek channel.	No change in survey approach.
7	1.7	Random meander along channel, forest and forest edge (eastern and western) of north-south creek.	Less time was spent along stream channel (due to water levels) and proportionally more time on creek banks compared to November 2009 survey.
8	1.4	Track up hill at Little Cove.	No change in survey approach.
9	1.1	Network of tracks around Little Cove.	No change in survey approach.
10	1.7	Ella Bay Road between house/shed (on EBIRD site) and Heath Point Headland.	No change in survey approach.
11	0.6	Little Cove beach and foredune .	No change in survey approach.
12	1	Random meander along Flying Fish Point Beach and foredune near the fish farm.	No change in survey approach.
13	1.5	Ella Bay Road between Heath Point (adjacent to car park) and intersection with Ruby Street.	No change in survey approach.
14	1.3	Random meander through Flying Fish Point Reserve and along eastern and southern edge.	No change in survey approach. Note: transect does not replicate that followed in November 2009.
15	1	Vicinity of proposed road alignment over Seymour Range between Flying Fish Point Road and Ella Bay Road.	No change in survey approach. Note: transect does not replicate that followed in November 2009.
Total	29.1		

Table 2: Description of attributes used to record data on Cassowaries and their sign during surveys at Ella Bay in April 2010

Cassowary Sign	Primary Attribute	Secondary Attribute	Tertiary Attribute
Scats	Age of scat. <ul style="list-style-type: none"> • Very fresh: dropping is raised from ground surface and has complete structure; very wet and sometimes steaming; negligible sign of oxidisation; fruit still fleshy. • Fresh: dropping is raised and has complete structure; thin outer layer is dry but dropping is otherwise wet; signs that outer layer is oxidising; fruit still fleshy. • Recent: dropping is raised and has complete structure; dry outer layer but wet in centre and base; outer layer is oxidised; fruit partly fleshy. • Old: dropping is slightly raised but has weak structure; completely dry; fruit in advanced state of decay. • Very old: dropping is flat and lacking structure; very dry and deteriorated; no sign of fleshy fruit; some seeds might be germinating. 	Size of scat. <ul style="list-style-type: none"> • Small: <12 cm diameter (possible evidence of a juvenile or subadult Cassowary) • Large: >12 cm diameter (evidence of an adult Cassowary) 	Contents of scat.
Footprint	Social structure. <ul style="list-style-type: none"> • Independent bird: no chick prints accompany adult print. • Family group: chick prints accompany adult print, including number of chicks discernable from footprints. 	Footprint quality: footprints can be measured from tip of middle toe to back of heel. High quality: tip of toenail and back of heel are clearly defined; scale imprints are often visible; print is on relatively flat surface and not speared into or smudged on substrate. Low quality: tip of toenail and edge of heel not clearly defined, obscured by vegetation, smudged or speared into substrate.	Length of each measured print (in millimetres) and direction of travel.
Sighting	Social structure. <ul style="list-style-type: none"> • Family group: adult male and number of chicks. • Independent adult: feathers totally black; blue and red on face and neck; well developed casque. • Independent subadult: feathers totally brown or contain proportion of brown; face and neck may or may not be blue and red; casque small. 	Sex. <ul style="list-style-type: none"> • Male: tail droops below body line; smaller than fully grown female; with or without chicks. • Female: tail small and does not droop below body line; larger than male when fully grown; without chicks. 	Description of casque (bends, notches, colours), wattles (length and colour) and/or other distinguishing face or body markings.

