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Working Paper No. 103

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Visitors' Ecological Impacts

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Clem Tisdell[†] and Clevo Wilson[‡]

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BIRDS IN AN AUSTRALIAN RAINFOREST: THEIR ATTRACTION FOR VISITORS AND VISITORS' ECOLOGICAL IMPACTS

Abstract

Lamington National Park in Queensland, Australia is noted for its rainforest and is part of the World Heritage listed property but prior to this work, no systematic study has been done of the importance of birds to its visitors. This study is based on data from survey forms handed to visitors at an important site in the park and completed by visitors following their visit. It yielded 622 useable responses. These enabled us to establish the comparative importance of birds as an attraction to this site for this sample of visitors. Furthermore, logit regression is used to target analysis and to identify factors that increase the likelihood of a visitor saying that birds are an important attraction. In addition, the relative importance to visitors of various attributes of birds at this site is established. These attributes include hearing birds, diversity of birds, seeing lots of birds, presence of rare birds, presence of brightly coloured birds and physical contact with birds. Logit regression analysis is used to isolate independent variables that increase or decrease the likelihood that visitors find diversity of birds, brightly coloured birds or physical contact with birds at this site to be important. For example, factors such as the level of education of visitors, their gender, knowledge of birds and conservation attitudes and statistically significant influences. As a result of the analysis potential conflicts between different types of park visitors in relation to human interaction with birds are identified. Some potential ecological implications of human interactions with birds are modelled and discussed, and their economic conservation and biodiversity consequences are considered.

BIRDS IN AN AUSTRALIAN RAINFOREST: THEIR ATTRACTION FOR VISITORS AND VISITORS' ECOLOGICAL IMPACTS

1. Introduction and Background

Few studies appear to have been done (especially in Australia) of the importance of birds as a factor encouraging visitors to travel to rainforests and of the various attributes of birds that visitors find appealing. To remedy this situation, we conducted a survey of visitors to Lamington National Park (LNP), Queensland, Australia at the O'Reilly's/Green Mountains site.

LNP is located in the southeast of Queensland in the hinterland of the Gold Coast (see Figure 1) approximately 110 km south of Brisbane (Reader's Digest, 2000) and is part of the Central Eastern Rainforest Reserves of Australia (CERRA), which are World Heritage listed (QPWS, 2001).

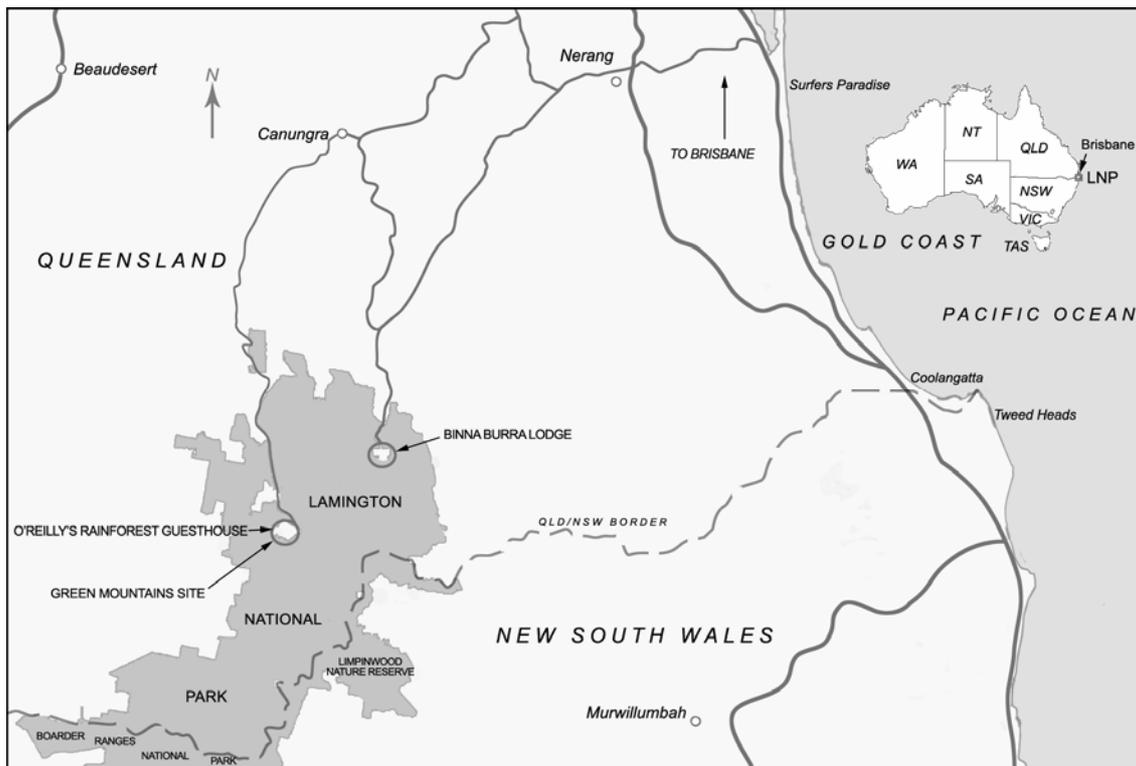


Figure 1: Generalised location map of Lamington National Park, Australia

Source: Based on the Joint Tourism Committee (2000) regional map of Southeast Queensland in 'The Guide'

Note: National park area is shaded and private properties within the park are shown in white.

LNP was established in 1915 and was the second national park to be proclaimed in Queensland (Jarrot 1990). It is the most visited national park in Queensland (Moon and Moon, 2000) and received about 200,000 vehicle arrivals in 2001 (QPWS, 2003). This suggests that about 0.8 million visits occur annually because, as mentioned later, average party size of respondents to the survey was 3.83.

