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The use of infra-red sensors and digital cameras for documenting visitor use patterns: a case study from D'Aguilar National Park, south-east Queensland, Australia.

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Abstract

This study assesses the use of pyroelectric infra-red sensors combined with digital cameras to document visitor use patterns on a horse-trail network within an area of D'Aguilar National Park; a peri-urban bushland reserved for a range of purposes and used by several user groups. Data were obtained from four cameras and comprised 7000 photographs over 1000 days. Forty-five per cent of photographs were false-triggers attributable to environmental factors and 42% were of confirmed users. An exercise aimed at assessing camera success revealed that in this study capture rates were in the order of 63% for cyclists, 82% for pedestrians, 90% of motor vehicles and 100% for horses. Sources of error can be minimised and primarily include the internal and external camera settings. Major advantages of infrared digital cameras include the portability of the technique, low cost, digital data format, and discrimination of user types. In this case study, two-thirds of total observed visitor numbers occur on weekends and two-thirds of all use occurs during morning daylight. Cyclists were the most common user-group per day, followed in descending order by walkers, joggers, motorised users, dogs, bushwalkers, horse riders and trail-bike riders. Implications of this data for management are discussed.

Keywords: Australia, *Equus*, Horse Trail Network, visitor monitoring

Introduction

Information about visitor use patterns, such as the numbers of different users and their temporal and spatial extent, is highly essential for informing decisions on management of protected areas (Arnberger et al. 2005). Applications are numerous and include determining appropriate infrastructure (eg. track type and sanitation amenities), informing the number and nature of users potentially impacted by a management activity (eg. fire and smoke), dictate the best time of day or season to conduct certain activities (eg. track maintenance), and provide information that can contribute to identifying trends in visitor use that enlightens longer-term planning. However, for protected areas within Australia, quantified information on visitor use is relatively rare or inadequate (Hawden et al. 2007).

Strategies for management of visitors within Queensland's protected areas have been outlined by the Queensland Parks and Wildlife Service (2001) and include keeping records of visitor numbers and evaluating visitor management. Many approaches to monitoring visitor numbers are available and have been extensively reviewed (eg. Cessford and Muhar 2001, Muhar et al. 2002, Wardell and Moore 2004, Watson et al. 2000) with a range of options suggested to suit a specific situation.

Many governments, such as the Queensland government elected on 24th March 2012, see the recreational use of protected areas as being an important part of the tourism industry (which in Queensland is regarded as one of the four pillars of the economy). Queensland's national parks and forest attract more than 16 million visits annually and contribute an estimated $4.43 billion annually to Queensland's economy (Queensland government 2011). As one of their actions in the first 100 days of government, the Queensland Government established DestinationQ as part of the tourism strategy to ensure a whole-of-government approach to tourism (Qld government 2012a). A large number of actions were suggested at Destination Q to support the Government's policy of opening up National Parks for more access to users such as horse-riders, four wheel drivers and ecotourism operators, and removing impediments, including regulations, to creating new or improved accommodation, attractions and tours in protected areas (Queensland government 2012b). Similar changes in policy to allow horse-riders and feral animal hunters into protected areas are also occurring in New South Wales (ABC 2012, NSW government 2012). With more access and less regulation (which is often a good source of information on users), there is an increasing need to monitor the numbers, type and behaviour of users

The D'Aguilar National Park in south-east Queensland is a classic example of a protected area with multiple uses, multiple user-groups and predictable increasing rates of visitor use. The 36,500 ha Park adjoins Brisbane city's metropolitan area (population 2.1 million) and provides part of the watershed for much of Brisbane's terrestrial water supplies. It provides important nature-based recreational and educational opportunities with up to 400,000 visitors annually (Queensland National Parks and Wildlife Service 1998). Visitor numbers are expected to increase across the Park estate (Auditor-General of Queensland 2010). The Park contains a number of broad vegetation types from Eucalypt woodlands on the mid-slopes to rainforest on the higher summits, each of which contain both rare and iconic species. Sealed roads traversing the Park provide access to places of interest including vantage points affording views of the greater Brisbane area, Moreton Bay and associated islands. Selective logging has historically occurred in some areas, a legacy of which is a network of unsealed roads throughout the current Park. Approximately 400 km of unsealed roads are maintained for access and fire-control purposes but are also used by a range of user-groups.

Management issues of D'Aguilar National Park include potentially extensive fires in the Eucalypt country, maintenance of roads, management of weeds around high-use areas, managing visitor expectations, protection of cultural and historic sites and maintenance of positive relationships with neighbours (Queensland National Parks and Wildlife Service 1998). A contemporary, longer-term issue is the future of a

65km Horse Trail Network within the Park which is subject to studies on the environmental, economic and social impacts of horse riding. Knowledge of visitor use patterns within such areas serves to inform the above issues.

The goal of this study was to unobtrusively sample all user groups from walkers to vehicles and horses, capture all users on relatively wide tracks and establish patterns of use throughout a 24hr period over many months. Infra-red sensors attached to digital cameras (hereby referred to as infrared cameras) were considered a potentially viable method and have the advantage over infrared sensors not tied to cameras where counts of large numbers of users, predominantly walkers, have been shown to vary from confirmed users by more than double (Schwartz et al. 2010). In addition, most counter data cannot provide any information on user type (Arnberger et al. 2005). Hence to distinguish between the multiple users on these trails in D'Aguilar National Park, an array of two magnetic (for motorbikes and four wheel vehicles), two optical (humans and horses) and a seismic (bicycles) sensors was required costing more than $12,000 per site. A single infrared camera costing under $1000 provided a significant cost saving in equipment.

