Please email tom.geraghty@yahoo.co.uk for more information.

THE NOTTINGHAM TRENT UNIVERSITY

AN EXAMINATION OF THE PHYSICAL AND SOCIAL ASPECTS OF MOUNTAIN BIKING AT BESTWOOD PARK.

By

TOM GERAGHTY

Dissertation submitted in partial fulfilment of the requirements for B.Sc. (Honours) Combined Studies in Sciences.

2000

Abstract

This study investigated the physical impacts social issues and conflicts which arise due to mountain biking in the countryside. The study concentrated on the situation at Bestwood Park in Nottinghamshire.

It was found that, at Bestwood Park, the impact of horses on the trails is great and that the impacts due to mountain bikes are largely the result of trail selection and the actions of a minority of irresponsible riders. The impacts of mountain biking differ greatly from other uses. Although some assumptions about mountain bikers are true, such as the fact that they generally consist of young males, it is not true for example that they care for the environment any less than other users.

It was also found that different users prefer and appreciate different settings and environments to other users. Horse riders for example appear to prefer wider, straighter, and more open trails than other users, while mountain bikers prefer narrow, frequently turning trails. Hikers appear to prefer a wider variety of trails than others, and it was also found that hikers are generally a more varied group in terms of age, sex, education and opinion.

It was determined that the trails at Bestwood park are very often not appropriate for the type of user for which they are designated. While the landscape has been altered significantly to cope with changes in agriculture, forestry and the accommodation of an increasing population, we have continued to attempt to squeeze leisure onto a limited number of trails and parks that have been in use for many years. Mountain biking is a relative newcomer to the countryside and most areas are not at present designed or properly able to accommodate it.

Acknowledgements

I would like to thank everyone who completed a questionnaire, including all members of The Nottingham Trent University Cycling Club, and Hiking Club, and of course the riders who rode up and down the hill thirty times. I also wish to thank Dr Chris Terrell-Nield for supervising and proof reading, Ruth Blunt for asking horse riders to complete questionnaires (even when the horses go bolting down the trail), and of course Paul Finn for his great help and patience.

Contents

List of figures

List of Tables

List of plates

List of maps

1. Introduction.

1. Aims and subject targets.

Outdoor and countryside recreation has, in recent times, increased greatly in popularity. One of the major increases in use has been that of the off-road cycle – or "mountain bike" as it is called in this study. The mountain bike phenomenon is believed to have originated in the late 1970s in Marin County in California. Since then, mountain bikes have evolved into lightweight, high-tech machines with up to 27 gears and highly effective brakes.

This study addressed the issues arising from conflicts between mountain bikers and other users, their views on preferred trail type, and also the erosional impacts of mountain bike use. This information was used to develop part of a management plan to deal with the ever-increasing use of mountain bikes in Bestwood Park. The study also applies of course to many other areas where mountain bikes may be considered an issue. Three questions were considered in the study:

- **What are the comparative physical and environmental effects of mountain biking? (at Bestwood)**
- **What social aspects and conflict issues arise from mountain biking?**
- **What types of trail and environment settings do mountain bikers prefer compared to other users?**

This information can then be used to design new trails, and alter and maintain existing trails for all users, including mountain bikers. Other strategies such as signing, education, use of area related restrictions, or restricting the use of mountain bikes to times of the year when they are least damaging can be employed as management practises. Barriers, one-way systems, speed limits, patrols, route separation, or even closure of trails could be considered.

The erosional study concentrated on the areas within the Park that are heavily used by cyclists, such as the play areas and certain trails, and the downhill course in the Crimea plantation to serve as a comparison of a designed and maintained trail as opposed to a trail that has evolved over time and is not actively managed. The impact of more general or leisure cyclists was considered to be a similar process that occurs to a lesser degree. The impact of horse riders and walkers was investigated in approximately the same way for comparison.

1. Mountain biking and the countryside – physical impacts.

One of the Park Manager's biggest environmental problems may be soil erosion. Since it takes anywhere from 50 to 100 years to build 2.5cm of topsoil, this vital resource must not be wasted. While all soils erode, some erode more rapidly than others due to factors such as vegetation, soil type, precipitation, topography, wind, and animal and human impacts. (Sharpe *et al*, 1983)

Because the mountain bike is such a relative newcomer to the countryside, few scientific studies have been conducted on the impacts and conflicts caused due to its use. However, there is much discussion and heated debate about the environmental impacts of mountain biking and mountain bikers. There are a vast number of web sites devoted to the apparent impacts of mountain bikers, though much of it is subjective and anecdotal. The best known study of the erosional effects of mountain biking is that by Wilson and Seney (1994). They studied the erosional impact of these different users in terms of water run-off and sediment yield. The study indicated that wheels (motorcycles and mountain bikes) made less sediment available than the hooves and feet of horses and hikers, and that this effect was more pronounced on pre-wetted trails. The study also indicated that wheels made more sediment available when going uphill than when going downhill, and that this was probably due to the rolling nature of wheels on downslopes as opposed to the high torque applied when driving a cycle uphill. Hooves and feet made a more pronounced effect on downslopes than upslopes, probably due to the "braking" effect that is apparent when attempting to walk downhill. This confirmed studies by Weaver and Dale (1978) and Weaver *et al* (1979). These studies also showed that soil properties such as soil texture, structure, and moisture content determine the resistance to erosion.

Erosion generally occurs through water runoff, which can be affected in a number of ways. Trail damage can also occur by vegetation trampling and widening of trails. Cessford (1995) suggested four types of impact problems on trails:

- **Excessive erosion from enhanced water flows and disturbed soil surfaces on sloping sections of track, or at drainage points across the track.**
- **Muddy stretches in water-saturated sections of tracks, often including major soil structure disruption and widening of tracks.**

- **Development of multiple parallel tracks where the main track is harder to traverse than the adjacent surfaces.**
- **Development of informal tracks, including shortcuts on corners and switchbacks, and around focal sites such as huts, campsites and attractions.**

While a mountain bike plus rider will have a higher mass than a hiker, the "mean ground contact pressure" (the pressure exerted by the wheel – wheel load divided by contact area) is likely to be roughly equal. (Soane *et al,* 1981) It is likely that mountain bikes still have a higher environmental impact when travelling downhill due to high speed combined with poor braking and control of the bike. Trail design obviously plays an important part in determining the speed of a cycle, amount of braking, and degree of cornering. (Keller, 1990) Land managers (and countryside users) often point out that mountain bikes can gouge ruts in trails, which can rapidly lead to erosion and further trail damage. (Cessford, 1995)

Ruff and Madison (1994) proposed three categories for erosional impact on footpaths:

- **Physical – scarring of the landscape;**
- **Ecological – deterioration of flora and fauna;**
- **Perceptual – a change in the personal experience of the user.**

Erosion needs to be avoided for a number of reasons; any deterioration in the condition of the trail can inhibit subsequent use of the trail, especially for users that are less able than others. Widening of the trail causes possibly valuable habitat to be damaged or destroyed, and at the very least can be undesirable from an aesthetic point of view. Deepening of the trail again inhibits certain users. The simple compaction of the trail substrate can damage the roots of nearby trees.

1.3 Mountain biking and the countryside – social impacts.

There was, and still is, much debate about the conflicts arising from the use of mountain bikes in the countryside, an area which until recently was the sole preserve of walkers and horse riders. Most mountain bikers will comment on the conflicts that they have encountered themselves, while many walkers and horse riders also comment on the conflict felt between them and the increasing number of mountain bikers in the countryside. There is evidence that conflict between users at Bestwood park is increasing, and the management team have received complaints of "speeding" mountain bikers, and frequent "near-miss" incidents.

