CONTRASTS IN DIET AMONGST BARBARY MACAQUES ON GIBRALTAR: HUMAN INFLUENCES

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*A four-month study was conducted on three groups of free-ranging, provisioned Barbary macaques (*Macaca sylvanus, *L) on Gibraltar in 1992. The groups exhibited marked contrasts in the levels of provisioned, tourist-derived and natural foods in their diet, which related to differences experienced in the level and nature of human visitation.*

Feeding on natural plant items accounted for only 17–20 per cent of feeding records at all sites, whereas provisioned food was the dominant element (over 75% of records) at the least visited group. In contrast 51.7 per cent of items consumed at the site most used by tourists (Apes' Den) involved tourist-derived foods, with provisioned food contributing only 28 per cent of feeding records. The high caloric content of tourist-derived foods together with their dominance in the diet at Apes' Den is implicated in the well-documented weight-related problems affecting this group.

Current levels of uncontrolled tourist feeding present a health and welfare threat to the Barbary macaques of Gibraltar, particularly the Apes' Den group. Future management plans must recognize and seek to remedy the negative impacts of tourism.

Keywords: *animal welfare, Barbary macaque, human-impact, provisioning, tourists*

Introduction

A population of Barbary macaques (*Macaca sylvanus* L.) has existed on Gibraltar probably since Arab or Spanish conquests, but attested by definite recorded introductions from North Africa since 1740. The Gibraltarian monkeys have received food from the human population over most of this period. A full history of the development of provisioning is given by Fa (1991), noting the progression from casual feeding with scraps to a more planned, officially provided diet which now meets or exceeds estimated caloric needs. Since the 1950s, the trend in feeding monkeys calorie-rich and/or cariogenic foods (sweets, pasta, biscuits etc) at tourist sites, to encourage these well-habituated animals to approach tourists, has accelerated. Visitor numbers at tourist sites have also risen dramatically since the re-opening of the land border with Spain in 1985 (Fa 1992). In 1979/80 there were an estimated 15 people per hour visiting Queen's Gate, while point counts of 135 visitors on site at peak times were recorded by 1991 (Fa 1991; O'Leary 1991; O'Leary & Fa 1993).

Earlier, comparative studies of the ecology of macaques living in the touristed area of Queen's Gate (Apes' Den) and those of groups based on military land at Middle Hill, where

tourists have been denied access since 1972, revealed significant differences in their behaviour and demography. These differences have been related to the degree of tourist exposure (Fa 1984a, 1988). It was also suggested that tourism at Queen's Gate was having adverse effects on the health and reproduction of the population (Carver 1987; Fa 1984a, b; 1988, 1991). However, the impact that the large increase in tourist visitation since 1985 might have had on the ecology and feeding behaviour of the macaques had not been examined. A study addressing these issues was commenced in 1992, from which new data on comparative activity budgets and diet composition were obtained (O'Leary & Sharples in preparation). This paper describes the results of the comparison of diets amongst three groups of macaques on Gibraltar experiencing different levels of tourism.

The study groups

Throughout this paper the following abbreviations for group names are used: Apes' Den (AD), Royal Anglians' Way (RAW) and Lower Middle Hill (MH). The name 'Queen's Gate', which in earlier studies referred to the single group then based at Apes' Den (but with a home range including portions of present day Royal Anglians' Way) can be taken as synonymous with the present day Apes' Den group. Details of the groups are summarized below. All figures exclude infants born in 1992.

Lower Middle Hill (MH): 31 animals inhabiting military land on the Upper Rock. They experience low levels of human contact (ie only the ape-keeper and RAF personnel) since tourist access is prohibited.

Royal Anglians' Way (RAW): 11 animals which formed a separate group by fission from the Apes' Den group in May 1991. They experience variable levels of tourist contact, depending on location in their home range. By ascending to areas along Queen's Road, the main access road to Apes' Den, (amounting to 3% of the total RAW home range area) animals can meet tourists and vehicles, and interact at appreciable levels (O'Leary & Sharples in preparation). However, on RAW itself interaction levels are negligible with mean point counts of 0–1.16 visitors per hour (O'Leary & Sharples in preparation).

Apes' Den (AD): the main tourist group of 19 animals with mean 1992 point counts ranging from 2.65–53.3 visitors per hour (O'Leary & Sharples in preparation). In 1991, up to 200 people were counted on site at peak times (O'Leary & Fa 1993).