Most published literature documenting the use of infrared cameras as monitoring tools is associated with wildlife surveys. Favourable comparisons have been found with live trapping (De Bondi et al. 2010), track counts (Olsson et al. 2008) and other techniques for surveying fauna (Vine et al. 2009, Claridge et al. 2010) such that robust population estimates are possible (Sweitzer et al. 2000). The major cited advantage of this technique is typically an economic saving, especially when sampling over longer timeframes (Roberts 2010).

The major limitation of infrared cameras has been false triggers with the dominant cause being environmental (Towerton et al. 2008) and to a lesser extent inappropriate camera setup (Swann et al. 2004). The primary limitation of the technique cited by Campbell (2006) was false triggers associated with the time lag between sensing an object and camera emerging from stand-by mode. There is possibly a seasonal effect whereby moisture affects camera operation and effectiveness (Kays et al. 2011, Rowcliffe et al. 2011).. The dominant benefit was the cost saving relative to other techniques. For example, the total cost of infrared cameras is likely to be several times cheaper than direct observations and other optical, magnetic or seismic techniques. Cost is a major concern regarding the frequency and accuracy of assessing visitor numbers across numerous Australian protected area management agencies (Darcy et al. 2007). Despite these cost benefits, the technique has received surprisingly little attention in tourism-related literature with the notable exception of Arnberger and Hinterberger (2003) and Arnberger et al. (2005), and Campbell (2006) who employed them on trails within an Austrian and Canadian National Park respectively.

The limitations of infrared cameras discussed in the above studies were ameliorated as much as possible in the current study, which primarily aims to assess both the practicalities and effectiveness of infrared cameras for visitor monitoring. It also aims to document visitor use patterns, such as the relative proportions of different user-groups and temporal usage patterns on a Horse Trail Network within an area of D'Aguilar National Park.

Methods

Field

Four pyroelectric infra-red motion detectors (“TrackSnap Digital Eye” model TS-DE 7.2-01) linked to digital cameras (Sony DSCW55 modified for infra-red) were employed on or close to South Boundary Road within D’Aguilar National Park, SEQ (Fig. 1). Cameras and sensors were housed in the same camouflaged sealed unit to protect them from the weather, limit visibility to users and assist in preventing vandalism or theft. At the broader scale camera locations were established within easy access from Brisbane for maintenance purposes, were set to cover a range of track settings and placed away from a track entrance to accommodate for the possibility of capturing illegal track use (mainly trail bikes). Sensors are designed to detect a change in infra-red levels, in this case a moving object warmer than ambient temperature. Movement in any direction can be detected and recovery time of the sensor is half a second. The camera has a start up time of 1.6 seconds and shutter time lag of approximately 0.3 seconds (Skelley 2008). However, throughout the entire dataset, even where large groups of people passed or people resided within range of the sensor for half a minute or more, the minimum time between photographs throughout the study was four seconds. Time and date of the image are recorded digitally. Battery life of the camera was approximately 290 photographs and storage capacity greatly exceeded this. After testing the systems *in situ* every couple of weeks at the start of the project, battery life of the sensor was established to be the dominant factor affecting the frequency of visiting the camera. Over the course of the survey, data were typically downloaded and batteries for both the sensor and camera replaced every seven weeks.

The following criteria had to be met for precise camera locations: 4-5 m above the ground on trees with diameters greater than 30 cm at the attachment point and no more than 8m from the track centre; on trees with a bark most amenable to camouflage (to reduce the chance of detection and vandalism); facing at least 25 m of track in one direction (substantially longer in three cases); angled towards the track centre; not facing the rising or setting sun; and not having any vegetation or other moveable objects within close proximity to the detection zone. A picture taken from each camera showing the roads and environmental setting are provided in the Supplementary Material. At around 20°C ambient temperature and 3m from the track centre the width of sensor capture is 19 m (Skelley 2008). Sites were also chosen to be facing downslope, so that non-motorised users would be travelling at slower speeds toward the cameras, thereby increasing the chance of detection. Cameras were set to detect 24 hours/day on still picture and trail mode.

Privacy issues have been raised with regard to camera-based monitoring (eg. Muhar et al. 2002), including surveys of visitor use within Australian protected areas (*sensu* Warnken and Blumnstein 2008). In this dataset people are not considered any further than their presence, mode of transport, direction of travel in relation to the camera, time of day and day of week. No attempt has been made to ascertain an individual’s identity or track a user’s movements in space or time apart from an exercise aimed at determining camera effectiveness (see below). Photographs have not and will not be passed to any other party, and the interpreter of the photographs had no knowledge of the survey area. The counts were not compared with any other form of concurrent visitor monitoring, and only images where individuals are unidentifiable will be published in any public media.

Analytical

Of the 7030 photographs, 41 were deleted from the analysis where the same user was also captured in subsequent photograph(s) due to stopping in range of the camera for one reason or another. Where users occurred in both the background of one photograph and the foreground of another (110), only their presence in the foreground photograph was recorded. 240 photographs capturing camera maintenance operations before or after battery replacement were also excluded leaving a dataset of 6637 photographs.