Two roads lead into the park. One terminates at Binna Burra Mountains Lodge and the other ends at the Green Mountains/O'Reilly's Rainforest Retreat. Vehicle entries at the latter site are about a third less than at the Binna Burra site, probably because the travel time to reach Binna Burra is less from the Gold Coast and Brisbane. Nevertheless, 77,209 vehicle entries were recorded at Green Mountains in 2001. Birds frequent both sites and these sites are good points for commencing bushwalks into the rainforest. The rainforest setting, abundant wildlife, especially birds, picnic facilities, walking tracks and the panoramic views attract a wide range of visitors to the park. Around 20 percent of the visitors are from overseas and many are from Europe and North America, especially the USA. The majority of visitors are day visitors, but there are also overnight visitors.

LNP is well known for its birdlife and some threatened species such as the Albert's Lyrebird *Menura alberti* [Bonaparte, 1850], Rufus Scrub-bird *Atrichornis rufescens* [Ramsay, 1867], Eastern Bristlebird *Dasyornis brachypterus* [Latham, 1801] and the Coxen's Fig Parrot *Cyclopsitta coxeni* [Hombron and Jacquinot, 1841] are found in the park. Furthermore, a variety of bird species (which are mostly brightly hued) are fed at the guesthouses and nearby in the park. Hence, this park caters to generalist visitors (average visitors) who like the physical contact and the bright colours of the birds as well as the specialist birdwatchers. Therefore, in many respects, activities related to birds significantly cater for the average visitor and specialist birdwatchers. The importance of LNP to specialist birdwatchers is highlighted by Birding Tours Worldwide (2003) published in Texas, USA. It promotes O'Reilly's as one of the important birding locations for their tours in Australia. LNP is also promoted by the O'Reilly's Rainforest Retreat and the Binna Burra Mountain Lodge operators as a birdwatching destination. The data collected from our survey show that the number of specialist birdwatchers is small compared to the total number of visitors to LNP.

Three parcels of private land are enclosed by the national park (see Figure 1). Tourist enterprises providing overnight accommodation have been established on two of these sites.

O'Reilly's have guesthouses and a small shopping centre. Its shopping centre contains a restaurant, caters for take out food and sells birdseed for feeding wild birds, and a gift and souvenir shop. It is adjacent to a picnic area in the national park.

The purposes of our survey were as follows:-

- To determine how important birds are as an attraction to visitors to Lamington National Park using the Green Mountains/O'Reilly's site as a case study;
- To discover the type of visitors who are likely to say that birds are an important attraction to this site;
- To determine and analyse the comparative importance that respondents place on particular attributes of birds at this site; and
- To identify what types of respondents are likely to place importance on the different attributes of birds paying particular attention to the attributes of diversity of birds, presence of brightly coloured birds and physical contact with birds.

2. Methodology

Between October, 2001 and March, 2002, 1,536 survey forms were distributed at the Green Mountains car park that adjoins O'Reilly's (with a response rate of 35%) and a further 225 forms (with a response rate of 34%) were distributed to guests at O'Reilly's guesthouse by its management. Response rates in the low 30s are usual for this type of survey (Jakobbsen and Dragun 1996). Respondents were asked to complete this survey form after their visit and were provided with a self-addressed postage paid envelope for its return. A total of 622 useable replies were received. Only one respondent per party was sought and party sizes averaged 3.85 persons. Days of the week on which survey forms were handed out at the car park were varied to reduce possible biases.

Twenty per cent of respondents were visitors to Australia and they were from 17 countries mainly from Europe (mostly UK), North America (mostly USA) and fewer visitors from Asia. The low number of Asians recorded may be due to many Asian visitors not responding to surveys due to language barriers. Of the foreign visitors, 23% were North Americans of which 16% were from the USA.

The modal age of the respondents was in the 50-60 years range and 80% of respondents were over 30 years of age. While that may reflect older members of a party completing the survey form, this park appears to be very appealing to those in more mature age groups. Furthermore, the family annual income of respondents was relatively high. The percentage of respondents saying that their salary was more than Aus \$60,000 and above was 31% which was the highest of all the income groups in our study. The high income levels of respondents may be partly explained by the presence of a high proportion of ecotourists, especially birdwatchers who are in general well educated and have above average incomes (Sekercioglu, 2002; Ceballos-Lascurain, 1996). According to Cordell and Herbert (2002) the income of an average birdwatcher in the USA is US \$50,000 and about a third of the birdwatchers have at least a college degree. The data collected at LNP also show a very high level of educational qualifications among the respondents with 15% possessing post-graduate degrees. Apart from being well educated, birdwatchers also have a high degree of ecological knowledge and a high awareness of conservation issues (Cordell and Herbert, 2002). However, it should be pointed out that the results in our sample are not solely explained by the presence of specialist birdwatchers since they constitute only a fraction of the sample as pointed out earlier. The results suggest that most ecotourists (nature lovers) have similar characteristics to birdwatchers. Most visitors to this site were nature lovers with 59% expressing a strong or very strong support for nature conservation.

Of the 622 respondents 47% were male, 51% were female and 2% did not indicate their gender. For 47% of the respondents, it was their first visit, for 34% their second, for 9% their third and once again 9% indicated that they had visited more than thrice. One per cent did not respond. Sixty-two percent of respondents were day visitors and 38% stayed overnight either within the national park at O'Reilly's, or at the camping ground, or nearby.