Table 3: Deployment period for surveillance cameras¹

Camera No.	Pre-Survey			Survey Period			Post-Survey Period		
	Deployed	Retrieved	Days	Deployed	Retrieved	Days	Deployed	Retrieved	Days
S1	5/3/2010	19/3/2010	14	-	-	0	-	-	0
S2	9/3/2010	19/3/2010	10	13/04/2010	17/4/2010	4	18/4/2010	22/4/2010	4
S3	9/3/2010	19/3/2010	10	13/04/2010	17/4/2010	4	18/4/2010	22/4/2010	4
S8	19/3/2010	12/4/2010	24	13/04/2010	17/4/2010	4	18/4/2010	22/4/2010	4
R1	5/3/2010	12/04/2010	38	13/4/2010	17/04/2010	4	18/4/2010	22/4/2010	4
R2a	5/3/2010	12/04/2010	38	13/4/2010	17/04/2010	4	18/4/2010	22/4/2010	4
R2b	8/4/2010	12/04/2010	4	13/4/2010	17/04/2010	4	18/4/2010	22/4/2010	
R3a	5/3/2010	12/04/2010	38	13/4/2010	15/04/2010	2	-	-	0
R3b	8/4/2010	12/04/2010	4	13/4/2010	17/04/2010	4	18/4/2010	22/4/2010	
R4a	8/4/2010	12/04/2010	4	13/4/2010	17/04/2010	4	18/4/2010	22/4/2010	4
R4b	5/3/2010	12/04/2010	38	13/4/2010	15/04/2010	2	-	-	
R5	8/4/2010	12/04/2010	4	13/4/2010	17/04/2010	4	18/4/2010	22/4/2010	4
R6	8/4/2010	12/04/2010	4	13/4/2010	17/04/2010	4	18/4/2010	22/4/2010	4
R7	8/4/2010	12/04/2010	4	13/4/2010	17/04/2010	4	18/4/2010	22/4/2010	4
R8	8/4/2010	12/04/2010	4	13/4/2010	17/04/2010	4	18/4/2010	22/4/2010	4
R9	8/4/2010	12/04/2010	4	13/4/2010	17/04/2010	4	18/4/2010	22/4/2010	4
R10	8/4/2010	12/04/2010	4	13/4/2010	17/04/2010	4	18/4/2010	22/4/2010	4
NRA 1a	-	-	0	13/04/2010	16/04/2010	3	-	-	0
NRA 1b	-	-	0	-	-	0	17/04/2010	30/4/2010	13
NRA 2a	-	-	0	14/04/2010	16/04/2010	2	-	-	0
NRA 2b	-	-	0	-	-	0	17/04/2010	30/4/2010	13
NRA 3	-	-	0	14/04/2010	16/04/2010	2	17/04/2010	30/4/2010	13
NRA 4a	-	-	0	13/04/2010	16/04/2010	3	-	-	0
NRA 4b	-	-	0	-	-	0	17/04/2010	30/4/2010	13
TOTAL			246			70			100

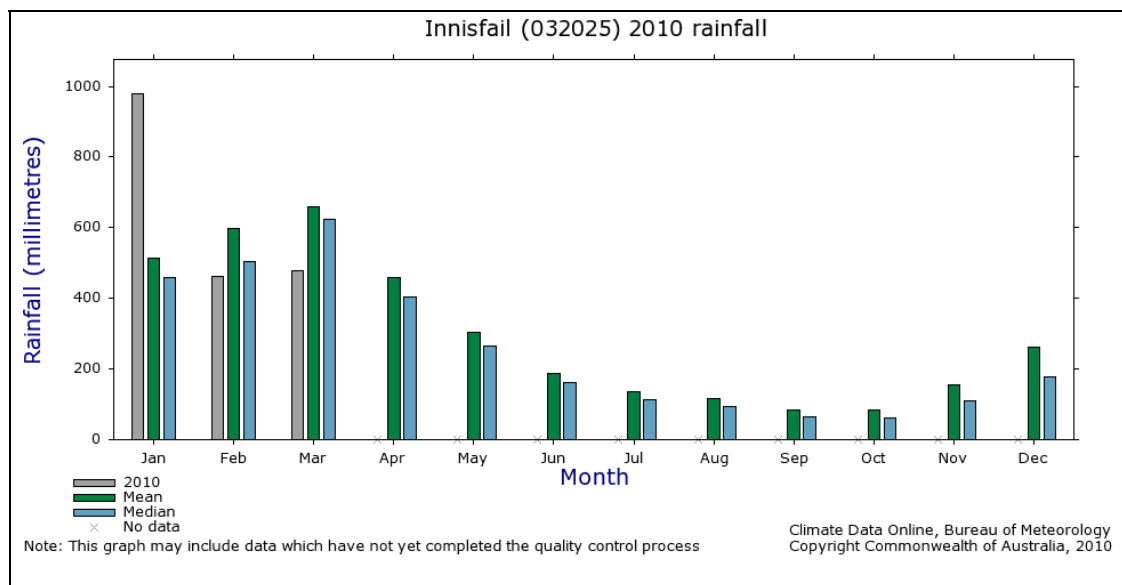
1 - Camera locations are shown on **Figures 1a and 1b**.

3. Results

3.1 Weather Conditions

While it did not rain in the three days prior to the field survey, approximately 280 mm of rain fell between 1 and 9 April 2010. No cyclones occurred in 2009 or 2010 and no extreme weather events (flooding, extended dry or gale force winds) occurred during or immediately prior to the survey. The high water levels observed along some sections of the study area are typical of the wet season.

Rainfall for the 2010 calendar year is shown on **Graph 1**. Weather data is based on the Innisfail weather station and obtained from the Bureau of Meteorology web site (<http://www.bom.gov.au>).