For each remaining photograph the number of users was recorded and assigned to one of the following 'user-group' categories: "Walkers" (people clearly walking); "Joggers" (people clearly running); "Bushwalkers" (people with backpacks); "Mountain Bikes' (all bicyclists); "Trail bikes" (motorbikes); "Motor vehicles" (all four-wheeled vehicles including quad bikes) and "Horses" (which were all accompanied by at least one rider). Headlights, tail lights and a torch are clearly visible after dark and were assigned to the appropriate user. Dogs were also counted. Only the use at the time of image capture is considered, for example some walkers may also have been jogging elsewhere within the Park, and each user was recorded as moving "towards" or "away" from the direction the camera was facing.

Where photographs did not contain a user (hereby referred to as false triggers) the likely cause of the photograph was attributed to one of the following: "Motorised users", which were characterised by photographs of dust and in wetter conditions tyre tracks; "Environmental factors" which were photographs that were caused by wind where trees moved between photographs; light which was demonstrated by photographs of reflections from the lens, a suspected heat differential on the camera or target area as it moved in and out of shadow; and possibly heat rising from a warmed patch of ground (Skelley 2008). Latent heat contained in (moving) vegetation against a background of cooler ambient temperature is not thought to have been a cause of false triggers. In many cases multiple photographs occurred in close temporal proximity, with some occurring around the same narrow time period on consecutive days. Some false triggers were also assigned 'Suspected users' on the basis that the photographs were isolated in time, did not show any of the above features and also occurred around peak traffic time according to preliminary investigations and Dowling and Goulding (2010).

Where any of the above situations were not clearly attributable the cause of the photograph was "Unknown". The lenses or sensors were never obscured by raindrops. Partial obscurity of the lens of one camera was attributable to a speck of mud arising from a trail bike. It remained for a small number of photographs but never affected the determination of numbers of users or user-group. The infrared sensor was never obscured by dirt. Triggers by animals such as birds or macropods are thought to be effectively non-existent although an insect walking on the camera housing may have triggered three photographs.

The "unknown" category was further examined in relation to its temporal occurrence and known patterns of visitor use. For both false triggers and confirmed photographs of users, the proportion of the total represented by each hour was calculated and the two sets of hourly figures were correlated using the Pearson Product-Moment Correlation Coefficient.

Data from confirmed users were collated according to day of the week and hour of the day per user group per camera. Small errors will occur with both use per day of the week and use per hour as incomplete days and hours were sampled across the dataset due mainly to battery expiration.

To obtain an estimate of the effectiveness of the infrared cameras as employed here, confirmed users travelling past camera 2 towards cameras 3 and 4 were sought in cameras 3 and 4 (when cameras 3 and 4 were also active at that time, n=72). The assumption is that these users subsequently passed either camera three or four (Fig. 1). This process allows for a percentage estimate of missed users per user group. The same exercise was conducted for all confirmed users travelling past camera 4 towards cameras 2 and 3 (n=105), and for users travelling past camera 3 towards cameras 2 and 4 (n=89). It is possible that some users turned around before passing the subsequent cameras and where this may have occurred users were looked for in the original camera within a reasonable timeframe from their first capture. A definitive error assessment is not possible without a reliable, alternative and concurrent method of determining visitation use.

A possible effect of seasonality on visitor use was also explored by comparing data from confirmed walkers, joggers, bushwalkers and mountain bikes between all cameras and across all months.

Results

Approximately 993 days were surveyed in total (Fig. 2). Given uncertainties regarding the precise time a battery expired, sample time was probably between 988 and 998 days, including a few part-days. Some of the shorter periods reflect times when a battery expired due to a high frequency of photographs due to environmental factors (see below). Cameras three and four were stolen *in situ*. Through documenting user-data from the photographs several limitations of the method became apparent and need to be considered when interpreting the data.

Of the 2769 photographs of users, 13 are known to contain either a user which had not triggered a photograph but had clearly passed prior to a following user triggering the camera (ie. a user only appeared in the distance of one photograph), or a distant on-coming user in one photograph did not subsequently trigger a photograph shortly after. Thus a proportion of some users were not photographed and the absolute numbers of confirmed users presented here are an underestimate of reality. The calibration exercise (Fig. 3) indicates that on average 37% of mountain bikes were missed, 12% of pedestrians (including joggers), 10% of motor vehicles and no horses.

The time-lag between the camera activating from sleep mode and initial photograph was at best 1.6 seconds, and while activated was four seconds between successive images. Thus a user may have triggered the sensor but passed before the image was taken. The possibility of this phenomena being represented by "unknown" photographs was explored in relation to known temporal and spatial patterns of confirmed users, with the relationship between confirmed user presence per hour and "unknown" photographs per hour being highly significant (r^2 of 92%, p<0.001). In other words, for example, the highest visitor use was between 10 and 11 am and the highest number of unattributed false triggers (unknowns) also occurred at this time. Nine per cent of motorised vehicles travelling in the direction the camera faced was half the corresponding proportion of motorised vehicles travelling towards the facing camera (18%). Similarly, the number of "unknown" photographs (858) potentially comprise half the total known non-motorised users travelling towards the camera (848). While not without unquantifiable associated error, these all support the case for unknown photographs being users that had travelled towards the camera, triggered it, but passed out of camera range by the time the photograph was taken. Evidence that this phenomenon occurs is provided by a few examples of a distant, oncoming user not appearing in a photograph triggered by that user a few seconds later.