After the data from the returned survey forms were collated and summarised, logit regression analysis was used to analyse the impact of independent factors on the likelihood that birds are an important attraction in bringing visitors to this site. Influences on the likelihood of respondents saying that various attributes of birds at this site are important were also analysed in a similar way.

3. Results – Importance of Birds as an Attraction

Visitors were asked to rank the features listed in Table 1 in terms of whether they were very important, important or unimportant reasons for their decision to visit the Green Mountains/O'Reilly's site of LNP. To obtain a ranking based on the degree of importance attached to these features by visitors, a weight of zero was attached to a feature if a respondent considered it to be unimportant, one if it was said to be important; and two if stated to be very important. The resulting ranking of the features based on the weighted averages are shown in Table 1.

Table 1:
Ranking of factors attracting visitors to O'Reilly's/Green Mountains site

Rank	Feature	Weighted Average
1	Rainforest	1.89
2	Birds	1.74
3	Get Close to Nature	1.68
4	Rare Ecosystem	1.45
5	Much Biodiversity	1.42
6	Good Start for Walks	1.41
7	Away from Routine	1.37
8	World Heritage	1.22
9	Cool Green Spot	1.07
10	Bringing Visitors	0.85
11	Good Picnic Spot	0.69
12	Other	0.27

* Weighted by using zero if respondent said a feature is unimportant, one if it is said to be important and two if it is said to be very important.

From Table 1, it can be seen that after the presence of the rainforest, birds are ranked as the second most important feature attracting visitors to this site.



Figure 2: Rainforest is the prime attraction to LNP



Figure 3: The survey site is a good starting point for bushwalks – walkers on the Border Track

In order to determine the type of visitors who are likely to say that the presence of birds is important we conducted logit and probit regression analyses. The results of these two analyses are shown in Table 2. For the purpose of this analysis, responses of ‘important’ or ‘very important’ were combined (coded as one) and ‘unimportant’ was coded as zero. Table 2 lists only the statistically significant independent variables and their levels of statistical significance.

Table 2:
**Factors listed increased the probability of visitors saying that the
presence of birds is an important site attraction**

Attribute of Respondent
LOGIT ANALYSIS
Female rather than male (6%)
Says important ^a as a picnic spot (1%)
Says important ^a for bringing visitors (1%)
Says important ^a for getting close to nature (1%)
Says important ^a as a good starting point for walks (4%)
Considerable biodiversity is an important ^a attraction (1%)
Close physical contact with birds is important ^a (1.2%)
PROBIT ANALYSIS
Rates diversity of birds as important ^a (1%)
Rates rare birds as important ^a (1%)
Close physical contact with birds is important ^a (5%)
Brightly coloured birds are important ^a (5%)

* Figures in parenthesis indicate statistical significance for at least the percentage level indicated

^a These factors are considered important or very important by respondents

Source: Based on the authors' survey data

As can be seen from Table 2, females are more likely to be attracted to this site by the presence of birds than males. The level of statistical significance of this is 6%. Visitors with varied reasons for visiting the site seem to find birds to be an important attraction. For example, although only a small proportion of visitors regarded this site as important for picnics or for bringing visitors (see Table 1) they were likely to say birds are important at this site. Also those who rate biodiversity generally, or diversity of birds at this site, as important attractions are likely to rate birds at this site as important. This is also true of those who like physical contact with birds or brightly coloured birds. But these latter persons seem to be relatively distinct from those who believe that diversity of birds or the presence of rare birds at this site are important.



Figure 4: Mother and child in physical contact with colourful parrots at O'Reilly's

Thus it appears that different types of visitors believe that birds are important at this site for different reasons.

4. Results – The Importance to Visitors of Attributes of Birds at this Site

Respondents were asked to rank the attributes of birds listed on Figure 5 as unimportant, important and very important at this site. Once again weights of zero, one, and two were used respectively to compute a weighted average of the importance of these attributes. The results are set out in Figure 5.



Figure 5: The average ranking of the importance of various attributes of birds at this site

Hearing birds turned out to be the most important aspect of birds, followed closely by the diversity of birds and seeing lots of birds. Presence of rare birds occupied fourth place. Seeing brightly coloured birds and physical contact with birds were given a lower ranking although they still remained important on average.

Brightly coloured birds commonly seen at the O'Reilly's site and in the national park picnic grounds opposite O'Reilly's are the King Parrot *Alisterus scapularis* [Lichtenstein, 1816] and the Crimson Rosella *Platycercus elegans* [Gmelin, 1788]. The Regent Bowerbird *Sericulus chrysocephalus* [Lewin, 1808], Australian Brush-turkey *Alectura lathami* [Gray, 1831] and the Wonga Pigeon *Leucosarcia melanoleuca* [Latham, 1801] are also some of the frequently seen birds in this area. It must be mentioned here that although these birds are found in the rainforest and in the guesthouse/QPWS picnic grounds they are not exclusively restricted to rainforests but can also sometimes be found in wooded areas, farms, gardens and parks within their range (Reader's Digest, 1997).

Grain is used by many visitors to feed the parrots (the above mentioned species) and the Regent Bowerbird may be fed with fruit. Parrots perch on people to obtain access to food and this aspect is popular for photographing. Birds continue to be fed at O'Reilly's and in the

picnic area and surrounding area of the park despite signs by the Queensland Parks and Wildlife Service warning against the feeding of wildlife (see Figure 6).