Horn (1994) found that as a group, walkers disliked meeting mountain bikers on "tramping" tracks. Adelman *et al* (1982) also witnessed that conflict between canoeists and motorboat users was usually only felt by the canoeists alone. In fact, the canoeists usually smiled and greeted the motorboaters, reinforcing the motorboaters' beliefs that

no conflict existed between them. Horn (1994) also showed that mountain bikers often feel the same way about motorised vehicles as walkers feel about mountain bikes or bikers. This seemed to confirm studies by Devall and Harry (1981) who suggested a "hierarchy of technology" where users of one form of technology are apprehensive of or dislike "higher" or more advanced forms of technology. This would mean that walkers dislike (to some degree) cycling, and cyclists dislike (for example) ORVs (Off-Road motor Vehicles). Horse riders may not quite fit into this definition of technology, but there is evidently some conflict involving horse riders and horse riding. 75% of walker respondents in Horn (1994) cited damage as the most important reason for disliking mountain biking, with danger second and the sense of intrusion third. Many walkers indicated that mountain bikers ruined their sense of place and their feeling of sanctuary, and that they disliked having to move out of the way of mountain bikers, especially on narrow trails. Some felt that mountain bikers should be restricted to wide, open trails where they can be clearly seen and anticipated. Many of the walkers could not understand why mountain bikers wished to ride narrow singletrack trails, and also felt that mountain bikers could not appreciate the area or environment as much as walkers because they were "going so fast".

Horn also found that mountain biking is dominated by males in their twenties to thirties, while the non-mountain bikers may be significantly older and of a much more even proportion of gender. Mountain bikers also appeared to have taken part in many more other types of outdoor activity than walkers have. Mountain bikers are more likely to be hikers at other times than hikers are to be bicyclists. (Watson *et al*, 1991)

4. Bestwood Country Park.

Bestwood Country Park (designated in 1985) is located 4 miles immediately north of the city centre of Nottingham and comprises approximately 600 acres (245 ha). Heavily urbanised areas border the park to the south and west, and agricultural land to the north and east. Bestwood was formerly largely ancient woodland and part of the southern end of Sherwood Forest until the middle of the 14th century when it was emparked by King Edward III. Bestwood included in the Domesday Book as part of the parish of Lenton (Robinson, 1987.) and was a royal hunting preserve, which later became the seat of the Duke of St. Albans. The main house (on the site of the medieval hunting lodge) is now the Bestwood lodge Hotel, but the landscaped gardens are part of the park. In a map by John Chapman, of 1774 (see map 3) Bestwood was titled "Buskwood" and is roughly 4 – 6 times the size of the city of Nottingham. In the 19th century the area became heavily industrialised with the construction of Bestwood colliery (which was closed in 1967) and ironworks, and Bestwood village. The remaining woodland was largely felled during the Second World War leaving only a few specimen trees such as yew and sweet chestnut. The woodland found on the site today is the result of natural regeneration and succession, and is therefore secondary woodland on an ancient woodland site. There is a small amount of truly ancient woodland in the park, though a small group of mountain bikers severely damaged part of this in the recent past, which is one reason why a management plan aimed at controlling mountain bikers is considered so essential.

Bestwood Park includes many habitats of conservation value. Many of the habitats are those listed as national key habitats in the UK Biodiversity Action Plan. These include Wet broad-leaved woodland, lowland wood pasture and parkland, ancient and/or

species rich hedgerows, cereal field margins, lowland hay meadow, lowland dry acid grassland, lowland heathland, reedbeds, fens, eutrophic standing waters, and mesotrophic lakes. Other habitats present include improved grassland, marsh, rivers and streams, urban land and post-industrial land. The woodland at Bestwood covers 250 acres and consists of steep dry valleys formed by glacial melt-water. The dominant tree species are birch, oak, sycamore and sweet chestnut. Other species such as yew, rowan, elm, holly, and lime are present but not abundant. The understorey is sparse due in part to past management practices and the impact of visitors. Where present, the understorey consists of hawthorn, hazel, and willow. A number of heathland sites are present in the woodland, and heathland is returning to a number of sites due to present management. There is also the reclaimed colliery spoil heap (200 acres) and the Mill lakes area (150 acres). Most of the park (and most of the study area) lies on free draining acidic sandy soils derived from the bunter pebble beds. In the eastern part, a small outcrop of red marl has produced a neutral to alkaline clay loam.

The area is considered remarkable in that it contains such a wide range of varied habitats in an area so close to a major conurbation. Invertebrates present at the site include good populations of coleoptera and arachnids, and the area is particularly good for lepidoptera due to the variety of vegetation. The great crested newt has been sighted, and the common lizard is found in heath and open woodland areas. Red foxes, stoats and weasels are present, along with hares, and 4 species of bat. Birdlife is particularly abundant, with well over 80 breeding species. Bestwood is also considered the best site in the county for fungi.

The management team at Bestwood has developed a management plan that has two prime aims:

- **Develop, manage and promote the Country Park as a recreation and education resource for the local community, and for the community of the inner city areas of Nottingham.**
- **Maintain and enhance the ecological and landscape value of the Country Park for this and future generations.**

Access for disabled visitors is actively encouraged which means that trails need to be kept in good condition to allow wheelchair access. The management plan of the park does not mention cyclists at all, but does state objectives for reducing erosion, and resolving conflict between users of the park (indicating the conflict between horse riders and walkers). There are a number of stables and riding schools situated near to the park, and the park provides much of the local riding area for the riders from these stables.

The usual problems exist due to the urban fringe nature of the park, with vandalism, litter, and arson large concerns of any management decision. Most of the visitors are local, and a large proportion comes to the park to walk dogs. It is believed that much of the conflict and damage put down to mountain bikers is in fact due to local children and youths cycling in the park. These could be considered to be "pseudo-mountain bikers" since their bikes are largely their only form of transport and are used accordingly. Visitor numbers are estimated at between 350,000 and 500,000 per annum, and visits peak during the summer and during school holidays.

There is a network of 15-20 miles of paths through the park, but only one legal right of way, which is a bridleway. (See map 2) Section 30 of the Countryside Act 1968 states that cycling on marked bridleways is lawful, but cyclists must give way to pedestrians and persons on horseback. Because of the age of the area, many traditional trails are designated as "Horse only" which means that neither walkers nor cyclists are permitted on those trails. This makes for an interesting study, since traditionally, trails in England have been either footpaths, or bridleways that allow both horses and cyclists to use them. Interesting conflicts appear to have developed between different users of the area. Much of Bestwood has wide, surfaced, maintained trails that are used frequently by walkers, and less frequently by cyclists. These trails are mostly used not by young, fast mountain bikers, but by family groups of cyclists or by older groups with different motivations and preferences. Bjorkman (1998) stated that "overall, trail users [cyclists] prefer trails that are eroded and rough, and dislike smooth, easy trails or management actions that make the trail easy and less technical." Bjorkman also stated that "Trail users [cyclists] differ in trail preferences by skill specialisation." Which means therefore "trails can be designed for these different levels of users."

Parts of Bestwood also serve as links to other areas such as the disused sand quarry to the north of the woodland. (See map 1 and plate 2) The quarry appears to be used by both cyclists and horse riders both as a link and as a place to ride in itself; with a small area that appears to regularly have jumps and trails constructed upon it. The owners, Tarmac Ltd., appear to periodically bulldoze the area as a disincentive towards building these trails.

A smaller, privately owned wood named The Crimea Plantation is present to the north of the quarry, (see map 1) and many cyclists and horse riders also ride here. There has been, since at least 1995, some form of course or trail constructed in the wood, originally for off-road motorcycles and quad bikes, consisting of jumps, berms (banked corners), and other obstacles. (See plate 3) The trail is now primarily used by mountain bikers and BMXers, though the trail does cut across other trails that are primarily used by horse riders and some walkers. The trail has changed the original shape of the path and in places is cut into the ground. The (largely sweet chestnut, and subsequently sycamore) plantation was created on ground that had been quarried, and it was found that because of the extremely sandy soil, the trees were not of a sufficient standard to be felled and used. The plantation is not managed in any way at the moment, except for the mountain bikers and BMXers who maintain the trail extensively and thoroughly. The number of riders frequenting the area is unknown, but is increasing steadily, which has led to widening of the trail and the need for increased maintenance, especially in wet seasons. The mountain bikers and BMXers who most regularly ride this wood do so with the permission of the owner, who has set conditions for continued use. New trails are being created all the time, but only in areas in which permission is granted. The riders do however realise the existence of conflict felt by other users, and were extremely apprehensive of any interference by "outsiders", since they fear that they may lose "their" riding area, as has happened so many times in the past.