The proportions of confirmed users plus 'unknowns' and environmental images are presented in Table 1, with 45% of all images suspected to have been caused by environmental factors. Of the total confirmed users, bicyclists are the most common followed by walkers, joggers, motorised users, dogs, bushwalkers, horses and trail-bikes (Fig. 4). Visitor use data per day of the week and per hour are presented graphically in Figure 5 with further detail provided in the Supplementary Material. Both show differences between cameras. Use by non-motorised users was highest on weekends with about two-thirds of all use occurring on Saturdays and Sundays. In contrast use by motorised vehicles was highest during the week and largely reflects various aspects of Park management. Most track use occurred during the morning and dropped off throughout the rest of the day with a smaller increase in track use by some user groups in the late afternoon. There was no apparent seasonal (monthly) difference in use for walkers, bushwalkers and joggers combined or mountain bikes (provided graphically in the Supplementary Material).

Groups of four or more walkers, bushwalkers, joggers, cyclists and horses (once) used the HTN. However, precise group size is indeterminable due to both the time lag between photographs, distance between users in the same group and unknown relationship between users. In the course of the error assessment exercise for example, it was found that two cyclists appearing on a photograph from camera two triggered separate photographs on camera three. Track use has not been analysed in terms of group size, suffice to say that maximum group size was not more than four horses and four motorbikes and not less than eight joggers, nine walkers, fifteen mountain bikers and twenty-three bushwalkers.

Discussion

Infrared cameras proved able to detect the range of known user-groups and provide information on the relative abundance of each. As employed here the technique under-sampled total visitor numbers, missing a proportion of users travelling towards the facing camera (eg. users travelling away from the camera have a higher chance of capture given the lag time between sensor and image). As is, the reliability of capture appears greater for motorised users (>86%) than for non-motorised users, where 82% of walkers, joggers and cyclists and 63% of mountain bikes were captured in total. These values may underestimate total error of the exercise because the confirmed users employed in the calibration exercise may themselves be a proportion of the total that actually passed. While such error is likely to be only a few percent, the calibration exercise here is indicative of camera behaviour as used in this study and the results have not been adjusted accordingly. A more detailed direct calibration using human observers such as conducted by Arnberger et al. (2005) is recommended before using this study to provide definitive numbers of use.

The lack of significant seasonal bias for either visitor use and/or camera operation can only be described by using data from confirmed users. However, the conditions under which a seasonal bias has been detected elsewhere (a rainforest setting in the Panama using a different model camera and housing, Rowcliffe et al. 2011) do not apply here and any real seasonal effect is thought to be negligible.

The speed at which the user travels and the difference in users body temperature relative to ambient temperature would account for some error in absolute user numbers. It is also likely that error is subject to the precise location of the camera and orientation of the sensor in relation to the track (eg. Rowcliffe et al. 2011). In this case study, the optimum camera location was compromised by the potential of theft or vandalism and future studies should consider solutions with these in mind. A dedicated tamper-proof housing such as that used by Olsson et al. (2008) situated closer to the target area would reduce such error. Camera malfunctions have been recorded elsewhere (eg. Vine et al. 2009) although no malfunctions were suspected during this study.

Environmental factors were responsible for 45% of the total number of photographs. In a bushland setting shadows moving across the camera or target area are unavoidable. However, most environmentally-triggered photographs are discernible by their temporal occurrence (multiple photographs close together and often at a certain time of day), visible movement of the ambient vegetation (also resulting from the movement of the tree on which the camera was located) or light reflected on the lens. Ninety-eight per cent of photographs in Towerton et al. (2008) were environmentally-triggered, mainly through wind.

Individual users may occur on multiple consecutive images and their discrimination from other users needs to be made to improve the accuracy of determining visitor numbers. For example if several users appear in images taken four seconds apart the potential for double-counting the same user exists. In this dataset this was a potential issue only with distant cyclists, and was further hampered by the limited colour range of infrared images. The presence of other features though, such as a backpack or helmet type, allowed for successful discrimination in every case.

"Unknown" photographs comprised around five per cent of the total dataset and while their cause cannot be definitively assigned, an understanding of both mechanisms involved in camera operation and visitor use patterns allows for defensible assumptions of their cause to be made. In this study it appears that the majority of unknown photographs were users travelling in the opposite direction that the camera was facing, whereby they triggered the camera but had passed before the image was taken.

It needs to be noted that several sources of error encountered in this study can be substantially mitigated. Aside from citing the camera closer to the targets, the cameras can be set to be permanently active and not on 'stand-by' mode for example. The four-second delay between trigger and photograph would be eliminated and the chances of capturing the user substantially increased. Thus an alternative study designed around cameras that are always on is likely to improve the accuracy of detecting total visitor numbers. This would require more frequent visits to the camera to change the battery or the provision of alternative power supply. Other related cameras and sensors are readily available with other characteristics, such as varying trigger and consecutive image speeds. The challenge in bushland areas is to provide a more reliable power supply, but also protect equipment from vandalism or theft. It must also be noted that the proportions of missed users in this study may differ from other studies, even with the same product, due to site-specific variations in camera location or speed of the user.

In any event the information provided here can contribute to Park management. For example, in order to minimise the impact on users, road-works would be best conducted on Thursday afternoons, as indicated in Figure 5 the lowest daily use generally occurred on a Thursday, and the majority of use on all days was in the morning. This study has also informed longer term planning by providing information on the relative abundance of each user group: notably small proportions and small numbers of both horse and motorbike riders. Furthermore the technique demonstrated that these latter users did not use the Horse Trail Network during peak visitation times. The data may also be used to plan the timing of other types of visitor surveys.