Figure 6: Warning from Queensland Parks and Wildlife Service not to feed wildlife at Green Mountains

Birds that may be heard in the rainforest include the Green Catbird *Ailuroedus cassirostris* [Paykull, 1815] which makes a distinctive cat-like call and the Paradise Riflebird *Ptiloris paradiseous* [Swainson, 1825] which makes a high pitched whistle followed by a gunshot-like crack. The rare and difficult to see birds include Albert's Lyrebird *Menura alberti* [Bonaparte, 1850], Rufus Scrub-bird *Atrichornis rufescens* [Ramsay, 1867], Eastern Bristlebird *Dasyornis brachypterus* [Latham, 1801] and the Coxen's Fig Parrot *Cyclopsitta coxeni* [Hombron and Jacquinot, 1841].

While in comparison to other aspects of birds at the site, seeing brightly coloured birds and having physical contact with birds might seem to be relatively unimportant, they are very important for some groups of visitors. In fact a dichotomy exists in the interests of different types of visitors to the site. A high degree of cross correlation exists between visitors who believe physical contact with birds and brightly coloured birds are important. However, this

group is less likely to rank the other attributes of birds at this site, such as diversity of birds as important. Conversely, those who rank diversity of birds as important, and attributes other than physical contact and bright colours as important, are less likely to rate physical contact with birds and brightly coloured birds as important.

This is evident from Table 3 which shows the degree of association between the respondents' statements about the importance of various attributes of birds at this site.

Table 3:
**Cross tabulation of percentage of respondents specifying that various
bird attributes are important at this survey site**

ATTRIBUTES	Seeing lots of birds	Hearing birds	Large variety or diversity of birds	Presence of rare birds	Brightly coloured birds	Close physical contact with birds
Seeing lots of birds	100	83	79	73	71	66
Hearing Birds	85	100	80	75	68	63
Large variety of birds	78	78	100	84	67	62
Presence of rare birds	66	67	77	100	61	59
Brightly coloured birds	55	51	52	52	100	69
Close physical contact with birds	48	45	46	48	66	100

Further analysis supports the view that visitors to this site can be divided basically into two groups – those who enjoy brightly coloured birds and physical contact with birds and those who may have a more intellectual attitude and believe that diversity of birds at this site is important. Sometimes individuals from these two groups are in conflict. Many of those in the latter group oppose the feeding of birds at this site. However, the groups are not completely disjoint.



Figure 7: Many visitors enjoy feeding colourful birds at the O'Reilly's site and having physical contact with these birds

Logit regression analysis can be used to identify the factors that increase the likelihood of a respondent saying that diversity of birds of this site is important. It can also be applied to identify factors that increase the likelihood of a respondent saying that physical contact with birds and the presence of colourful birds are important. These results can then be used to form the basis to differentiate between the groups that place different values on the attributes of birds at this site.

Many possible independent variables were tested to determine whether they had a statistically significant influence on the probability of a respondent saying that the attributes listed in the headings of Tables 4, 5 and 6 are important. For example, level of income and age were tested but found not to be statistically significant. Only the statistically significant variables are listed in these tables.

Table 4 sets out the factors that increase the probability of a respondent saying that diversity of birds at the site is important. Respondents are more likely to say this if they are male rather than female, have a tertiary education rather than a lower level of education, and if they claim to have a good knowledge of birds rather than a poor level of knowledge of birds.

These relationships are statistically of high significance. While the statistical significance of the other attributes listed in Table 4 is not as high, they are still statistically significant.

Table 4:
The probability of a respondent saying that bird diversity is important increases with the attributes listed. Logit regression analysis*

Attribute of the respondent
Good knowledge of birds (1%)
Positive attitude to nature conservation (3.5%)
Higher level of education (1%)
Stays overnight (3%)
Male rather than female (1.5%)

* Relationship is statistically significant for the percentage level indicated in brackets

Table 5 lists factors that are associated with a fall in the likelihood of a respondent saying that physical contact with birds at this site is important and indicates the statistical significance of the relationship. Similarly, Table 6 lists factors that are associated with a decline in the probability of a respondent saying that brightly coloured birds at this site are important.

Table 5:
The probability of a respondent saying that physical contact with birds is important falls with the attributes listed. Logit analysis*

Attribute of the respondent
Higher level of education (1%)
Good knowledge of birds (2%)
Member of a conservation organisation (1%)
Positive attitude to nature conservation (1%)
Male rather than female (9%)

* Relationship is statistically significant for the percentage level indicated in brackets

Table 6:

The probability of a respondent saying that brightly coloured birds are important falls with the listed attributes. Logit analysis*

Attribute of the respondent
Has a higher level of education (1%)
Has a good knowledge of birds (1%)
Is a member of a conservation organisation (2.5%)
Has a positive attitude to nature conservation (1%)
Male rather than female (1%)

* Relationship is statistically significant for the percentage level indicated in brackets

As highlighted by Table 7, the relationship for the importance of diversity of birds is the opposite in sign to those for physical contact with birds at this site. This is also true for the importance of brightly coloured birds except where the respondents' 'attitudes to nature conservation' is positive.

Table 7:

Signs of probability relationships between the importance of bird attributes and respondent's characteristics using logit regression analysis*

Respondent's characteristics	Diversity	Physical contact	Brightly coloured
Higher level of education	+	-	-
Good knowledge of birds	+	-	-
Member of conservation organisation	+ ⁿ	-	-
Positive attitude to nature conservation	+	-	+
Female rather than male	-	+ ^a	+
Stays overnight	+	- ⁿ	- ⁿ

All relationships are significant at the 5% level or less unless otherwise stated

^a Significant at 9% level

ⁿ Not statistically significant

Table 7 indicates that those who have a higher level of education, have a good knowledge of birds, and have a positive attitude to nature conservation are more likely than others to say that diversity of birds at this site is important, but less likely to say that physical contact with birds or the presence of brightly coloured birds are important. These factors provide a basis

for dividing visitors into two partially overlapping groups in terms of the importance they place on the attributes of birds at this site.