All three groups inhabit maquis habitat (scrub of *Olea-Ceratonia-Pistacia* vegetation) on the Upper Rock. This habitat also contains various artificial elements such as buildings, concrete terraces and roads, walls, fences and (at Middle Hill) radio aerials and masts. The variation in human visitor numbers is the principal element of difference in the physical environment of the groups. Detailed site descriptions are given in Fa (1986) and O'Leary and Fa (1993).

All groups were provisioned by the ape-keeper on a daily basis with food delivered between 0800 and 1200h to regular 'provisioning areas' covering a few square metres within each group's home range. A breakdown of identifiable provisioned items consumed by the macaques is given in Table 1. By 1992 the proportion (by fresh weight) of peanuts/sunflower seeds in provisioned foods had fallen to approximately 30 per cent, with the remainder consisting of fruit and vegetables (E Asquez personal communication 1992; M Zammit

personal communication 1992). At the two sites which were accessible to tourists, as visitor numbers rose to midday and early afternoon peaks (O'Leary & Fa 1993; O'Leary & Sharples in preparation), additional foods were made available to monkeys from tourists (Table 1).

Methods

Scan samples, (Altmann 1974) based on methodology described in O'Leary and Fa (1993), were employed during the study period, June–October 1992. A total of 36 days of scan samples were conducted (AD, n = 13 days; RAW, n = 13 days; and MH, n = 10 days). Walk-through scans, recording the behaviour of all visible animals in a group, each lasting 2–4 minutes were conducted every 20 minutes, 0800–1800h on selected sample days. Observations were scheduled so that unbiased coverage of hours of the day, days of the week and months of the study period were obtained.

'Feeding' activity was defined as direct and unaided consumption of any food item by a monkey during a scan. Following O'Leary and Fa (1993), being fed from the hand of a human was classified separately as 'interaction feeding'. Data from both feeding and interaction feeding were included in the main analyses.

When feeding or interaction feeding was observed, the food item consumed by the animal was identified where possible and assigned to one of five exclusive classes according to its origin and/or nature: *provisioned food* included all items supplied by the ape-keeper; *tourist-derived food* was supplied by visitors or tour-guides. By definition, all interaction feeding involved tourist-derived food. Some overlap between these two classes existed with respect to certain food items (see Table 1). However, the important distinction between the classes is that whilst the level and nature of provisioned food reaching the macaques can be regulated by the ape-keeper, there is no such control over tourist-derived foods.

Natural plant food was defined as material which grew wild on the Upper Rock and thus did not include fruit and vegetables provided by tourists or in provisions; *drink* included all fluids; and *other/unseen* included all other items and those that were unidentified.

Items of tourist-derived food were further classified as 'suitable' or 'unsuitable'. Unsuitable foods were those regarded as unhealthy because they were cariogenic or carbohydrate-rich (increasing obesity and, as in humans, the risks of heart disease, diabetes and arthritis). They were mainly of anthropogenic origin and included sweets, chocolate, candied popcorn, crisps, crackers, bread, ice creams, pasta, cakes, sweet biscuits and carbonated soft drinks (O'Leary 1991; Table 1).

Suitable foods included all fruit and vegetables, all natural plant materials and pure water. All nuts and sunflower seeds were considered suitable because they are of natural origin (and correspond to some extent to the seeds of *Pinus spp* and fruits of *Quercus spp* reported in the diets of wild Barbary macaques by Drucker (1984)). Also, their carbohydrate content was significantly lower than that of most unsuitable items (Table 2). Since efforts were made throughout 1991 to encourage tourists to feed low calorie savoury popcorn to the monkeys in place of sweets and pasta (J Fa personal communication 1991), this was also classified as a 'suitable' food. Unsuitable foods are marked with an asterix in Table 1.

Table 1 Individual food types recorded in feeding activity.