Conclusion

This study demonstrates the potential for infrared cameras as a visitor monitoring tool and was also able to illustrate limitations of the technique. These include the chance of taking an image but missing the user, users not triggering the sensor at all, and in the bushland setting a large proportion of environmentally-caused photographs. The extent of all of these limitations can potentially be mitigated in full, although maximising the internal and external settings of the camera may compromise camera security and maintenance times. Major advantages of the technique are the low initial outlay and running costs, unobtrusive sampling method, potential for the unit to be used in multiple places, the ability to discriminate between user types and the data format (digital images) enabling information to be magnified, checked or re-analysed in the future.

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TABLE CAPTIONS

Table 1. Summary data of broad categories assigned to each photograph.

FIGURE CAPTIONS

Figure 1. Location of cameras (C1-C4) with the direction they face indicated by arrows. The inset shows the city of Brisbane (urbanisation is white) and vegetation within D'Aguilar NP is the dark region in the SW. Major roads within the park are highlighted

Figure 2. Dates covered by active cameras (C1-C4). The study spanned the 20th Aug. 2009 to 18th Jan 2011

Figure 3. The proportion of users initially seen in cameras two to four (C2,C3,C4) that were subsequently seen in another camera. For example, 88% of all 109 mountain bikes seen on camera 4 that were travelling towards cameras 2 and 3 triggered either camera 2 or 3. The number of users is indicated below the proportion. Walkers, joggers and bushwalkers have been combined into the pedestrian category. The motor vehicles category also contains motorbikes.

Figure 4. Proportions of the total number of confirmed users.

Figure 5. Average number of users per day of the week and total number of users per time of day. Data from both panels is based on the maximum number of confirmed users from any individual camera for a given day or time of day. Joggers, walkers and bushwalkers are combined and presented as pedestrians.

Camera	Days active	No. user images	Environment triggered	Unknown	Images suspected to have been triggered by motorised users	Images suspected to have been triggered by non-motorised users
1	240	1389	1022	169	3	405
2	341	789	410	71	16	95
3	202	368	734	33	2	26
4	210	223	820	29	1	34
Total	993	2769	2986	302	22	558

Table 1. Summary data of broad categories assigned to each photograph.

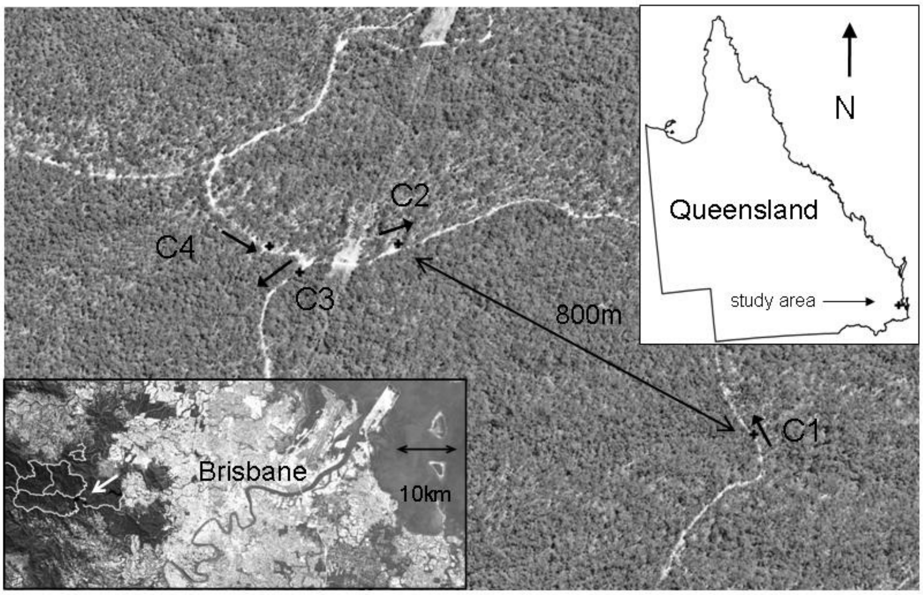


Figure 1.

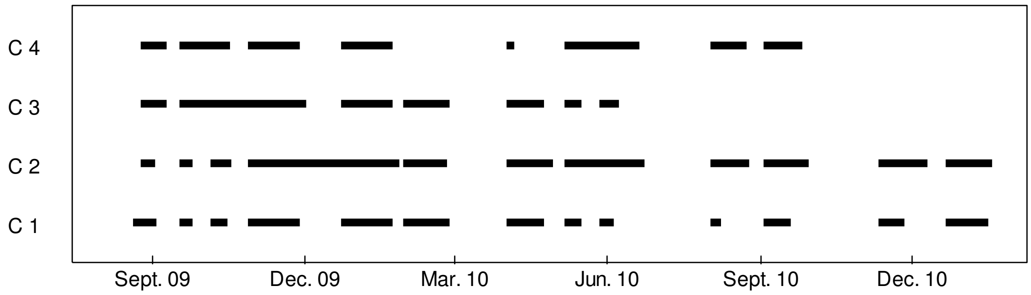


Figure 2.