5. Human Conflict and Ecological Impacts of Rainforest Visitors on Birds, especially Effects from Feeding Birds

From the above analysis, it can be seen that potential or actual conflict exists between visitors to a tourist site who like brightly coloured birds and physical contact with birds as at the O'Reilly's site and those who like diversity of birds and attributes closely associated with this. Many of our survey respondents in the latter category mentioned that the feeding of birds at the O'Reilly's site should be stopped. It is the feeding of birds at this site that attracts brightly coloured birds and results in their physical contact with visitors. Members of the pro-diversity group may oppose the feeding of birds for several reasons: (1) that it is an unnatural intervention in a natural system; (2) it may harm the birds that are fed; and (3) could alter species composition and potentially reduce species diversity.

Müllner et al. (2004, p.549) after pointing out that little is known about the influence visitors have on rainforest animals, state: "The rare empirical evidence available indicates that even low numbers of visitors can change activity patterns or expel rainforest animals from potential foraging or breeding sites (Groom, 1991; Griffiths and van Schaik, 1998; Schaik and Staib, 1998; de la Terre et al. 2000). All of these effects can reduce reproductive success, and therefore, hamper conservation goals of protected areas. At the same time negative impacts on wildlife reduce both ecotouristic as well as the economic value of the visited area".

While the ecological part of the statement by Müllner et al. (2004) seems valid and is supported by their study of the hoatzin chicks in the Amazonian rainforest, their generalisation in their last sentence is dubious.

It is dubious because different groups of tourists or recreationists have different views about what is a valuable ecotouristic, or wildlife experience as is apparent from the survey results, analysed above. Secondly, not all negative impacts on wildlife arising from human interaction with wildlife reduce the utility of visitors or their economic value obtained from wildlife. In fact, such interaction may be encouraged to some extent by entrepreneurs because it attracts extra visitors to a site and may result in increased willingness of visitors to

pay to enter the site or to purchase commodities from businesses at or near the site. The business owned by O'Reilly's sells grain to visitors for feeding the wild birds and they are regarded as a commercially valuable activity from business's point of view.

Orams (2002, p.281) points out that "the feeding of wildlife has become a popular means by which tourists and tourism operators can facilitate close observation and interaction with wildlife in the wild". This supports the view that extra economic value can be obtained from tourists feeding wildlife, even when it involves some negative impacts on wildlife. Oram (2002, p.281) also states: "Certainly there are psychological, social and economic benefits that are experienced on the human side of the interaction (humans feeding wildlife) and, in a limited number of cases, the wildlife can be shown to have benefited as well. The issue of feeding wildlife for tourism is a controversial one with little consensus regarding how it should be managed". One reason why consensus about the management of that problem occurs is that different groups of humans are in social conflict because they value different, and often incompatible attributes of nature. This is evident from our study of valuations of visitors of different attributes of birds at the O'Reilly's/Green Mountains site.

Warnken et al. (2004, p.109) also points out that "many nature-based tourism destinations around the world have a history of allowing or encouraging visitors to feed local wildlife. Most instances of wildlife feeding have arisen either spontaneously, through the public's natural urge to interact with wildlife, or through a more deliberate attempt by commercial operators to attract wildlife to public viewing areas". They find from their study that human feeding of the Australian brush-turkey *Alectura lathami* [Gray, 1831] has an adverse impact on the forest-floor near its feeding sites, and on small animals in this localised environment and they recommend "greater consideration of small mammals and the potential indirect impacts when regulating wildlife feeding in National Parks and other nature conservation areas" (Warnken et al. 2004, p.109).

It is worthwhile considering some simple models illustrating aspects of human conflict in relation to interaction of tourists with wildlife. The first model demonstrates the need to qualify the statement made by Müllner et al. (2004) that negative impacts of visitors on wildlife reduce the economic value of the visited area. This is then further developed to illustrate human conflict issues involving the type of visitor interactions considered by Müllner et al. (2004). Subsequently, some simple applications of interspecific competition

models highlight the way human conflict can arise from visitor interactions with wildlife. Specifically we consider how visitors feeding of such wildlife may alter the diversity or composition of species at or around a visitor site.

Economics of the Case Involving a Reduction in a Species Attracting Tourists. This Case Allows for Types of Ecological Interactions Mentioned by Müllner et al. (2004)

Müllner et al. (2004) consider the situation in which the increasing presence of visitors to a tourist site reduces the population of the wildlife species that draws tourists to that site. Some economic aspects of this can be modelled.

For simplicity assume that tourists visit a site for the exclusive purpose of viewing a particular species of wildlife. Furthermore, suppose that the utility obtained by visitors to the site (or their maximum willingness to pay (WTP) for the experience of viewing the wildlife at the site) depends on the population density (at the site) of the species attracting the visitors. Let P represent this population density.

Then the utility obtained or WTP of a visitor (the i -th visitor) to the site might be expressed as

$$U_i = f_i(P), \quad (1)$$

assuming only one visit by the visitor in the period covered. It **may be** usual for $f' > 0$ and $f'' < 0$. This implies that the utility obtained by each visitor to the site (or their WTP) increases with the population of the species at the site but at a decreasing rate.