Food	Provisioned food[1]		Tourist-derived food and[2] interaction feeding	
	Number of observations n = 1253	Per cent	Number of observations n = 435	Per cent
peanuts	139	11.09	137	31.49
sunflower seeds	409	32.64	34	7.82
bananas	28	2.20	48	11.03
potatoes/sweet potatoes	83	6.60	10	2.30
other nuts			28	6.44
* *pasta*	2	0.16	40	9.20
* *sweets*			28	6.44
* *bread*	41	3.30	14	3.22
* *biscuits*	8	0.64	24	5.52
* *cakes*			3	0.69
popcorn			12	2.80
* *dried fruit*			2	0.46
oranges	99	7.90	6	1.40
plums	42	3.35	3	0.69
pears	36	2.90	3	0.69
melons	19	1.52	1	0.23
apples	19	1.52	21	4.83
apricots	3	0.24	2	0.46
peaches	2	0.16	1	0.23
grapes	2	0.16	6	1.40
cherries	2	0.16	3	0.69
lettuces	90	7.18	1	0.23
cucumbers	50	3.99	4	0.92
carrots	44	3.50	1	0.23
cabbages	32	2.55		
celery	18	1.40	2	0.46
tomatoes	30	2.39		
peppers	16	1.28		
green beans	15	1.20		
aubergines	9	0.72		
spring onions	6	0.48		
pumpkins	5	0.40		
leeks	3	0.24		
radishes	1	0.08		

[1] Data from AD, RAW and MH
[2] Data from AD and RAW only
* Unsuitable food

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Table 2 **Nutritional values of selected items recorded in feeding activity. All values for energy and carbohydrate content are per 100g fresh weight unless stated otherwise and as cited in: Considine and Considine (1982); Souci *et al* (1987); Holland *et al* (1991a, b, 1992).**

Food type	Energy (kcal $100g^{-1}$)	Carbohydrate (g $100g^{-1}$)
Tourist-derived foods		
unshelled peanuts	564	12.5
bananas (whole)	95	23.2
sunflower seeds	581	18.6
'Smarties/M&Ms'	456	73.9
chocolate	529	59.4
dry pasta	378	75.8
popcorn	592	48.6
bread	235	49.3
salted nuts (cashews)	611	18.8
potatoes/sweet potatoes	70–87	16.1–21.3
plums	34	8.3
Provisioned food		
sunflower seeds	581	18.6
unshelled peanuts	564	12.5
potatoes/sweet potatoes	70–87	16.1–21.3
pears	36	9.1
watermelon	31	7.1
plums	34	8.3
lettuce	14	1.7
carrots	30–35	6–7.9
spring greens	25	1.6
Natural plant foods		
raw green olives[1]	116	1.3
rosemary leaves[1]	99	13.5
dandelion leaf & stem[1]	45	9.2
raw figs[1]	43	9.5
chives	23	1.7
parsley leaf & stem	17	2.7
natural vegetation on Gibraltar[2]	4	

[1] These items were recorded in the natural plant diet of Gibraltarian macaques by Fa (1986).

[2] A value of 4kcal g^{-1} dry weight for the energetic value of natural vegetation consumed by *M. sylvanus* on Gibraltar is cited by Fa (1986) based on values cited by Golley (1961) and Iwamoto (1974).

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Results

Diet composition

Diet composition differences between groups were tested by partitioning a chi-square contingency table of recorded food types by group (Table 3). The differences were highly significant (chi-square = 728.67, $df = 8$, $P < 0.001$). The partitioned chi-square was then compared with individual cell standardized residuals (Siegel & Castellan 1988) to identify the main contributors to the overall chi-square.

Table 3 **Comparison of diet between groups.**

a) Food items recorded during feeding activity in scans, individual cells show the raw data (top left), the percentage contribution of each food type to each group's diet (in brackets) and the cell standardized residuals (lower right). The residual critical values were: 1.96 ($P < 0.05$); 2.58 ($P < 0.01$); and 3.29 ($P < 0.001$).

	Natural plants	Provisioned	Tourist-derived†	Drink	Other/ unseen	Total
Apes' Den	111 (17.3) -1.07	179 (28.0) ***-7.61	331 (51.7) *** 19.54	15 (2.3) 0.03	4 (0.6) 0.61	640
Royal Anglians' Way	108 (19.6) 0.24	307 (55.8) -0.63	121 (22.0) 1.46	13 (2.4) 0.06	1 (0.2) -1.18	550
Middle Hill	243 (20.0) 0.80	925 (76.1) ***7.26	13 (1.1) ***-18.50	28 (2.3) -0.08	7 (0.6) 0.73	1216
Total	462	1411	263	56	12	2406

† Includes interaction feeding

b) Partitioning of the chi-squared values in Table a (Siegel & Castelan 1988) ns – not significant; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Partition	Groups	Food type	Chi-squared (1 *df*)
1	AD vs RAW	NP vs P	5.407 *
2	AD/RAW vs MH	NP vs P	23.382 ***
3	AD vs RAW	NP/P vs T	169.693 ***
4	AD/RAW vs MH	NP/P vs T	528.721 ***
5	AD vs RAW	NP/P/T vs DR	0.000 ns
6	AD/RAW vs MH	NP/P/T vs DR	0.006 ns
7	AD vs RAW	NP/P/T/DR vs O	1.171 ns
8	AD/RAW vs MH	NP/P/T/DR vs O	0.293 ns
			Total (8 *df*) = 728.673 ***