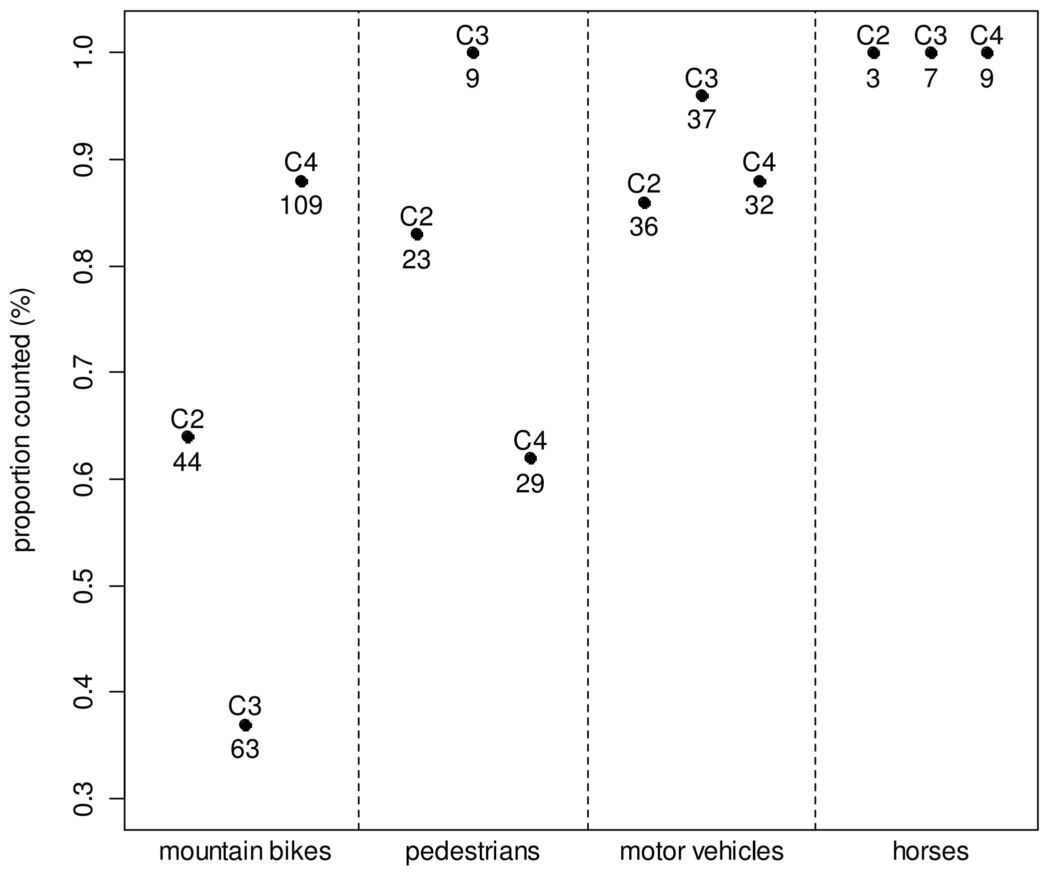

proportion counted (%)
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
C2
44
C3
63
C4
109
C2
23
C3
9
C4
29
C2
36
C3
37
C4
32
C2
3
C3
7
C4
9
mountain bikes
pedestrians
motor vehicles
horses

Figure 3.