Such an incident was recorded in an article in The Nottingham Recorder on July 15, 1999, which was headed "Bikers in Ban Threat" and was about another area in Nottingham known as "Hemlockstone" in Bramcote. The action of erecting signs carrying a code of conduct, and the threat of a total ban on bikers in public spaces in the area resulted from complaints from the public about "speeding bikes posing a

hazard to walkers and dogs." The article also stated that "woodland … has also been systematically damaged to create ramps for stunts. It is estimated that more than 20 mature trees have been vandalised to create ramps, jumps, and stunt courses." The article also quoted a director of technical and leisure services as saying "off-road biking had been tolerated as a genuine leisure pursuit for more than a decade, a line now had to be drawn." Incidents such as these obviously need to be avoided, and it is effective management and education of both land managers and all countryside users that may help to achieve a more harmonious environment for all to enjoy the countryside as they wish.

There are areas within Bestwood (much like those of the "Hemlockstone" mentioned earlier) that are ridden often and extensively by mountain bikers, some are what could be called "play areas" that consist of a large pit or hole with steep sides that can be ridden down. The most popular area is situated in the south west of the area known as Big Wood. (See plates 4 and 5) This specific area contains over 15 separate routes into (and out of) the depression, most of these are quite significantly eroded, with some routes eroded up to 18 inches into the soil. There is an artificially constructed "jump" in the centre of the area, and an older attempt at construction present at the top. Mountain bikers appear to ride most of the paths around Bestwood, with some favourites such as downhill routes and long narrow singletrack that appear to be used exclusively by mountain bikers. (See plate 1)

1.5 Maps

Map 1. (Ordnance survey, SK54: NE, 1980. 1:10 000) Showing Bestwood Country Park, the quarry, and the Crimea plantation. (With alterations)

Map 2. Trail map of Bestwood Park.

Map 3. Nottinghamshire as surveyed in 1774, by John Chapman. Bestwood (Named "Buskwood" at the time.) can be seen to the north of Nottingham.

1.6 Plates. (All taken by the author unless otherwise stated)

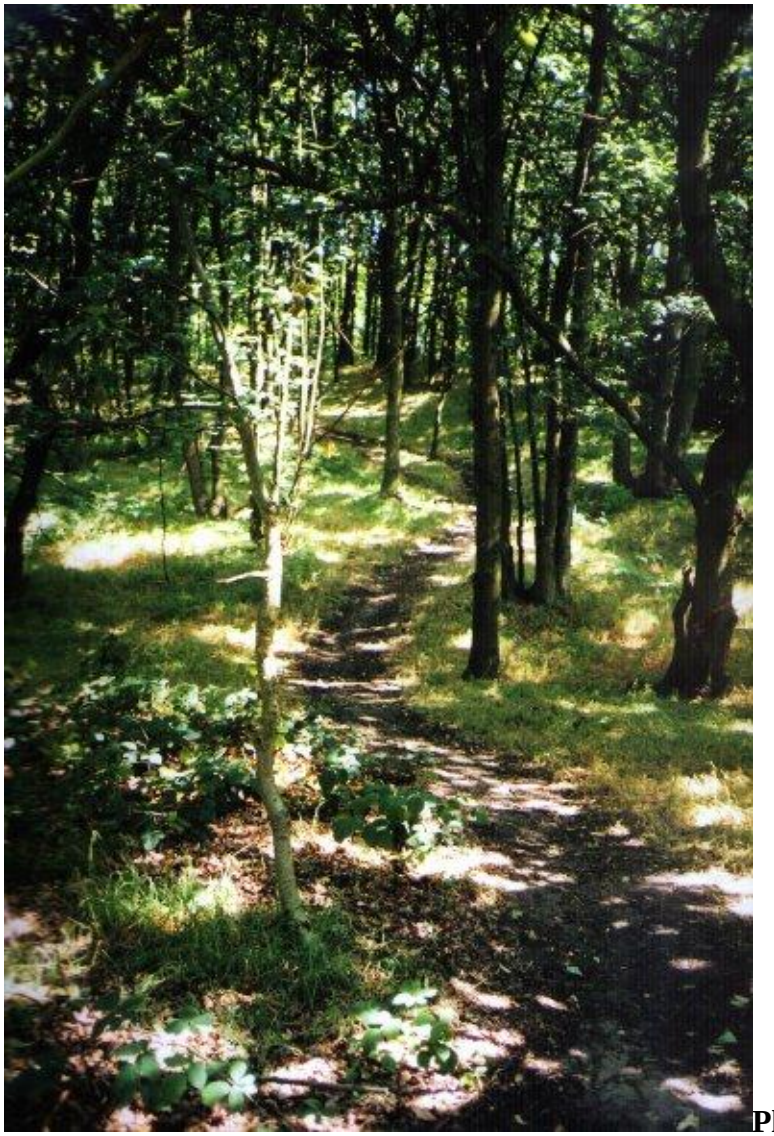
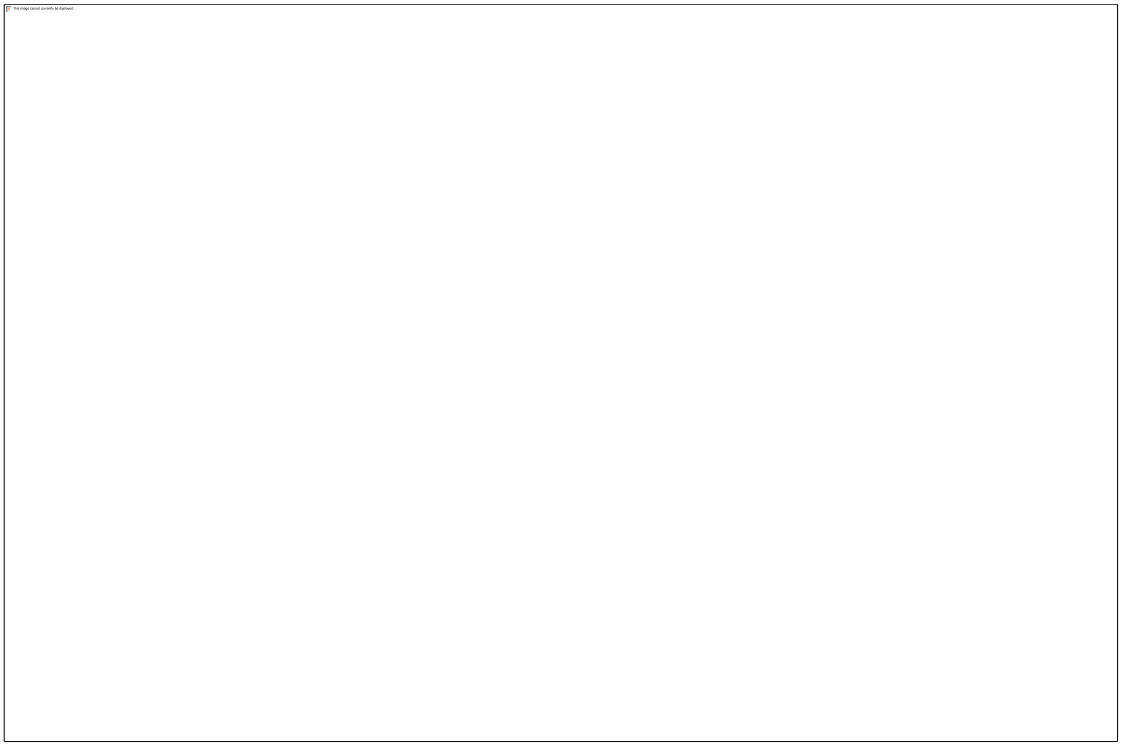


Plate 1. A popular "singletrack" section at Bestwood Park.

Plate 2. The quarry present to the north of Bestwood Park (viewed from the south).