NP – natural plants
P – provisioned
T – tourist-derived
DR – drink
O – other/unseen

The cell standardized residuals show that four cells were responsible for the deviation from expected values. Tourist-derived and provisioned foods had significant residuals at AD and MH. Provisioned food use decreased with increasing tourism whilst tourist-derived food use increased (Table 3). Natural plant foods contributed 17–20 per cent of the records at all sites – although the residuals reveal a non-significant tendency for natural plant feeding to be slightly lower than expected at AD.

Partition 1 was significant. The highly significant negative value of the cell standardized residual for provisioned foods at AD emphasizes their much lower contribution to diets at AD versus RAW (28% versus 55.8%).

Partition 2, together with the highly significant positive residual for provisioned food at MH, indicates that provisioned food makes a significantly higher contribution to MH diets than at the more visited sites.

Partition 3 indicates a significant dietary difference between AD and RAW, which the residuals confirm lies mainly in the proportion of tourist-derived food to provisioned food, since the contribution of natural plant food to both groups is similar. At AD provisioned and natural plant foods account for 45.3 per cent of the diet, with food from tourists comprising the majority of remaining contributions. At RAW the provisioned and natural plant contributions exceed 75 per cent. The residuals indicate that AD consumes significantly more tourist-derived food and significantly less provisioned food than expected.

Partition 4 separates MH from AD and RAW. With natural plant foods making similar contributions to diets at all sites, the significant cell standardized residuals indicate that the main difference lies in the proportions of provisioned and tourist-derived foods. At MH the 76.1 per cent contribution of provisioned foods is significantly higher than expected and that of tourist-derived food significantly lower.

None of the remaining partitions were significant, indicating a similar level of drinking between groups and the negligible effect of unidentified food items on overall results.

Suitable and unsuitable foods

Table 1 breaks down the range of provisioned and tourist-derived foods observed during the study and indicates the frequency of occurrence of individual items. As feeding on tourist-derived food was unusual at MH, this small sample was excluded from the comparisons. Peanuts and sunflower seeds dominated in both sets of records but the tourist-derived diet was less diverse in terms of fruit and vegetable consumption. Whilst 4 per cent of provisioned food (51/1253 records) was unsuitable, the corresponding figure for tourist-derived food was 25.8 per cent (112/435 records).

At AD, 72.6 per cent of all identifiable items (231/318 items) were classed as suitable and 78.6 per cent at RAW (92/117 items). The difference between RAW and AD was not significant (chi-square = 1.29,1 *df*, $P > 0.05$). A further analysis of records at AD and RAW contrasted the proportions of suitable and unsuitable tourist-derived foods observed in feeding and interaction feeding.

An analysis of identifiable items recorded only during interaction feeding – ie excluding feeding activity – showed that 71.1 per cent of these items were suitable at AD (111/156 items) and 72.2 per cent at RAW (26/36 items). The difference was not significant (chi-square = 6.05×10^{-3}, 1 *df*, $P > 0.05$). Suitable items recorded during feeding activity – ie

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excluding interaction feeding – comprised 74.1 per cent of all items at AD (120/162 items) and 81.5 per cent at RAW (66/81 items). The difference was not significant (chi-square = 1.26, 1 *df*, $P > 0.05$).

Discussion

All Gibraltarian macaques rely on food of human origin for the bulk of their nutritional intake (about 78% of all food items are provisioned or tourist-derived, Table 3). However, there is a negative correlation between tourist pressure and the contribution of provisioned foods and a positive one with the contribution of tourist-derived foods. Differences in the nutritional quality of these food sources (Table 2), given their unequal representation in the diets of the study groups (Table 1), have important implications for the groups.

Table 2 indicates the contrast in energetic values and carbohydrate content for selected items commonly consumed by the macaques. As energetic values for tourist-derived and provisioned items were cited in the literature in terms of fresh weight, direct comparisons with known energy values per dry weight of natural vegetation were not possible. Consequently, fresh weight nutritional values for culinary plants were chosen to provide a comparable indication of the caloric and carbohydrate content of natural materials regularly consumed by the macaques. Olives (*Olea europaea*), rosemary leaves (*Rosmarinus officinalis*), dandelion plants (*Taraxacum officinale*) and figs (*Ficus carica*) have all been observed in natural plant feeding by macaques on Gibraltar (Fa 1986). Values for chives and parsley are listed as representative of the *Liliaceae* and *Umbelliferae* that Fa (1986) reported in their diets.