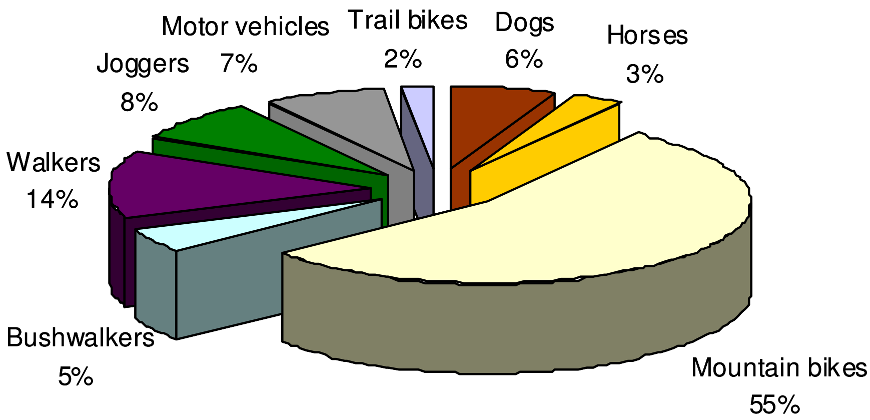
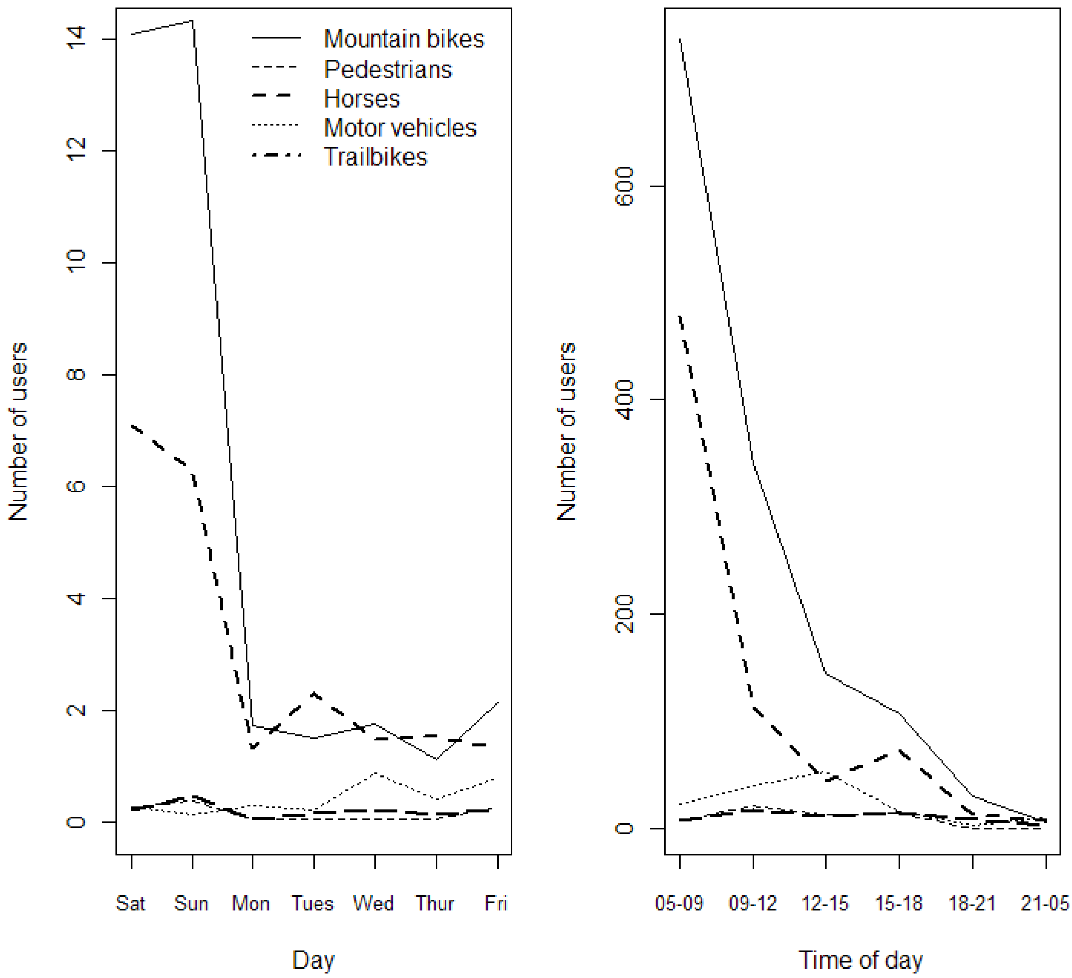

Motor vehicles
7%
Trail bikes
2%
Dogs
6%
Horses
3%
Joggers
8%
Walkers
14%
Bushwalkers
5%
Mountain bikes
55%

Figure 4.



Mountain bikes
Pedestrians
Horses
Motor vehicles
Trailbikes
Number of users
0
2
4
6
8
10
12
14
Sat
Sun
Mon
Tues
Wed
Thur
Fri
Day
Number of users
0
200
400
600
05-09
09-12
12-15
15-18
18-21
21-05
Time of day

Figure 5.

SUPPLEMENTARY MATERIAL

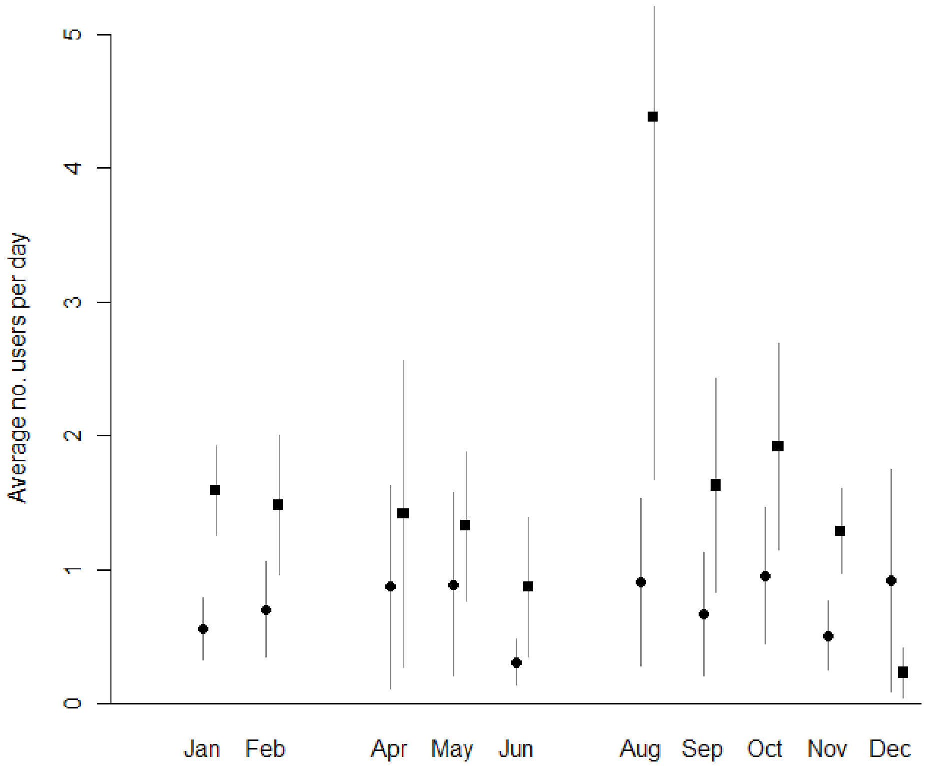
View from Camera 1

View from Camera 2

View from Camera 3

View from Camera 4

Camera 1 *in situ*



The mean number of daily occurrences per camera per month of pedestrians (walkers, bushwalkers and joggers combined, circles) and mountain bikes (squares). The standard error within cameras is also presented. Only months with ten or more days of capture are employed.