Graph 1: Rainfall data from the Innisfail weather station

3.2 Cassowary Survey Results

3.2.1 Overview

Seventy-two scats (23 were recent or fresher) and 14 sets of footprints (including two high quality prints) were recorded during the field survey. No birds were sighted during the survey. Surveillance cameras captured photographs of Cassowaries at six general locations between March and April 2010. The locations of Cassowary sign recorded during the field survey and on surveillance cameras between March and April 2010 are shown on **Figures 2a and 2b**.





PROJECT: Supplementary Survey (April 2010) for the Southern Cassowary (*Casuarus casuarius johnsonii*)
at the Proposed Ella Bay Integrated Resort
TITLE: Cassowary Survey Results

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JOB NO: 340004
DATE: October 2010
SOURCE: NRA, Google Earth



Figure 2b

3.2.2 Estimates of Population Abundance, Sex, Age and Social Class

Within the survey period (March to April 2010), it was estimated that at least five adult Cassowaries (four male and one of indeterminable sex), one subadult bird and five chicks (**Table 3**) were using the study area. Two other adult Cassowaries (possible adult female plus adult of indeterminable sex and age) may have also resided in the study area. The identities of these birds are summarised as follows.

- **Male A + 2 chicks.** Chicks medium-sized (chicks' backs were above height of adult underbelly), feathers are brown and they lack developed casques. The male has uneven-sized wattles (left wattle shorter than right). This group was observed in the same general area during the November 2009 survey (NRA 2010). The chicks have grown since November 2009, indicating that resource availability has been favourable since the last survey.
- **Male B.** Male conspicuous by the absence of wattles. Photographed at the same location on two occasions (five photos). This male was using a similar area in November 2009. At that time the bird had three small to medium chicks (chicks' backs were about height of adult underbelly). Chicks not evident in the five photos and it is possible that this male no longer has chicks.
- **Male (D?) + 2 chicks.** Evidence based on photos of two equal-sized chicks (*ie* no photos or data on adult Cassowary). Chicks small to medium, brown and lack casques. Presence of other chicks cannot be discounted on available data. Family group may belong to Male D who had three small chicks in this general area in November 2009. Unlikely to be other males previously recorded in this area, *ie* unlikely to be Male C which in November 2009 had two unequal-sized chicks (one small and one medium-sized) or Male E which had a single small chick.
- **Male E + 1 chick.** Male E based on features of casque (left and right side). Chick small to medium (back of chick is about height of adult underbelly). Used a large area during survey period (approximately 2 km long). Photographed once at Little Cove and once heading into coastal forests in the southern section of the EBIRD site (**Figure 2a**).
- **Subadult.** Brown and possibly sections of black feathers (photo image is sepia) with small casque.

The general areas used by identified Cassowaries are shown on **Figures 2a and 2b**. These areas of activity were created by drawing minimum convex polygons around those Cassowary sign (plus buffer) that are attributable to individual birds. While these areas include sections of individual Cassowary home ranges they are not entire home ranges nor are they accurate representations of the actual areas used during the assessment period (March to April 2010). For example, some polygons include areas of open paddock which in many cases Cassowaries don't use.

Some observations could not be conclusively attributed to specific Cassowaries and these are summarised as follows.

- A 210 mm poor quality print collected in the north-west of the EBIRD site (**Figure 2a**) may have been from a female Cassowary. While prints of this size are usually attributable to female birds, the poor quality precludes confirmation.
- Evidence of Cassowary activity adjacent to the proposed access road (*eg* Flying Fish Point Reserve and Seymour Range – **Figure 2b**) is insufficient to distinguish specific birds. However, given the location, distance and relative proximity of Cassowary sign, we suspect the sign is attributable to at least two adult Cassowaries.

Analysis of photos and video footage of Cassowaries, collected by Satori staff in the months before and after the survey period, provided the following additional information.

Table 4: Estimate of Cassowary population abundance, sex, age and social class using the Ella Bay survey area between March and April 2010¹

Category	EBIRD Site	Access Road	Total
Adult male	4	0	4
Adult female	0 (possibly 1)	0	0 (possibly 1)
Adult Undetermined Sex	0	1 (possibly 2)	1 (possibly 2)
Subadult	1	0	1
Family groups	3	0	3
Chicks	5	0	5

1 - Some observations could not be conclusively attributed to specific Cassowaries and a possible estimate is therefore provided in parentheses.