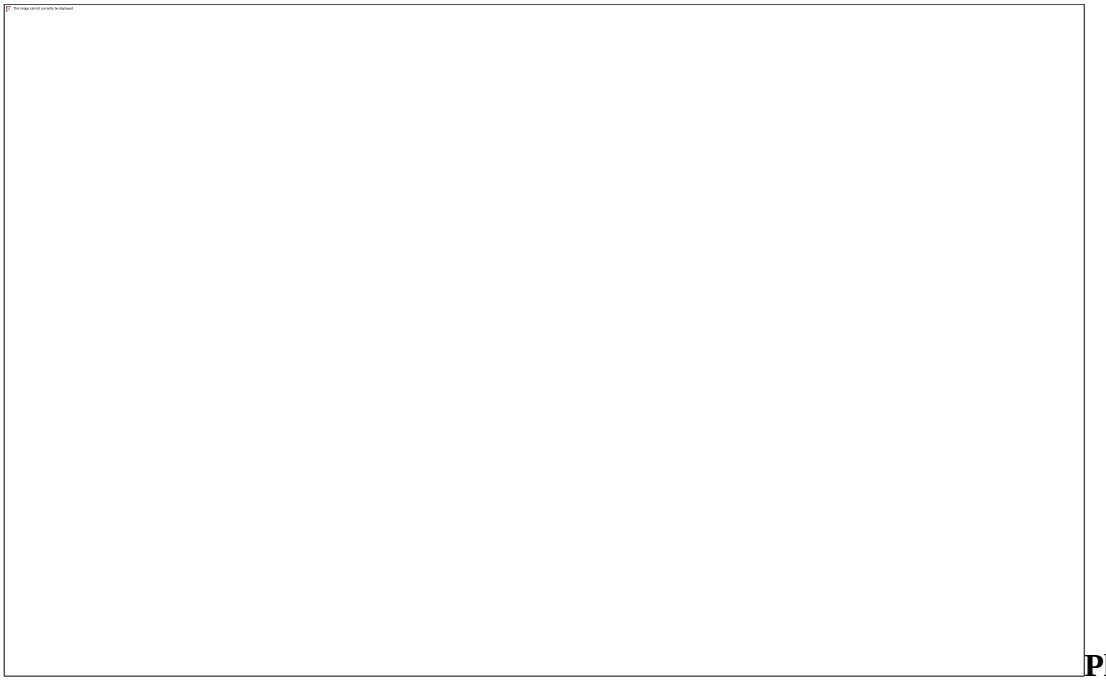
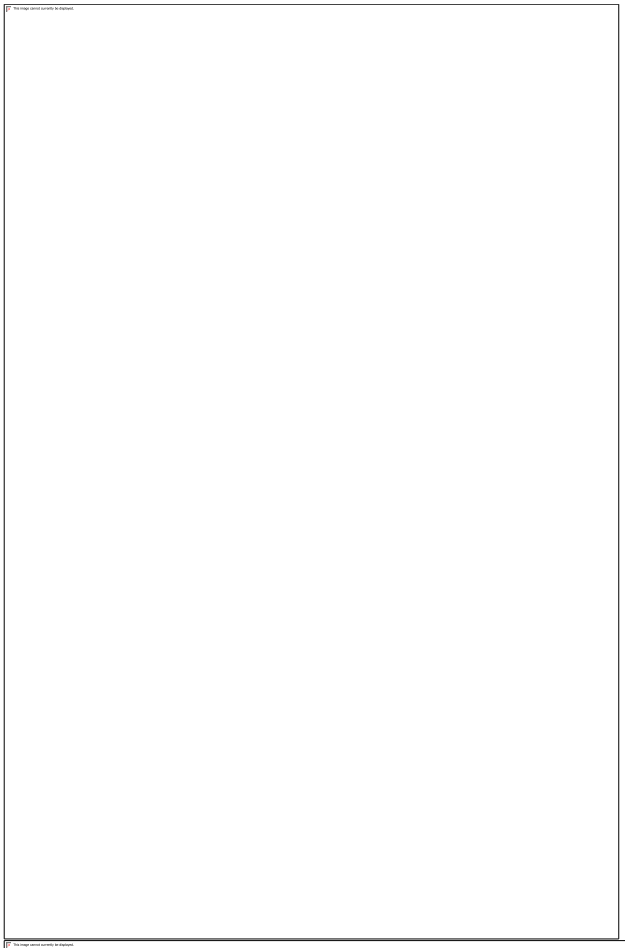


Plate 3. Trail and jump construction at The Crimea Plantation.



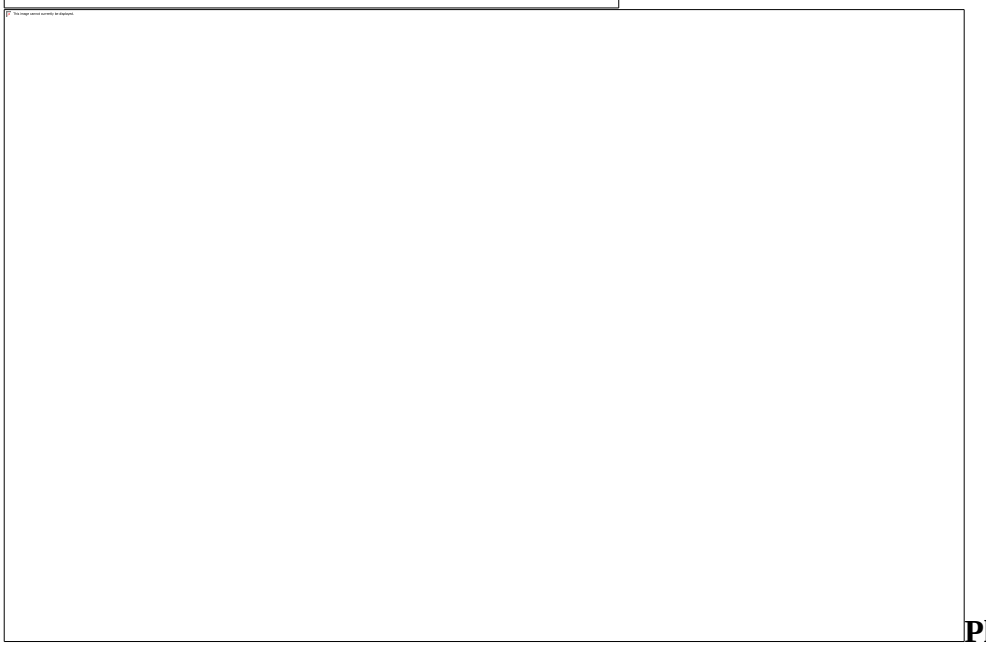


Plate 4. The most frequented "bombhole" at Bestwood.

Plate 5. A rider on one of the trails in the bombhole.

(Photograph by Ben Wright)

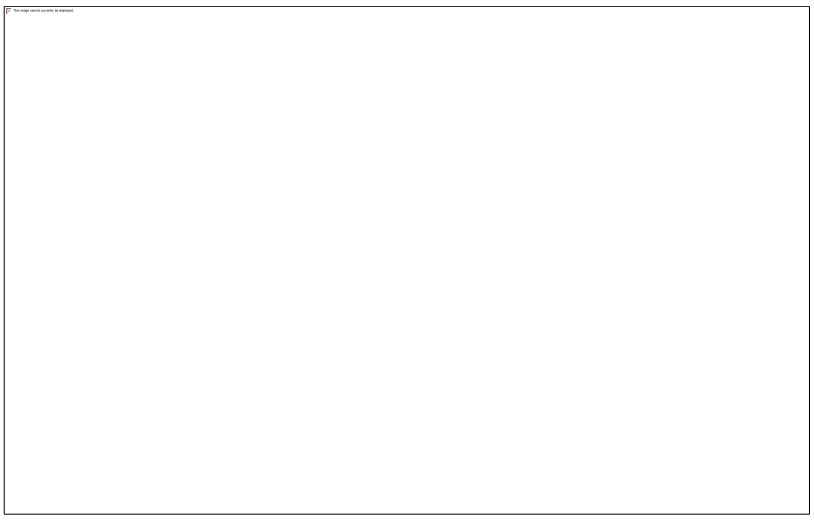
2. Method

Two principal experiments were employed in the study – a questionnaire and an erosion study of different trails and specific cycle paths and trails. A visitor count was carried out on a main multi-user trail that provides entry and exit to the park. It was carried out on a single Sunday, in good weather, for three hours. This was intended to give a comparison between numbers of different users, not an actual visitor count.

2.1 Erosional impact study.

The erosion studies were carried out on a footpath, horse trail, and cycle trail. There was no guarantee that only these types of user would use the trails over the period but the trails were selected to be of one predominant type. The soil types were the same in all trails, and the trails selected were all within the same area of the park.

Table 1: key for measuring erosion using dispersion of material.