Most natural plants, provisioned fruit and vegetables have significantly lower caloric values (per fresh weight) than tourist-derived items though there is some overlap between values for the different classes (Fa 1991; Table 2). When the carbohydrate content of these foods are considered, the nutritional differences between food classes are further accentuated.

From Tables 1 and 2 it is apparent that even with peanuts and sunflower seeds accounting for over 40 per cent of the records of provisioned feeding (and constituting up to one-third by weight of supplied provisions), the current provisioned diet provided to the monkeys is otherwise dominated by fresh fruits and vegetables and offers an average caloric and carbohydrate intake per unit (fresh) weight well below that provided by tourist-derived items. Similarly, average energetic intake per unit fresh weight from natural plants and average ingested weight per unit feeding time was reported to be orders of magnitude lower than that for provisioned food (Fa 1988, 1991).

Amongst wild rhesus macaques (*Macaca mulatta*) recently in contact with humans, a preference for starchy human foods over natural vegetation has been recorded (Malik & Southwick 1988). The Gibraltarian macaques show a similar preference for provisioned foods which offer the macaques higher caloric gain per unit feeding time than natural plants (Iwamoto 1974; Fa 1986; Forthman-Quick & Demment 1988). With an estimated mean caloric requirement for a wild Barbary macaque of 500kcal per animal per day (Drucker 1984), the Gibraltarian monkeys at all sites can now easily meet or exceed these energetic requirements from provisioned foods alone. Indeed this has been the case since 1979/80 (Fa 1991).

A preference for tourist-derived foods would be expected even when provisioned items are abundant, if tourist-derived foods offered higher energy gains per unit time. On Gibraltar since tourists prepare and bring food to the monkeys, this greatly reduces the search/handling costs for tourist-derived foods relative to other food classes (O'Leary & Fa 1993). The AD macaques in particular use mainly passive tactics to obtain tourist-derived foods since, with heavy tourism, if they merely sit and wait on site, food will be offered to them or even placed in their mouths (Fa 1992; UFAW 1994).

Preference for tourist-derived foods may be further exaggerated if many unsuitable tourist-food items act as addictive, extranormal stimulants to the Gibraltarian macaques, as suggested by Fa (1988, 1991). At all three sites a very clear preference for calorie/sugar-rich tourist-derived food items was apparent: monkeys at AD often ignored offers of vegetables and fruit if sweets, pasta or bananas were sighted (O'Leary, unpublished data); RAW monkeys spend most time at Queen's Road (where tourist-derived feeding occurs) after provisioning (O'Leary & Sharples in preparation), when there can be little energetic motivation for seeking tourist-derived food.

Adult monkeys at AD are noticeably overweight in comparison with wild macaques, those in the naturalistic enclosures of the de Turckheim parks and even those at Middle Hill (Fa 1984a, 1988; O'Leary 1993; UFAW 1994). RAW juveniles appear less heavy than age-mates at AD but adults (who matured at AD) are similarly built in both groups. These differences could be explained if there was a reduction in activity levels at AD, typical of groups reliant on high levels of tourist-derived food and/or by the increased caloric intake in such groups due to the high mean energy values of tourist foods.

Overall time spent moving is similar in all three groups, constituting 7–8 per cent of daily budgets (O'Leary & Sharples in preparation). With similar terrain at all sites, overall energetic costs of activity will therefore be similar and can be excluded as a factor influencing the observed physical differences between groups. However, the singular prominence of tourist-derived food in AD diets clearly implicates this as the main factor influencing the observed differences. Similar weight increases have been reported in olive baboons (*Papio anubis*) consuming starchy, highly digestible human crops and foods in Kenya (Forthman-Quick & Demment 1988).

The more limited access to visitors, coupled with increased energetic demands of locating them on Queen's Road and the uncertainty of securing tourist-derived food on any one ascent to Queen's Road, will decrease the level and energetic benefits of tourist-derived feeding for RAW monkeys. The substantial reduction in tourist-derived food in macaque diets at MH appears to be an important factor in limiting weight gain. Therefore if the RAW juveniles continue to experience relatively low levels of tourism and tourist-derived foods their physical development should resemble MH, rather than AD monkeys. If this proves to be the case, arguments for increased control of tourist feeding at tourist sites will be greatly enhanced.