3.2.3 Diet, Habitat and Areas of Activity

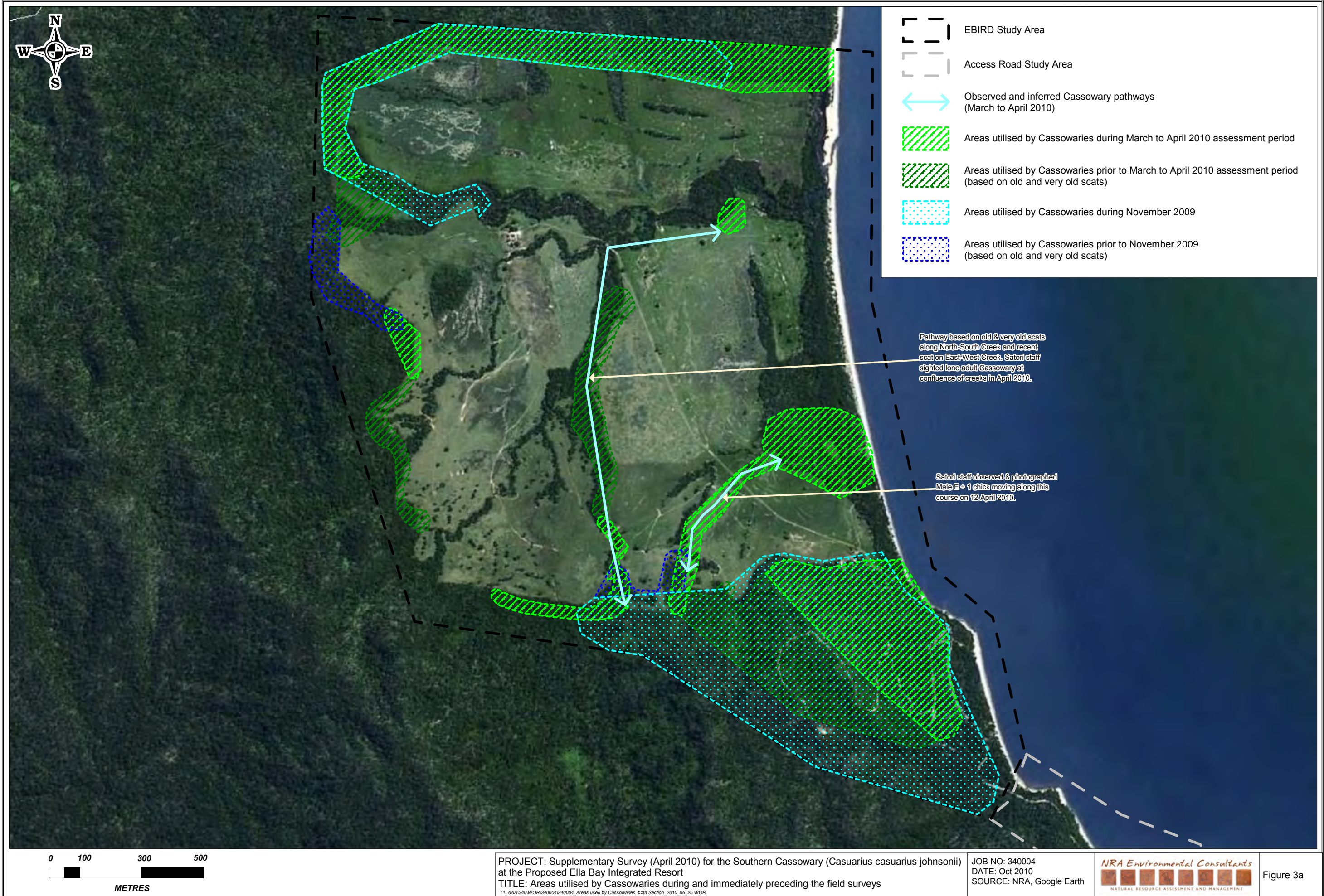
Seventeen different food items were found in recent, fresh and very fresh scats, indicating what Cassowaries were eating during and immediately prior to the survey (**Table 5**). The food items were predominantly fruit but a few scats also contained fungi and flowers. While no food items were especially dominant in the scats, *Annona glabra* (Pond Apple), *Elaeocarpus bancroftii* (Kuranda Quandong), *Terminalia catappa* (Beach Sea Almond) and *Ficus* spp. (Figs) were the most commonly occurring items. The scat contents confirm the use of beach and foredune communities (eg Beach Sea Almond) and lowland rainforests. The number of fresh and very fresh scats was very low (five scats) generally and when compared to November 2009 (16 scats). This result, in addition to the observed low abundance of fruiting trees, suggests a natural food shortage during and immediately prior to the survey.