The general erosion study consisted of laying lines of crushed brick cat litter on the trail in approximately 10cm wide strips and about 1cm deep. These were laid in a groove scraped into the trail using a garden trowel and firmed down by foot. They were measured weekly over one month using a scale of dispersion (See figure 1). The depth and width of trail were also measured, along with notes about the nature and position of the erosion. Rainfall and maximum and minimum temperatures were also recorded during the one-month study. Rainfall was measured using a standard 5-inch funnel and rainfall gauge, placed near to the trails in an area of scrub where it was expected that it would not be disturbed. Although scrub was not the ideal area to site the rainfall gauge, it had to be chosen to ensure that it was not disturbed (although it was disturbed towards the end of the study.) The temperature was measured using a maximum and minimum thermometer placed on a small platform raised approximately one inch above the ground. The thermometer was covered with a plastic seed tray to avoid disturbance and damage.

A specific mountain bike erosion study was conducted by selecting one trail that was as representative of most of the Bestwood trails as possible. Erosion markers of crushed brick spaced one metre apart were then applied along the length of the trail at regular

intervals. The trail was then ridden down by a number of riders of different skill and style 20 times. The erosion was then measured using the same scale.

The scale was designed after testing the technique on similar soil and walking and cycling over the markers to obtain an eight-point scale of erosion that was likely to occur over the period of testing. The width and angle of the trail was also measured at each of the marker points, along with notes on the type and position of erosion that occurred. Sections of trail such as corners, drops, and slow and fast sections were identified so a comparison of erosion could be made between the types of trail section.

2.2 Questionnaire design and survey technique.

A questionnaire was designed to answer many of the questions posed in this study – See appendix for a copy. A number of informal interviews were conducted with the ranger of Bestwood Park and other park users to identify some of the issues that needed to be studied. A number of pilot questionnaires were designed and handed out so questions could be checked for clarity and important issues could be identified. This information was then used in the production of a final questionnaire.

The questionnaire was handed out to many different users including hikers, walkers, horse riders and mountain bikers. 75 questionnaires were handed out, with the distribution roughly split equally between hikers and walkers, mountain bikers, and horse riders. Most of the questionnaires were handed to the respondents personally to fill out themselves, but many of the horse rider respondents were interviewed on the trails in Bestwood Park. Since the horse riders were on horseback at the time, it was safer and easier to ask the questions verbally.

To acquire enough questionnaires for the survey, it was decided that clubs and societies could be contacted to allow members to complete the survey. The Nottingham Trent Hiking club was used for some of the respondents, while the Nottingham Trent cycling club was used to acquire mountain bikers' views. A horse-riding club did not exist at the time, so horse riders were mostly contacted by other methods such as interviews at Bestwood Park and by contacting the local stables and riding schools. Both hikers and mountain bikers were also contacted by interviews in and around Bestwood, along with personal contacts. An internet-based survey was carried out by posting the questionnaire and an introduction to the survey on specific hiking, horse-riding, walking, mountain biking and backcountry newsgroups, but had a very low response of only 7 completed questionnaires – of which only two were from the UK. The overseas respondents were not included in the survey but were instead used as a comparison between UK and overseas views on trail conflict and management.

Respondents were initially asked for a name and contact to ensure more accurate and truthful answers. Respondents were ensured of complete confidentiality and also told that the name and contact were not essential. The questionnaire began with easy and non-confrontational opening questions about favourite activities, and places where these activities were carried out. Questions on age, gender, membership of environmental organisations and charities, and education status followed to put the respondent at ease with the survey. This type of question would not usually be put near the beginning but it was found in pilot questionnaires, possibly due to the length of the questionnaire, that respondents often ignored these questions if put at the end.

Subsequent questions were made slightly more difficult as the questionnaire followed on. These questions consisted of conflict experiences, perceptions of danger, perceived levels of damage caused by different types of user, and views on other users – concentrating on perceptions of mountain bikers and mountain biking. Questions such as these were interspersed with less confrontational questions on trail access preferences and beliefs and on preferred trail types, to ease the flow of questions and decrease any tension brought about by questions on conflict. Subsequent questions were factual and attempted to discover how "well connected" the respondent was in relation to the local landowners of their trails – whether they knew them, and whether they could or had contacted them. Mountain biker specific questions followed, and to end, questions about their reasons for wishing to go to the countryside and take part in their specific activity, together with a hypothetical question asking if they would be prepared to help maintain and build trails. The final question for non-mountain bikers asked if they would like to see anything provided at their local area, or Bestwood Park, depending on their previous answers. This was aimed to reassure the respondent. Mountain bikers were finally asked about their type of riding, and whether they had helped to build artificial trails themselves, without the permission of the landowner. This type of question would not usually be put at the end of a survey, but the structure of the previous questions caused this subject to be set last.

All questions were designed to be as short and as unambiguous as possible, and sensitive questions were positioned between less sensitive questions in order to put the respondent at ease. The use of "leading" questions was avoided. Wherever necessary, the option of "don't know" or "other" was given.

3. Results

3.1 visitor survey results.

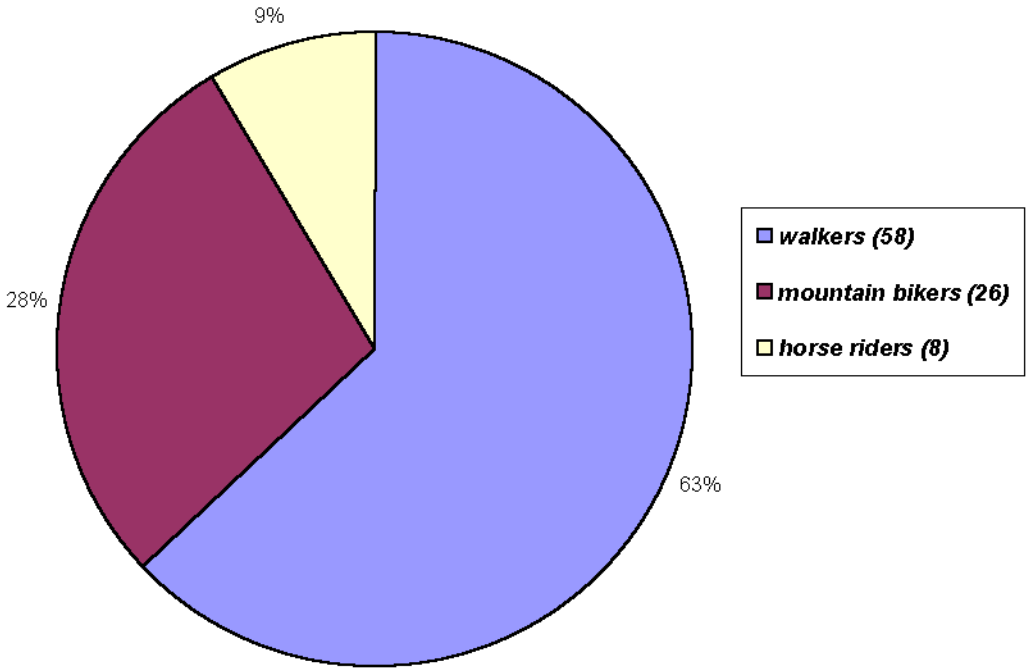


Figure 1. The percentage of different users recorded on a multi-user trail during a three-hour period at Bestwood Park.

This shows that walkers were by far the most dominant group of users (63%) at Bestwood Park, with mountain bikers (including any type of off-road cycling) demonstrating 28% of the total user numbers and horse riders only 9%.

3.2 Differential user trail erosional impact study results.

Table 2. Raw data for the differential trail erosion study, showing erosion levels, depth of trail, erosion characteristics, trail characteristics, and rainfall and temperature recordings.