At all three sites, recorded levels of natural plant feeding were too low to make any significant caloric contribution to daily energy budgets, in contrast to the contributions made by provisioned and tourist-derived items. Natural plant feeding might take place as a displacement behaviour because of boredom or curiosity, filling in time before the arrival of provisioned foods early–mid morning. Alternatively, because carbohydrate-rich foods and anthropogenic foods, such as those consumed by Gibraltar's macaques, have relatively low

protein and fibre contents compared to natural vegetation, complementary protein intake (from natural plants) may be required to compensate for these deficiencies and for the potentially higher faecal nitrogen losses of such diets (Fa 1986; Forthman-Quick & Demment 1988). The similar level of natural plants in all groups' diets lends support to this interpretation.

Food suitability

In comparison with 1979/1980 estimates which reported 39 per cent unsuitable food in interaction feeding (Fa 1988), the present study indicates a reduction in levels of unsuitable feeding over the last decade to 27.8 per cent. Nonetheless, the increased food volume and high energy values of all unsuitable, and some suitable, tourist-derived items (such as nuts) still pose serious dietary and health problems at the more visited sites.

Though there were no significant differences between RAW and AD in proportions of unsuitable to suitable tourist-derived foods ingested, a minority of taxi/coach drivers and tourists at AD persist in offering unsuitable but desirable foods (particularly sweets and pasta) to lure monkeys close for photo opportunities. The monkeys are also adept at grabbing such items from unsuspecting visitors (O'Leary & Fa 1993). The non-significant trend for recording higher levels of unsuitable food of tourist origin in feeding at AD (27.4%) versus RAW (21.4%), may indicate a greater opportunity at the more visited site for obtaining unsuitable foods.

Conclusion

From the present study it is clear that the composition and nutritional value of dietary intake amongst Gibraltar's macaques is affected by the intensity of tourism at different groups. Despite ample provisioning the macaques show a preference for tourist-derived foods, when these are readily available. This appears to exert tangible, negative physical effects on exposed groups such as Apes' Den (and to a lesser extent, Royal Anglians' Way). A reduction in reproductive performance, life expectancy and general health in the main tourist groups which has been linked to this obesity, is documented in the literature (see Introduction and Animal welfare implications).

Animal welfare implications

This study strongly implicates the virtually unregulated tourist feeding at Apes' Den as a major factor in the obesity of adult monkeys in this group. This obesity has been linked in the past to a range of weight-related health problems (particularly heart disease), reduced life expectancy and to the reduction in birth rates at Apes' Den (Carver 1987; Fa 1984a, 1988, 1991; Fa & Lind 1996). Despite knowledge of these problems, on-site supervision of tourist activity carried out by Medambios was actually curtailed in 1992 by the new management and has yet to be satisfactorily reinstated (O'Leary 1993).

Reducing the volume of tourist-derived food reaching the AD monkeys must be a management priority if the long-term health and welfare of the entire Gibraltarian macaque population and its gene pool are to be safeguarded. Calculated extinction probabilities for the 'Queens Gate' group are already dangerously high (Fa & Lind 1996). With over half the food currently consumed at AD originating from tourists, and thus beyond the control of the authorities in terms of suitability and composition, no realistic effort to improve the

macaques' health/diet is possible until more stringent measures than those currently in force are enacted to control and limit visitor feeding.

Whilst MH macaques, on military land, remain relatively unaffected by tourists, and enjoy the highest birth rates of all groups on Gibraltar (Fa 1986), they represent only part of the gene pool of this semi-wild colony. In an economy to which defence makes a decreasing contribution, it is impossible to guarantee their continued isolation. It is critical that the reality and implications of tourism for all the Gibraltarian macaques are fully appreciated and ways sought to minimalize its adverse impacts - both now, and for the future.

The low level tourism associated with the natural development of the Royal Anglians' Way group since May 1991 is not dissimilar to proposals made at the 1982 *International Conference for the Conservation of the Barbary Macaque*, advocating a controlled reserve style 'Monkey Park' on RAW (Fa 1984b, 1987). Although caution and strict control of any further development of RAW as a tourist attraction would be required, the 1992 situation there might point the way to a working compromise between the interests of conservation and tourism on Gibraltar.

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