Therefore, it is assumed that each individual visitor's utility or WTP curve is of the nature shown by curve OKL in Figure 8, where P_l is the maximum possible density of the species at the site. [In the example given by Müllner et al. (2004) it corresponds to OA in Figure 9]. Note that in some cases, $f'(P)$, marginal utility as a function of the population density of the species at a site could eventually become negative if the population density of the species sought by tourists becomes quite high but this case is not considerable here. Furthermore, it is possible that total utility obtained by a visitor at a site to view wildlife may drop to zero

before the species disappears completely at the site. In that case, a utility relationship like that shown by OMNR would apply. This case, discussed in Tisdell and Wilson (2002), does not affect the argument below.

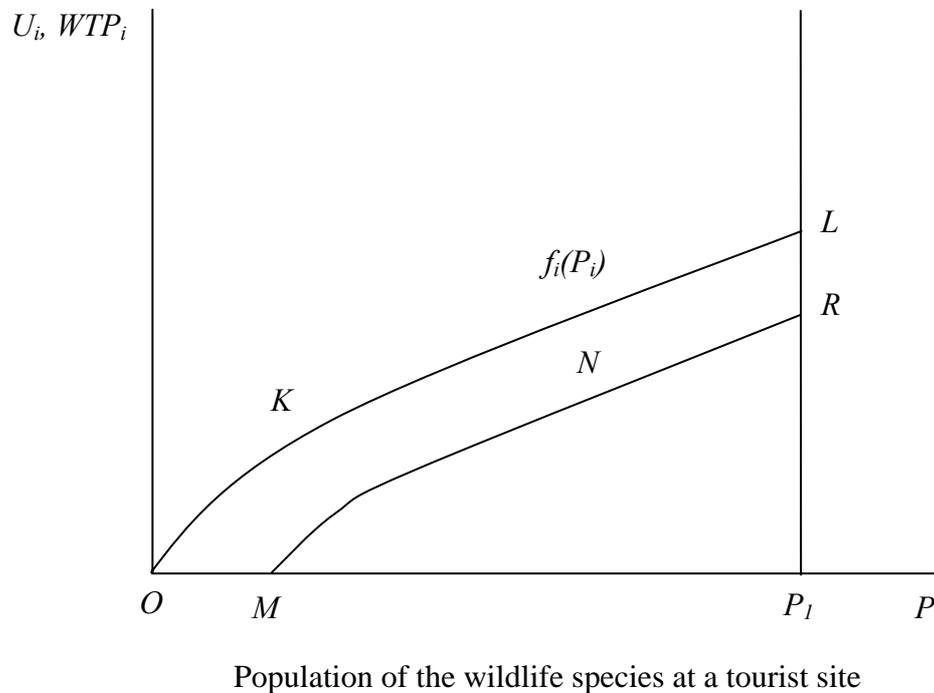


Figure 8: An illustration of how levels of utility obtained by a visitor coming to a tourist site to view a particular species of wildlife may vary with the population density of the species at the site

Other things constant, the population level of the species at the site may be a function of the number of visits to the site. In other words

$$P=g(v) \tag{2}$$

where v represents the number of visits to the site in a given period of time.

Müllner et al. (2004) emphasise cases in which $g' < 0$; that is those where the population density of the target species declines as visitor numbers increase. In practice, it may often be that P is constant up to a threshold of visits, v_0 and then declines as v rises. This may vary, however, from species to species.

Given relationship (2), relationship (1), the utility obtained or WTP of a visitor can be expressed as:

$$U_i = f_i [g(v)] \quad (3)$$

$$= k_i (v), \quad (4)$$

that is as a function of the total number of visits to the site.

Now assume that the objective is to maximise the aggregate utility or willingness of individuals to pay for their visits to the site. This is achieved when:

$$\Sigma_i h_i (v) = H (v) = W \quad (5)$$

is at a maximum. Here $H(v)=W$ represents the aggregate WTP or total utility obtained by visitors to the site. It indicates their economic benefit as a whole. Note that the maximum of W may occur for a number of visitors that significantly reduces the population density of the species at the site.

This can be seen from the hypothetical case shown in Figure 9. In this figure, the population density of the species attracting visitors is measured on the LHS vertical axis and the aggregate WTP or utility of visitors is measured on the RHS vertical axis. The curve ABC represents the population density of the target species as a function of the number of visits to the site. It is compatible with the type of relationship suggested by Müllner et al. (2004). The aggregate WTP for visits as a function of the number of visits is shown by the curve ODEF. The aggregate value of the site for tourist visits occurs at point E that is for v_l visits per unit of time. The resulting population density of the target species is P_0 . There is a reduction in the natural density compared with no visitors of $A-P_0$. This increases rather than reduces the aggregate economic value obtained by visitors to the tourist site.