	Camera	No. Days	MB	J	W	Bu	H	MV	TB	MU	NVU
MON	C1	29	1.72	0.28	0.90	0.10	0.00	0.07	0.07	0.14	3.00
	C2	48	0.83	0.06	0.02	0.04	0.00	0.17	0.06	0.23	0.96
	C3	27	0.26	0.04	0.19	0.15	0.04	0.30	0.07	0.37	0.67
	C4	28	0.11	0.00	0.07	0.07	0.07	0.14	0.00	0.14	0.32
TUES	C1	31	1.52	1.16	0.97	0.06	0.06	0.19	0.16	0.35	3.77
	C2	50	0.72	0.08	0.00	0.00	0.04	0.22	0.08	0.30	0.84
	C3	28	0.79	0.00	0.18	0.18	0.07	0.07	0.00	0.07	1.21
	C4	29	0.31	0.17	0.03	0.00	0.00	0.14	0.00	0.14	0.52
WED	C1	33	1.67	0.36	0.91	0.09	0.06	0.88	0.21	1.09	3.09
	C2	50	1.76	0.04	0.04	0.04	0.02	0.84	0.16	1.00	1.90
	C3	28	0.54	0.07	0.11	0.21	0.00	0.64	0.00	0.64	0.93
	C4	29	0.21	0.00	0.07	0.00	0.03	0.52	0.03	0.55	0.31
THUR	C1	39	1.13	0.13	1.21	0.05	0.05	0.41	0.13	0.54	2.56
	C2	50	0.60	0.04	0.06	0.00	0.04	0.38	0.10	0.48	0.74
	C3	30	0.27	0.13	0.23	0.20	0.07	0.40	0.00	0.40	0.90
	C4	31	0.06	0.00	0.03	0.00	0.06	0.42	0.00	0.42	0.16
FRI	C1	40	2.13	0.20	1.03	0.03	0.28	0.55	0.25	0.80	3.65
	C2	49	1.14	0.00	0.04	0.08	0.08	0.61	0.08	0.69	1.35
	C3	31	1.00	0.06	0.29	0.00	0.10	0.81	0.00	0.81	1.45
	C4	32	0.19	0.00	0.19	0.00	0.13	0.50	0.03	0.53	0.50
SAT	C1	36	14.08	2.22	4.06	0.81	0.28	0.11	0.14	0.25	21.44
	C2	47	5.57	0.83	0.53	0.30	0.19	0.06	0.21	0.28	7.43
	C3	30	1.80	0.83	0.73	0.17	0.13	0.27	0.03	0.30	3.67
	C4	32	2.44	0.16	0.75	0.22	0.06	0.25	0.06	0.31	3.63
SUN	C1	32	14.34	2.19	2.25	0.47	0.28	0.09	0.03	0.13	19.53
	C2	47	6.49	0.74	0.23	0.15	0.13	0.09	0.47	0.55	7.74
	C3	28	2.79	0.32	1.43	1.11	1.39	0.07	0.14	0.21	7.04
	C4	29	4.10	0.07	0.17	1.83	0.55	0.14	0.07	0.21	6.72

Average numbers of users per day use between cameras. MB=Mountain bikes, J=joggers, W=walkers, Bu=bushwalkers, H=horses, MV=motor vehicles, TB=trail bikes, MU=vehicles, trail bikes and use identified by dust and tyre tracks combined, NVU=all confirmed other users plus the “unknowns” suspected to be non-motorised users.

hour	camera	MB	J	W	Bu	H	D	MV	TB
	C1	737	174	268	20	0	127	11	6
05:00	C2	210	62	18	3	1	9	23	5
to	C3	131	40	46	36	7	20	13	0
09:00	C4	58	10	22	19	3	11	15	1
	C1	326	19	68	16	13	22	36	10
09:00	C2	340	11	17	25	5	8	40	17
to	C3	28	0	10	3	21	6	13	0
12:00	C4	120	1	12	6	13	4	21	0
	C1	84	2	10	11	10	6	28	6
12:00	C2	144	5	6	1	12	7	53	11
to	C3	15	2	11	16	9	4	31	4
15:00	C4	39	0	5	28	6	5	18	1
	C1	65	20	43	5	13	27	9	5
15:00	C2	107	7	2	0	6	4	15	14
to	C3	34	1	15	2	14	7	14	2
18:00	C4	5	1	2	9	5	2	7	2
	C1	30	4	0	0	0	11	0	5
18:00	C2	14	0	0	0	0	0	1	8
to	C3	7	0	9	0	0	0	0	1
21:00	C4	1	0	0	0	0	0	2	1
	C1	5	0	3	3	0	1	0	3
21:00	C2	2	0	1	0	0	0	1	1
to	C3	0	0	0	0	0	0	9	0
05:00	C4	0	0	0	0	0	0	9	1

Total numbers of confirmed users per hour (amalgamated by blocks of hours) per camera. To enable the proportion per hour to be calculated, the number of every hour represented by each camera is C1 240, C2 341, C3 202 and C4 210. MB=Mountain bikes, J=joggers, W=walkers, Bu=bushwalkers, H=horses, D=Dogs, MV=motor vehicles, TB=trail bikes.