A further seventeen species of fruit were recorded in old and very old scats but not recorded in recent, fresh and very fresh scats (**Table 5**). The much lower number of species in recent, fresh and very fresh scats may reflect the decrease in the number of available food plants in the months leading up to the survey.

Figures 3a and 3b show areas of general activity during the current assessment period (approximately March to April 2010) and November 2009 survey period. **Figures 3a and 3b** differ from **Figures 2a and 2b** in the following ways.

- **Figures 3a and 3b** contain data from November 2009 and **Figures 2a and 2b** do not.
- **Figures 3a and 3b** do not attempt to attribute sign to individual Cassowaries. The polygons therefore show areas of general Cassowary activity.
- Polygons are drawn around old and very old scats in **Figures 3a and 3b** (not done for **Figures 2a and 2b**) to show sections of the landscape used by Cassowaries in the weeks and months prior to the surveys.
- Polygons are clipped to exclude areas devoid of woody vegetation (eg paddocks) unless specific sighting data indicates use of such areas (eg the pathway shown in the south-east of the EBIRD site).

The results indicate that Cassowaries were using more sections of the landscape during the current assessment period. The most notable difference was that during the current survey Cassowaries were using beach and foredune communities (EBIRD site and proposed access road) and the north-south creek (EBIRD site). The reason for this change in use patterns is unclear but is probably related to food resources (eg less food availability may encourage use of larger areas). Alternative but less likely explanations are that the change in use patterns is related to natural behavioural cycles (eg the survey coincided with the period when Cassowaries may wander further in search of mates) and/or random explorations (eg there may not be a specific causal factor and observed patterns are the result of chance).





PROJECT: Supplementary Survey (April 2010) for the Southern Cassowary (Casuarus casuarus johnsonii) at the Proposed Ella Bay Integrated Resort
TITLE: Areas utilised by Cassowaries during and immediately preceding the field surveys
T:\AAA\340\WOR\340004\340004_Areas used by Cassowaries_both Section_2010_06_25.WOR

JOB NO: 340004
DATE: Oct 2010
SOURCE: NRA, GE

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Figure 3b

Table 5: Food items recorded in Cassowary scats at Ella Bay in April 2010

Species	Occurrence in Individual Scats	Presence in Scats		
		All	Old and Very Old	Recent, Fresh and Very Fresh (proportion %)
<i>Annona glabra</i>	22	Yes	Yes	Yes (17.3%)
<i>Elaeocarpus bancroftii</i>	18	Yes	Yes	Yes (15.4%)
<i>Terminalia catappa</i>	19	Yes	Yes	Yes (9.6%)
<i>Ficus</i> sp.	6	Yes	Yes	Yes (7.7%)
Unknown fruit	7	Yes	Yes	Yes (5.8%)
<i>Psidium</i> sp.	5	Yes	Yes	Yes (5.8%)
Fungi	5	Yes	Yes	Yes (5.8%)
<i>Alpinia caerulea</i>	5	Yes	Yes	Yes (5.8%)
Unknown Arecaceae	3	No	No	Yes (5.8%)
<i>Calamus</i> sp.	3	Yes	Yes	Yes (3.8%)
<i>Acmena</i> sp.	3	Yes	Yes	Yes (3.8%)
<i>Elaeocarpus eumundi</i>	3	Yes	Yes	Yes (3.8%)
<i>Pandanus species</i>	4	Yes	Yes	Yes (1.9%)
<i>Endiandra compressa</i>	4	Yes	Yes	Yes (1.9%)
<i>Archontophoenix alexandrae</i>	2	Yes	Yes	Yes (1.9%)
<i>Endiandra montana</i>	1	No	No	Yes (1.9%)
<i>Calamus caryotoides</i>	1	No	No	Yes (1.9%)
<i>Barringtonia calyptrata</i>	11	No	Yes	No
<i>Acmena graveolens</i>	10	No	Yes	No
<i>Syzygium forte</i>	5	No	Yes	No
<i>Myristica insipida</i>	3	No	Yes	No
<i>Melia azedarach</i>	3	No	Yes	No
<i>Cerbera</i> sp.	3	No	Yes	No
<i>Barringtonia</i> sp.	2	No	Yes	No
Unknown seed	2	No	Yes	No
<i>Elaeocarpus grandis</i>	2	No	Yes	No
Unknown seed (Solonaceae)	1	No	Yes	No
<i>Irvingbaileya australis</i>	1	No	Yes	No
<i>Aleurites moluccana</i>	1	No	Yes	No
Unknown flower	1	No	Yes	No
<i>Terminalia sericocarpa</i>	1	No	Yes	No
<i>Syzygium aliiligneum</i>	1	No	Yes	No
<i>Faradaya splendida</i>	1	No	Yes	No
<i>Rhodomyrtus macrocarpus</i>	1	No	Yes	No

4. Discussion

4.1 Population Estimates

Population estimates from the current and previous Cassowary surveys are shown in **Table 6**. Fewer Cassowaries were recorded during the current survey compared with the last survey in November 2009 (NRA 2010). However, more Cassowaries were recorded during the current survey compared with a survey conducted at a similar time of year in 2009 (February 2009 – Moore 2009).