16-Feb *week 1*		**Trail depth (cm)**	**Erosion**	**notes**	**max temp**	**min temp.**	**rainfa**
Horse only trail	1 (sloping)	24		very loose			
	2 (less sloping)	24					
Footpath	1 (sloping)	16					
	2 (less sloping)	5					
steep cycle trail		26					
23-Feb *week 2*		Trail depth	Erosion	notes	max temp	min temp.	rainfa
Horse only trail	1 (sloping)	24	7		9	-1	8.4mr
	2 (less sloping)	25	8	no trace of marker			
Footpath	1 (sloping)	16	5	water erosion in centre			
	2 (less sloping)	6	4	water erosion in centre			
steep cycle trail		26	6	most in centre, very smooth			
1-Mar *week 3*		Trail depth	Erosion	notes	max temp	min temp.	rainfa
Horse only trail	1 (sloping)	28	8	gully formed - bare rock	14	1	9.2
	2 (less sloping)	28	8	same			v. heav
Footpath	1 (sloping)	19	6	only edges left			rainsto
	2 (less sloping)	7	4	clear water runoff			
steep cycle trail		26	6	more even erosion			
8-Mar *week 4*		Trail depth	Erosion	notes	max temp	min temp.	rainfa
Horse only trail	1 (sloping)	28	8	gully less apparent	16	1	6.7
	2 (less sloping)	28	8	same			
Footpath	1 (sloping)	20	6	edges still visible			
	2 (less sloping)	7	4	more even than previously			
steep cycle trail		26	7	marker hardy visible			
15-Mar *week 5*		Trail depth	Erosion	notes	max temp	min temp.	rainfa
Horse only trail	1 (sloping)	21	8	deposition of soil	21	2	2.1
	2 (less sloping)	19	8	widening of trail			DISTURE
Footpath	1 (sloping)	19	7	hardly visible marker			
	2 (less sloping)	7	5	even erosion			
steep cycle trail		27	8	no trace of marker			

This table shows that the erosion of the different trails increases at different rates, and with different characteristics. All the trails demonstrated significant erosion after week one, and from then onwards the erosion for each trail appears to increase at a steady rate. The horse trail demonstrated that there was high sediment movement, though the trail appearance did not alter, and the depth actually decreased (sediment was deposited onto the trail) towards the end of the study. The footpath showed some degree of erosion due to water flow, but very little erosion was apparent due to the impact of walkers. The cycle path demonstrated erosion due to both water flow and the impact of bicycle wheels, but very little sediment yield was observed, except for the sides of the trail that formed banks, where sediment was observed to be falling onto the trail after

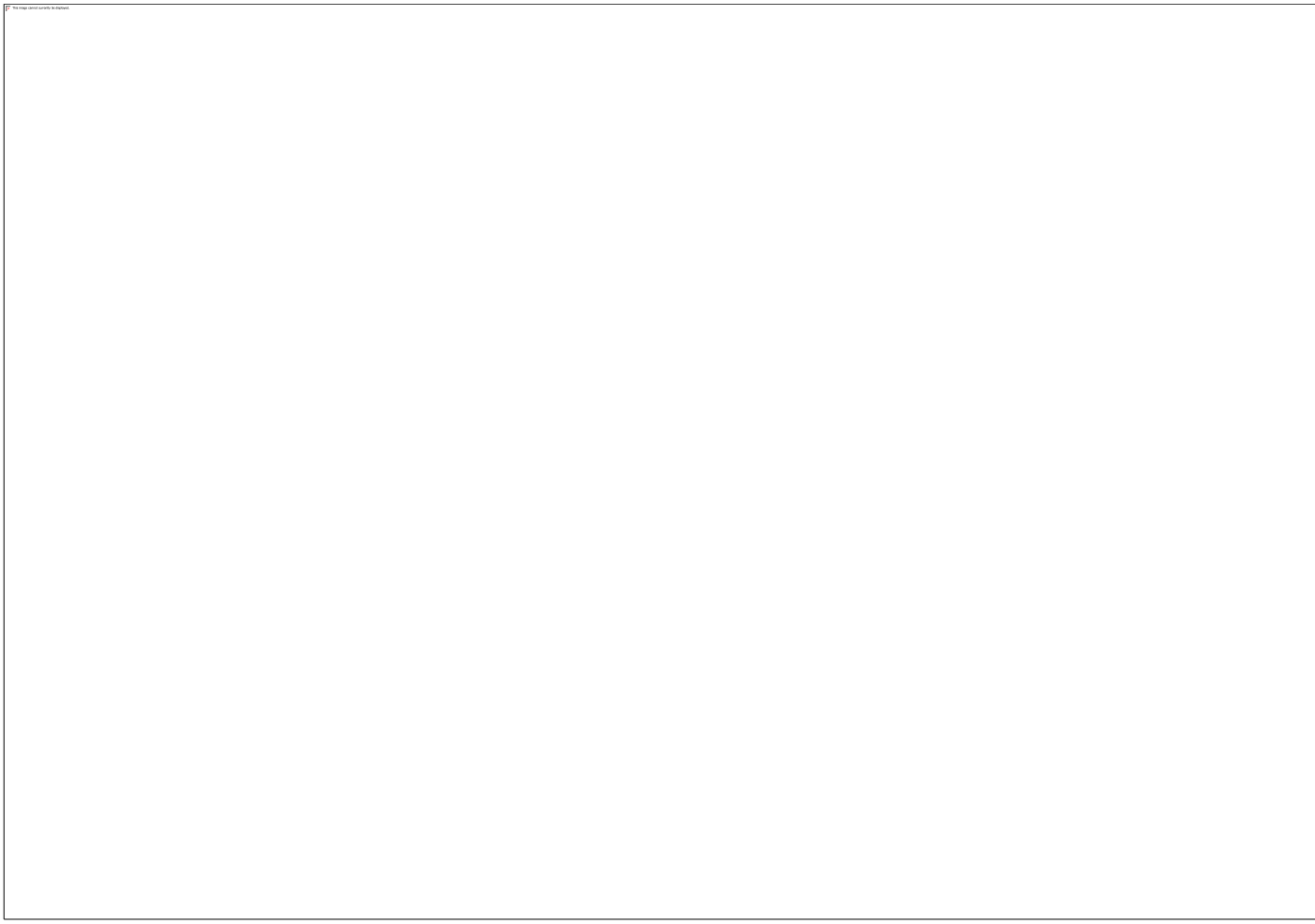
wet weather. The rainfall was greatest in the week 3, and least in the last week, though the gauge had been disturbed, so it must be assumed that the rainfall could be significantly more than the 2.1mm observed.

3.3 Erosional impact of cycling study results.

Table 3. Full results of the downhill trail study, showing erosion levels, depth of trail, erosion characteristics and trail characteristics.

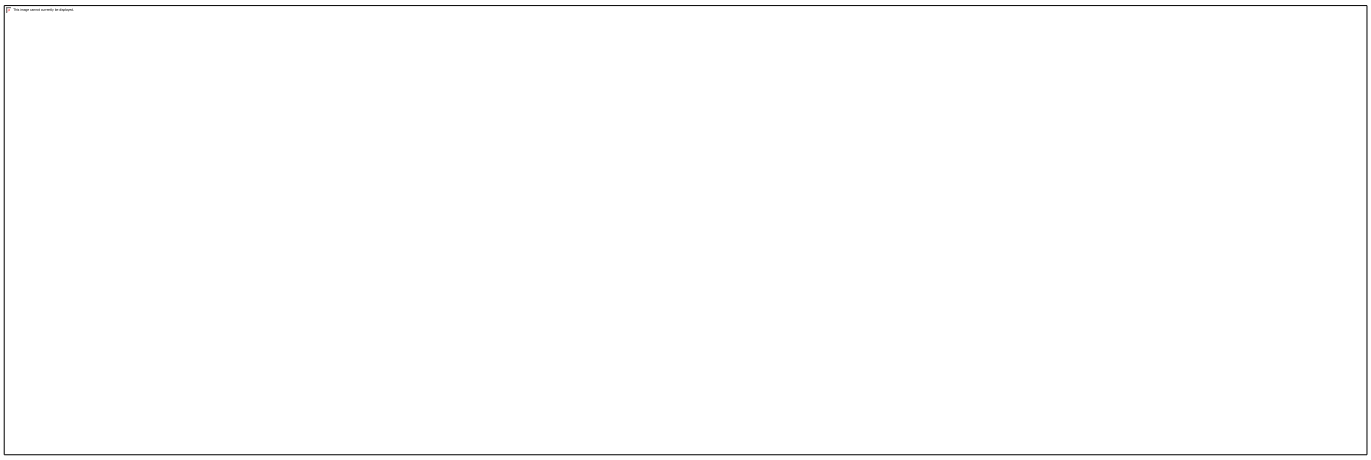
This shows that most erosion occurred when weight shifts and direction or velocity changes are being made. The least erosion was seen when the trail was straight and no braking or accelerating was occurring. The width of the trail appeared to have no effect on the degree of erosion. Erosion was observed to occur on the outside edge of all turns and corners. Significant erosion was observed at the end of the trail, where riders were made to brake and stop.