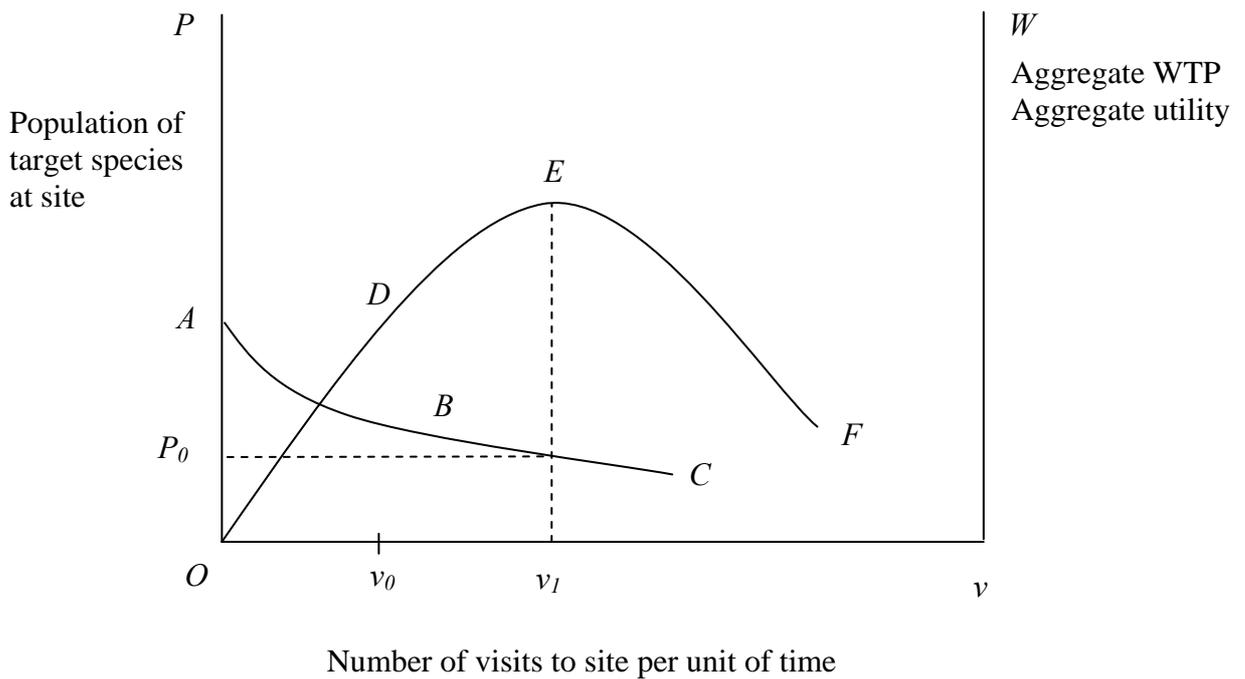


Figure 9: In order to maximise aggregate economic benefits of visitors to a tourist site, it may be necessary to permit a visitor-induced reduction in the population of the wildlife species that draws visitors to the site

Note that maximising aggregate economic benefits of visitors does not eliminate conflicts between visitors. In the case illustrated, each visitor gets less utility as more visitors come to a site. Each visitor will individually benefit if there are fewer other visitors. Observe also that if the demand for visits to the site exceed v_l but visits are restricted to v_l in order to maximise W , then those excluded will be dissatisfied. Furthermore, it should also be borne in mind that some individuals who do not visit a tourist site may feel they have a stake in wildlife conservation at the site and may resent tourist visits that reduce wildlife populations at such sites. The social situation is clearly quite complex.

Changes in Species Composition as a Result of Feeding of Wildlife by Tourists

The possibility also needs to be considered that as a result of tourists feeding wildlife species, the composition of species at or near a tourist site may alter. As pointed out by Orams (2002) the impacts on populations of species as a result of feeding by tourists can be quite varied. If only a particular species is being fed, there seems to be at least three possibilities:

- (1) The food is nutritious for the target species, and food is the limiting factor on its population. Hence, feeding results in an increase in the population of the targeted species. This does not seem to be rare (Boutin, 1990);
- (2) Although the food fed to the wildlife species is nutritious, food availability is not the factor limiting its population. This may, for example, be availability of nesting sites. In the case, feeding does not alter the population level of the species being fed; and
- (3) The food fed to the wildlife species is injurious, reduces the life-span and reproduction of the animals fed. This reduces its population level.

Feeding grain to birds at O'Reilly's seems to favour the population of King Parrots. It may expand their population at the expense of competing species. However, very little scientific information is available about interspecific competition involving the King Parrots.

Nevertheless, because the King Parrots appear to get the lion's share of the food provided by tourists at O'Reilly's, their populations may be favoured. They nest in tree cavities as do other competitors. An increase in the populations of the dominant King Parrots may reduce the population of other species that compete with King Parrots for nesting sites. But in the absence of specific scientific evidence this is speculative. Nevertheless, Newton (1994, p.268) observes "Because several bird species can use the same type of [nest] site, competition is frequent, and the number of dominant species can affect the numbers and distribution of others. In extreme situations, a species may be totally absent from areas where all suitable nest sites are occupied by dominant competitors".

Figure 9 can be used to illustrate potential population composition impacts of feeding of wildlife by tourists. Suppose a simple interspecific competition model of the Lotka-Volterra type (Begon et al. 1996, Ch.7; Gotelli, 1998, Ch.5) involving two species and focus on the stable case where co-existence of those species involves a stable equilibrium. Suppose for example, the *CED* represents the population of King Parrots, P_1 , in a tourist area as a function of the population competing species, P_2 . Conversely, let *AEB* represent the population of the second species as a function of the population of King Parrots. Then the equilibrium populations of both species correspond to point *E*.