While the survey areas for the four Cassowary studies (**Table 6**) are relatively similar, the environmental conditions during or preceding the November 2006 and February 2009 surveys would have greatly influenced survey results. The November 2006 survey (Moore 2006) occurred approximately eight months after Cyclone Larry, when forests were still heavily damaged and Cassowary food resources were very low. This probably accounts for the lower number of Cassowaries (especially younger cohorts) recorded by Moore compared with the more recent studies. The February 2009 (Moore 2009) survey occurred during heavy rain and flooding associated with Cyclone Ellie. These conditions affect Cassowary behaviour and detectability and probably explain the low number of Cassowaries recorded during that survey. Moore (2009) also reported the suspected death of the adult female Cassowary (labelled Cassowary #4) had previously inhabited forests adjacent to the proposed access road. Moore (2009) also reported the emigration of an adult male (labelled Cassowary #1 in Moore 2006 and #5, *aka* 'Hightower', in Moore 2009) to the western slopes of the Seymour Range (near Turalba Road).

It is not possible to attribute the decreased abundance estimate (from November 2009) to a single causal factor. However, the following may have influenced this result.

- **Detectability.** Water levels impeded access to some areas of the study area and conditions for detecting Cassowary scats and footprints were generally poor. These conditions may have influenced the results. However, these conditions do not account for the low number of photos during the April 2010 survey (13 photos in April 2010 vs 24 photos in November 2009). Camera survey effort was much higher in April 2010 (*cf* November 2009) and at least an equivalent number of photos were expected. This suggests that the lower number of Cassowaries recorded was not an artefact of the survey effort, conditions or survey methods.
- **Resource availability.** Food resources appeared to be low during and immediately prior to the field survey. This situation may have encouraged some birds to move outside of the survey area in search of food. April 2010 was the first time during formal surveys that Cassowaries were recorded foraging on Sea Almonds and Pond Apple in and around beach and foredune communities. This highlights the effect that resource availability has on Cassowary movements, *eg* Cassowaries may have moved into this area in response to the low abundance of food in lowland rainforest areas.
- **Life history stages.** The survey coincided with the period when adult Cassowaries begin looking for mates. Such movements may have resulted in some Cassowaries moving outside the survey area. Though less likely, some male Cassowaries may have already mated and were not detected because they were on their nest incubating eggs. Many Cassowary food plants were about to start fruiting and this period of abundant resources is probably an opportune time to hatch chicks.

- **Wet Season Migration.** Moore (2009) speculates that the local Cassowary population makes seasonal use of the coastal lowlands east of Ella Bay National Park, moving to higher ground and away from the flooded lowlands during the wet season. His hypothesis is largely (though not exclusively) based on sightings of an adult male Cassowary (referred to as *Hightower* due to the tall casque) on the EBIRD site in November 2006 and then on a ridge line 2.3 km west in February 2009. This bird has not been sighted again on the EBIRD site, which suggests that such movements may not be regular. Its presence in the EBIRD site in November 2006 may have been related to the impacts of Cyclone Larry. While there is insufficient evidence to suggest routine and large-scale 'migration' away from lowland areas during the wet season, the water levels at this time of year reduce the area of available habitat and would encourage at least small-scale changes in habitat use patterns.
- **Mortality.** There have been no recorded Cassowary deaths since the last survey. The activities of Satori within the study area currently pose negligible threat to Cassowaries and have probably reduced the likelihood of many threats, *eg* the presence of Satori within the EBIRD site has probably reduced the level of pig hunting in that area. The reduction in Cassowary numbers is unlikely to be related to human-related activities. Similarly, there were no extreme environmental events (*eg* cyclones, droughts) preceding the survey and such events are also unlikely to have contributed to the lower abundance estimate. Therefore, it is highly unlikely that the observed decrease since November 2009 is due to mortality.