Figure 2. Chart showing the relationship between the slope of the downhill trail and the observed level of erosion due to cycling impacts.



This shows that the level of erosion increased with increasing slope of the trail, though the correlation is poor.

Table 4. Full results of the uphill trail study, showing erosion levels, depth of trail, erosion characteristics and trail characteristics.



This shows the points at which turning occurred did not show significantly more erosion than other points in the trail.

Figure 3. Chart showing the relationship between the slope of the uphill trail and the

observed level of erosion due to cycling impacts.

This shows that, as with the downhill trail, the erosion was more significant on steeper sections of trail. The correlation is still poor, but better than the correlation for the downhill trail results.

Table 5. Full results of the second downhill trail study, showing erosion levels, depth of trail, erosion characteristics and trail characteristics.

This shows that the erosion levels are significantly lower than the previous downhill trail study, but that the angle of slope still demonstrated a positive correlation with the level of observed erosion. The erosion occurred at slightly different points on the trail in

this study, compared to the previous downhill trail results, though this trail demonstrated some different characteristics such as gradually banked corners.

3.4 Questionnaire results.

A total of 73 questionnaires were completed, consisting of 20 mountain bikers, 24 hikers, 11 horse riders and 18 respondents who both hike and mountain bike.

3.4(1) Structure and characteristics of respondent groups.

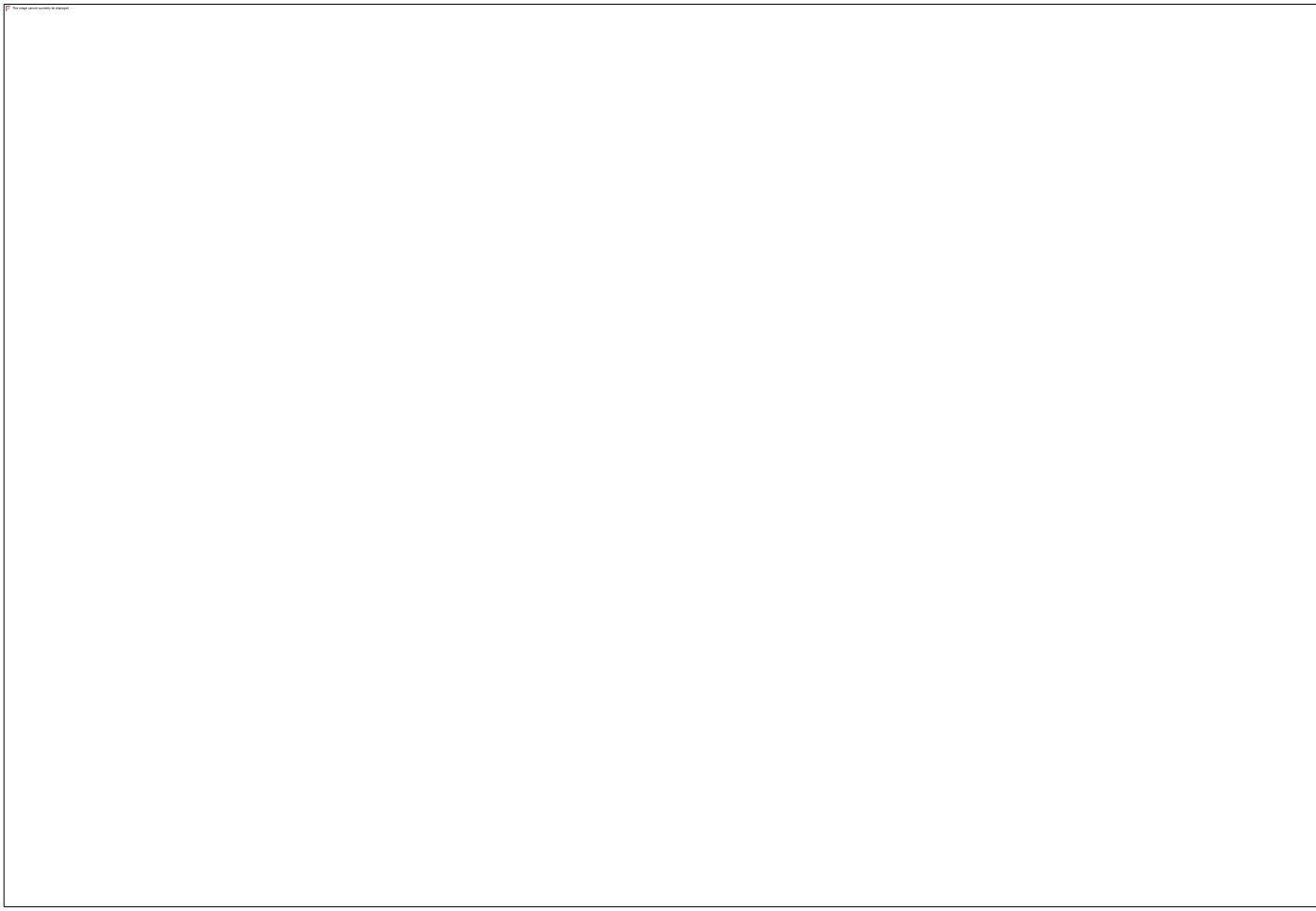


Figure 4. Chart showing the ages of respondents that classified themselves into the different user groups.

This shows that most of the respondents were aged 20-30. The mountain biking groups were generally younger, while the horse riders were significantly older. The hiker respondents showed the most diverse age groups.

Figure 5. Chart showing the percentage male versus female respondents in each user

category.

This shows that almost 60% of all respondents were male. Horse riders were most noticeably all female, while mountain bikers were predominantly male, with only one female respondent. Hikers were split equally between both genders. The respondents who both hike and mountain bike were predominantly male.

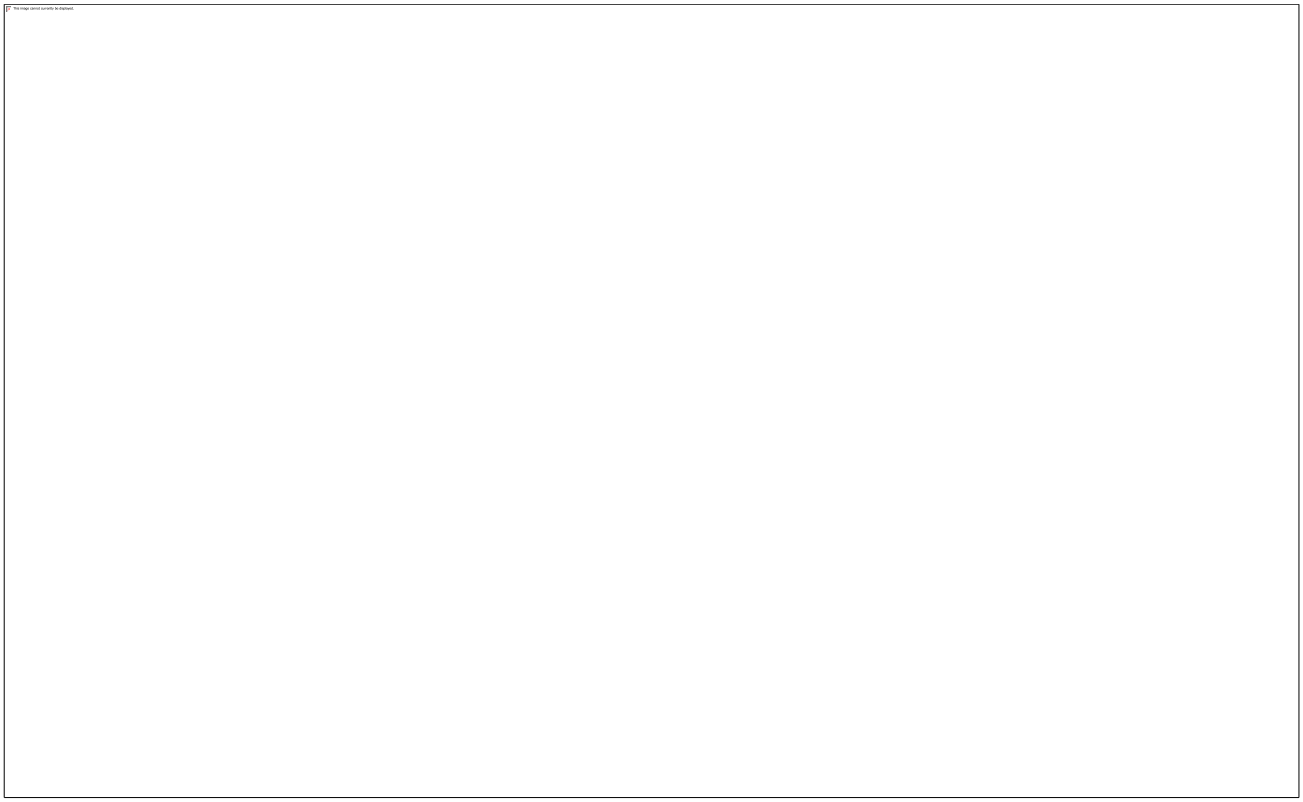


Figure 6. Chart showing the membership of environmental organisations or charities of respondents.