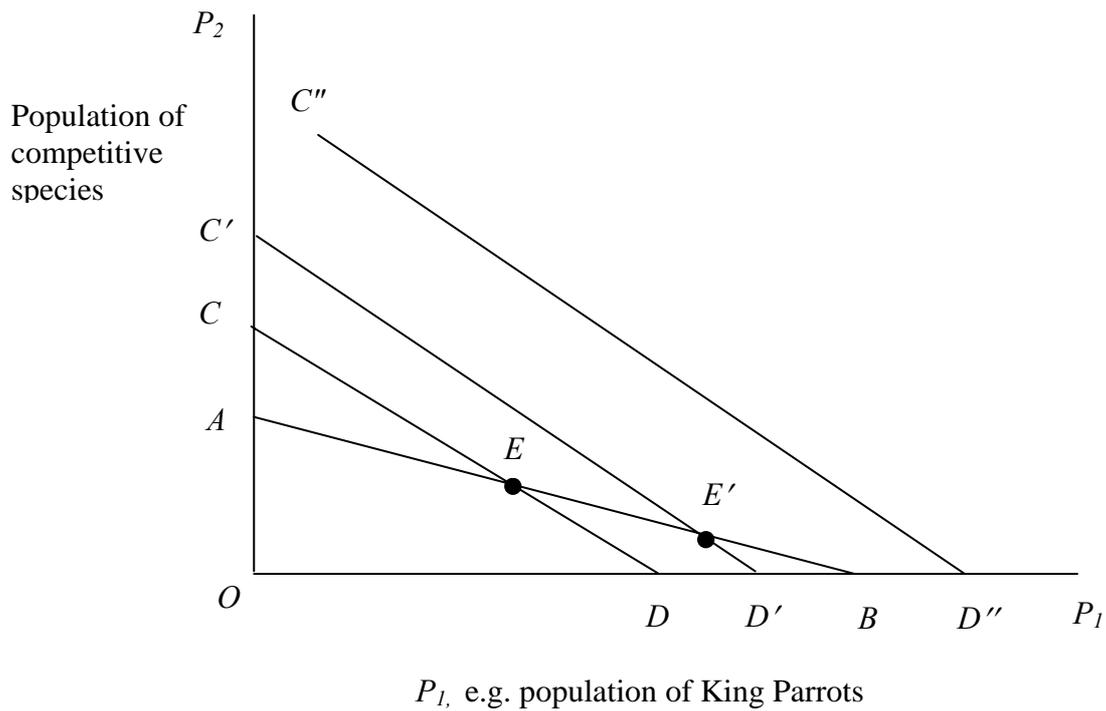


Figure 9: Feeding of birds by tourists favouring one species may lead to a reduction in population or local extinction of competing species

However, the feeding of species P_1 by tourists (and its assumed exclusive ability to benefit from such feeding) may overcome a constraint on its population. As a result, its population curve (zero isocline) can shift upwards. Two possibilities are shown in Figure 9. The zero-isocline for P_1 might move up from CD to $C'D'$. In that case, a new equilibrium is established at E' and the abundance of the second species declines. It is even possible that the isocline shifts up so much that intraspecific competition results in (local) extinction of the second species, as would be so if the isocline moves up to $C''D''$. In such cases, those visitors that like diversity or variety of bird species at a tourist site will be disadvantaged by the ecological impacts of other tourists who benefit from feeding the birds.

However, if the species benefiting from feeding is primarily constrained by nest-site availability (or a similar factor), and feeding does not increase its ability to compete for this limiting factor, its population would remain constant. Feeding then would not alter the composition of the species unless the competing species indirectly benefited. Nevertheless, a 'perverse' possibility exists: the feeding of a species by tourists may reduce its competition with the competing species for wild feed. Hence, the population of the competing species

might rise relative to the species fed by tourists. Feeding has an opposite effect (to that illustrated in Figure 9) on species composition if it only injures the target species fed. In that case, the isocline CD , moves downward, and equilibrium is established for a lower level of P_t .

Note that the unstable case has not been considered but could be taken into account. Furthermore, more complicated types of species interdependence could be allowed for. The main purpose of the illustration, however, is merely to show that feeding of wild animals by tourists can alter species composition or diversity.

While these are very simplified models, they do help to identify some possible sources of human-conflict arising from the ecological consequences of visitor interactions with wildlife at tourist sites.

6. Discussion and Conclusion

The presence of birds is clearly an important attraction for visitors to the Green Mountains/O'Reilly's site in LNP although some of the commonly seen birds are not confined entirely to rainforests. The presence of birds is the second most important feature attracting visitors to this site and is only surpassed by the rainforest as an attraction. On average, birds rank as quite an important attraction having a weighted average of 1.74 which is well in excess of the figure which would just result in their being ranked as important.

The importance of birds as an attraction at this site is underscored by a further result. Respondents were asked if there were no birds at this site, would they still visit it. If they answered 'Yes', they were asked whether they would reduce the frequency of their visits and if so, by what percentage.

Sixteen per cent of respondents said they would not visit the site if birds were absent and 27 per cent said they would still visit but reduce the frequency of their visits. Thus there would be a reduction or cessation of visits by 43 per cent of respondents if birds were absent.

Hearing birds in the rainforest proved to be the most important attribute of birds mentioned by visitors followed by diversity of birds at this site. Seeing lots of birds was ranked third.

The average weighted importance of seeing brightly coloured birds and physical contact with birds came lowest in the scale. However, they were very important for some visitors.

In fact the evidence suggests that there are basically two groups of visitors. One rates physical contact with birds and brightly coloured birds as important, the other rates diversity of birds as important as well as hearing birds, seeing lots of birds and rare birds. The two groups only partially overlap. Factors have been identified such as the level of the respondents' education, gender, and so on that help to differentiate between those groups. To some extent, the values of those groups are in conflict. Those belonging to the last mentioned group are generally opposed to the feeding of native birds whereas those in the first group enjoy feeding these birds and having physical contact with them. There seems to be no easy way to resolve their conflict.

This paper identified some of the ecological processes arising from tourist/recreational interactions with birds that intensify conflict between tourists/recreationists who value different attributes of birds. These include negative impacts of tourists on population levels of species that attract them to tourist sites, and changes in the composition and diversity of species at a tourist site as a result of visitor interactions with birds.

Both groups find birds to be an important attraction and support conservation of birds for different reasons. If those who feed birds because they like to have contact with them were denied this opportunity, the public's net support for bird conservation could decline. Public policy does, in any case, have to take account of the heterogeneity of the interests in birdlife of tourists/recreationists.

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