Table 6: Comparison of population estimates between the current and previous (NRA 2010, Moore 2006, 2009) Ella Bay Cassowary surveys

Category	November 2006		February 2009		November 2009		April 2010	
	EBIRD Site	Access Road	EBIRD Site	Access Road	EBIRD Site	Access Road	EBIRD Site	Access Road
Adult male	2	2	1	1	5 (possibly 4)	1	4	0
Adult female	1	1	0	0	1 (probably 2)	1	0 (possibly 1)	0
Adult sex uncertain	0	0	0 ¹	1 ²	0 (possibly 1)	0	0	1 (possibly 2)
Subadults	0	0	1	0	2	1	1	0
Family groups	0	1	1	1	5 (possibly 4)	0	3	0
Chicks	0	1	2	2	11 (possibly 9)	0	5	0
Total adults	6		3		8 or 9		5 or 6	
Total subadults	0		1		3		1	
Total chicks	1		4		9 to 11		5	

1 – Moore (2009) recorded scats along the north-eastern edge of the EBIRD clearing. While he could not definitively assign these scats to a separate bird, they were >3 km from other Cassowary sign and our experience suggests they may have been from an additional bird.

2 – Moore (2009) recorded this adult Cassowary in the swamps west of Flying Fish Point, approximately 3 km south-west of the proposed access road and 6 km south of the EBIRD site. This is outside the current (NRA) survey area.

4.2 Re-sighted Cassowaries

Imperfect photo quality and lack of detailed physical identity descriptions in Moore (2006, 2009) preclude reliable comparison with more recent NRA studies (NRA 2010 and the current study). Cassowary profiles based on the November 2009 survey results were developed prior to the current study and assisted in identifying specific birds. Photos of identified Cassowaries from the current survey period are provided on CD as part of this report.

Cassowaries recorded during November 2009 (NRA 2010) are discussed below in light of the April 2010 survey results.

- **Adult Male A** was re-sighted in the same general area (northern edge of EBIRD site) in November 2009 and April 2010. The two chicks observed with the adult in November 2009 are still present and have grown.
- **Adult Male B** was re-sighted in a similar area (north-western edge of EBIRD site) to that in which it was recorded in November 2009. There was no evidence of the three chicks recorded in November 2009.
- **Adult Male C** was not identified during the April 2009 survey. This bird and his two chicks (one large and one small) were observed using the Little Cove area and the south-eastern corner of the EBIRD site in November 2009.
- **Adult Male D** was not specifically recorded during the April 2010 survey. His potential presence is based on photos of two small to medium sized chicks in the southern extent of the north-south creek. This identification is based on the fact that Male D was the only bird that had >1 chick of equal size/age (he had three chicks) in this part of the study area in November 2009. It is assumed he has remained in the same general area and his chicks have grown slightly. On available data, the potential presence of a third chick cannot be discounted.
- **Adult Male E** was re-sighted in the same area (Little Cove) as in November 2009 and in areas further north that were not used in November 2009. The definable range of this bird had doubled to that recorded in November 2009. This bird still has a single chick which had grown since the last survey. Their activity included foraging in beach and foredune communities adjacent to the EBIRD site.
- **Adult Male F** was not identified during the April 2010 survey. Cassowary scats and poor quality prints were recorded in the same area that he was using in November 2009. While the prints were of poor quality, they were from a smaller bird and therefore unlikely to be from Female B which also uses this area and may have been from Male F.
- **Adult Female A** was not identified during the April 2010 survey. Female A was using the south-eastern corner of the EBIRD site and Little Cove area in November 2009.
- **Adult Female B** was not identified during the April 2010 survey. This female was last seen foraging along the beach foredune adjacent to the fish farm in February 2010 (based on video footage posted on the internet (<http://www.youtube.com/watch?v=c-d3A-6R92Q>)).
- **Adult Female C** was not identified during the April 2010 survey (note: the November 2009 study advised that the identity and presence of this bird required confirmation). A large, poor quality footprint recorded in the north-west of the EBIRD site in April 2010 may have been attributable to a female Cassowary. This is the area where Female C was tentatively recorded in November 2010. The poor quality of the print and lack of other visual data precludes the ability to verify the presence of Female C in this area.
- **Subadults:** a single subadult was recorded in the north-east of the EBIRD site during the April 2010 survey. The relationship of this bird to the two subadults recorded on the EBIRD site in November 2009 is unclear.

4.3 Areas of Cassowary Activity and Movement Pathways

4.3.1 EBIRD Site

Cassowaries used more sections of the study area during the current assessment period (March and April 2010) than during the November 2009 survey. The area of activity was more similar to that recorded by Moore (2006) in November 2006. As described in previous sections of this report, this increase, as well as forays into areas not used in November 2009, was probably resource-driven or possibly due to natural behavioural cycles and/or chance. There appeared to be less food resources in the lowland rainforests in April 2010 and this may have encouraged birds to move into other areas. Further surveys during 'ambient' conditions and across different seasons are required to ascertain if the observed changes are regular or predictable.

The following use patterns are of potential interest to ongoing site management and the planning and assessment process.

- **East-west and north-south creeks.** Cassowaries were observed using various sections of the north-south creek and downstream section of the east-west creek. As described above, use of these areas was probably resource-driven. The regularity of this behaviour can be determined via further fieldwork. Their absence from this area later in the year when fruit is more abundant may confirm previous speculations (NRA 2010) that they only move into these areas during periods of food shortage and there may be a reluctance to use these areas more frequently.
- **South-western boundary of EBIRD clearing.** As per November 2009 (NRA 2010), very little Cassowary activity was recorded in this area. Again no scats were recorded in this area, with the only sign being feathers on the perimeter barbed wire fence. Acacias dominate some sections of this area and the resultant reduction in fruiting plants may partially explain the absence of Cassowary sign. Greater survey effort (especially using surveillance cameras) should be devoted to this area.
- **Beach and foredune communities.** Cassowaries were using beach and foredune communities during and shortly after the field survey. Male E was observed moving across the open paddock area to access the southern section of this community (**Figure 3a**). The lone adult and adult with three chicks sighted by Satori staff at the confluence of the north-south and east-west creeks (April 2010 and January 2010 respectively) may have moved along these creeks from forests to the west or south. Further survey work at different times of the year (especially between February and March) is required to demonstrate the regularity of use.

Observed and possible movement pathways are shown on **Figure 3a**.

4.3.2 Proposed Access Road

The area of Cassowary activity during the current study was greater than in November 2009 (NRA 2010), February 2009 (Moore 2009) and November 2006 (Moore 2009). The reason for this difference is that Cassowaries were using beach and foredune habitats adjacent to the fish farm in April 2010, in addition to the areas where they were recorded in previous studies. Further survey work is required to ascertain how regularly and predictably Cassowaries use beach and foredune areas. NRA personnel have observed Cassowaries using such habitat types in a regular and predictable manner at Cowley Beach (20 km south of Ella Bay).

High water levels and dense stands of *Calamus* and *Pandanus* prevented extensive searches in Flying Fish Point Reserve. There were many Cassowary trails in the area searched just south of the fish farm, indicating recent and frequent use of this area. Based on observations to date, certain patches of Flying Fish Point Reserve are regularly and intensively used. Water levels will

always impede access in this area during the wet season but pose less of a problem during the dry season. Given the potential importance of this area, survey effort should be increased during the dry season.

A feather collected on the barbed wire fence just north of the fish farm indicates a Cassowary probably crossed at this point. Satori staff sighted an adult bird along the road in this area in January 2009. Based on available information, the regularity of crossings along this section is unclear. Birds may have been crossing at this point to access food along the beach and foredune. Analysis of scats (April 2010 survey) and video footage posted on the internet (dated 16 February 2009) indicate that birds were foraging on a variety of rainforest plants that grow behind the foredunes and on Sea Almonds (*Terminalia catappa*) that grow along the strand line. Cassowaries are also crossing the road near the intersection of Ruby Street and Ella Bay Road.

A noteworthy record prior to the current survey was an adult Cassowary along the road near the Heath Point headland (**Figure 3b**). This bird was sighted by Satori staff in January 2010 and is the first time a bird has been recorded along this section of road. The banks surrounding this section of road are steep and the bird is more likely to have wandered up the roadway. It is likely that Cassowary activity along this section is very infrequent. This is supported by the fact that this is the first Cassowary record along this road section and Satori staff have been driving on the road many times a day for over two years.

4.4 Summary of Information Relevant to the Ongoing Management of Cassowaries and the Impact Assessment Process

Four Cassowary survey events have been conducted to date. Two surveys occurred during or after extreme climatic events (Moore 2006, 2009) and two occurred during more ambient conditions (NRA 2010 and the current study). While all the information is valuable, the two more recent studies conducted during ambient conditions are the most relevant for current site management and for the planning and assessment process. The November 2009 and April 2010 studies show that eight or nine adult Cassowaries (including 2 or 3 females, 4 or 5 males and an adult of indeterminable sex) use the Ella Bay study area from time to time. Areas of activity change seasonally and during the wet season some Cassowaries make higher use of the beach and foredune communities while others may move out of the study area.

The regularity of observed Cassowary habitat use patterns can be ascertained via further field studies. As per NRA (2009b), the next survey event is recommended to occur in November (window period of October to December) 2010. Satori's routine surveillance camera effort should include sampling in the south-western corner of the EBIRD site to help determine the extent of Cassowary activity in this area.

5. References

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