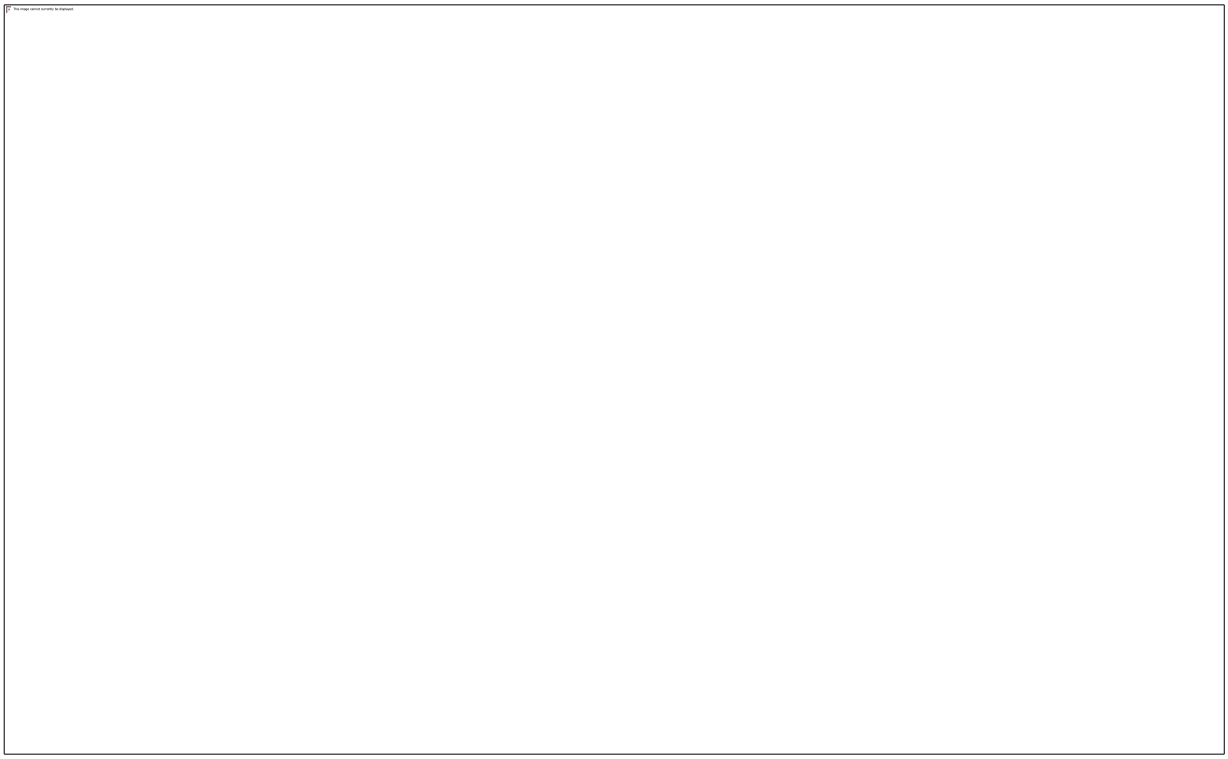


Figure 7. Answers of respondents to the question: would you spend time helping to maintain trails and conserve the natural value of your favourite area?

These two charts show that there is no significant difference between the groups in numbers of respondents belonging to an environmental organisation or charity, or those willing to help maintain trails and aid in conservation work.

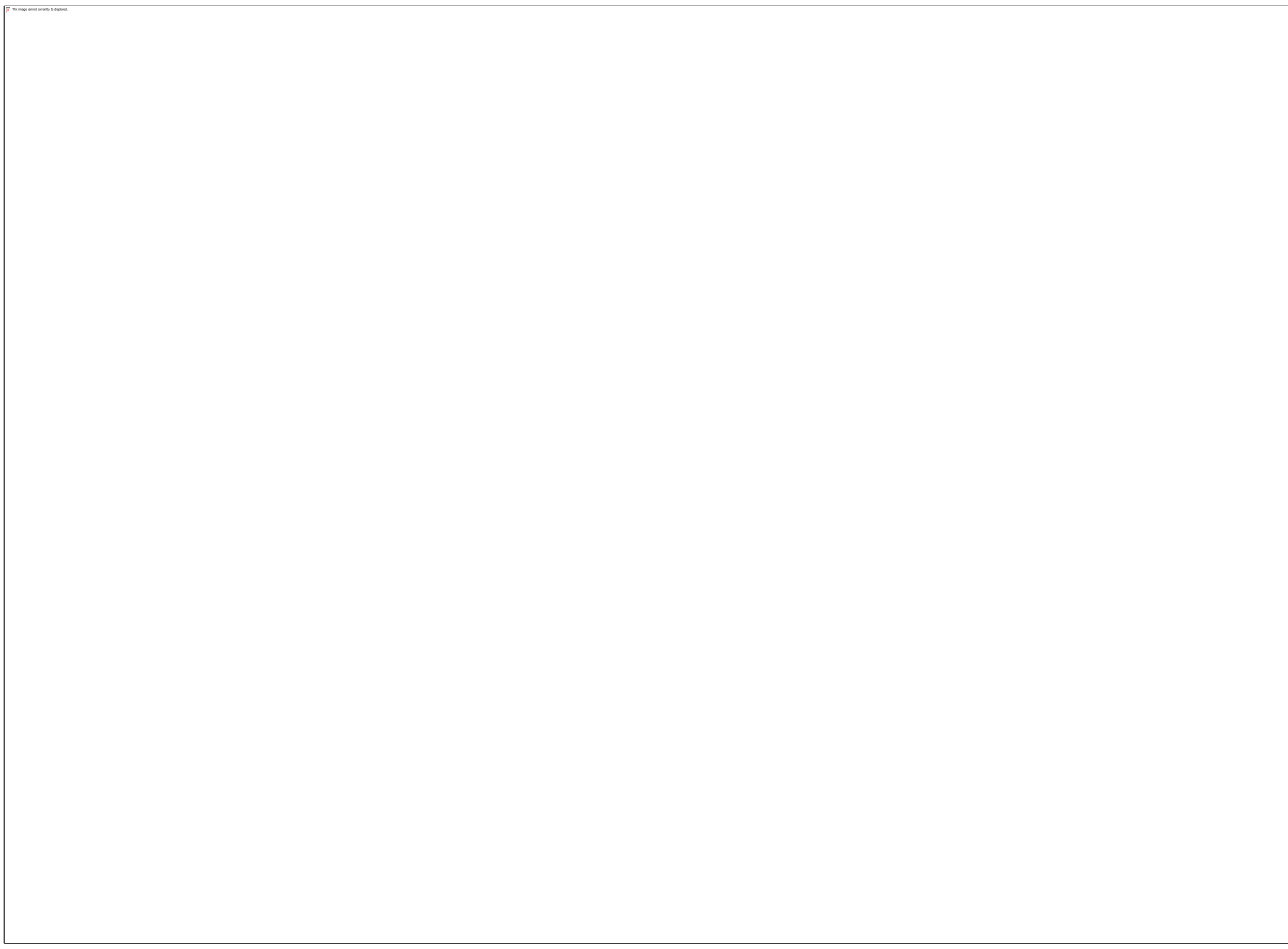
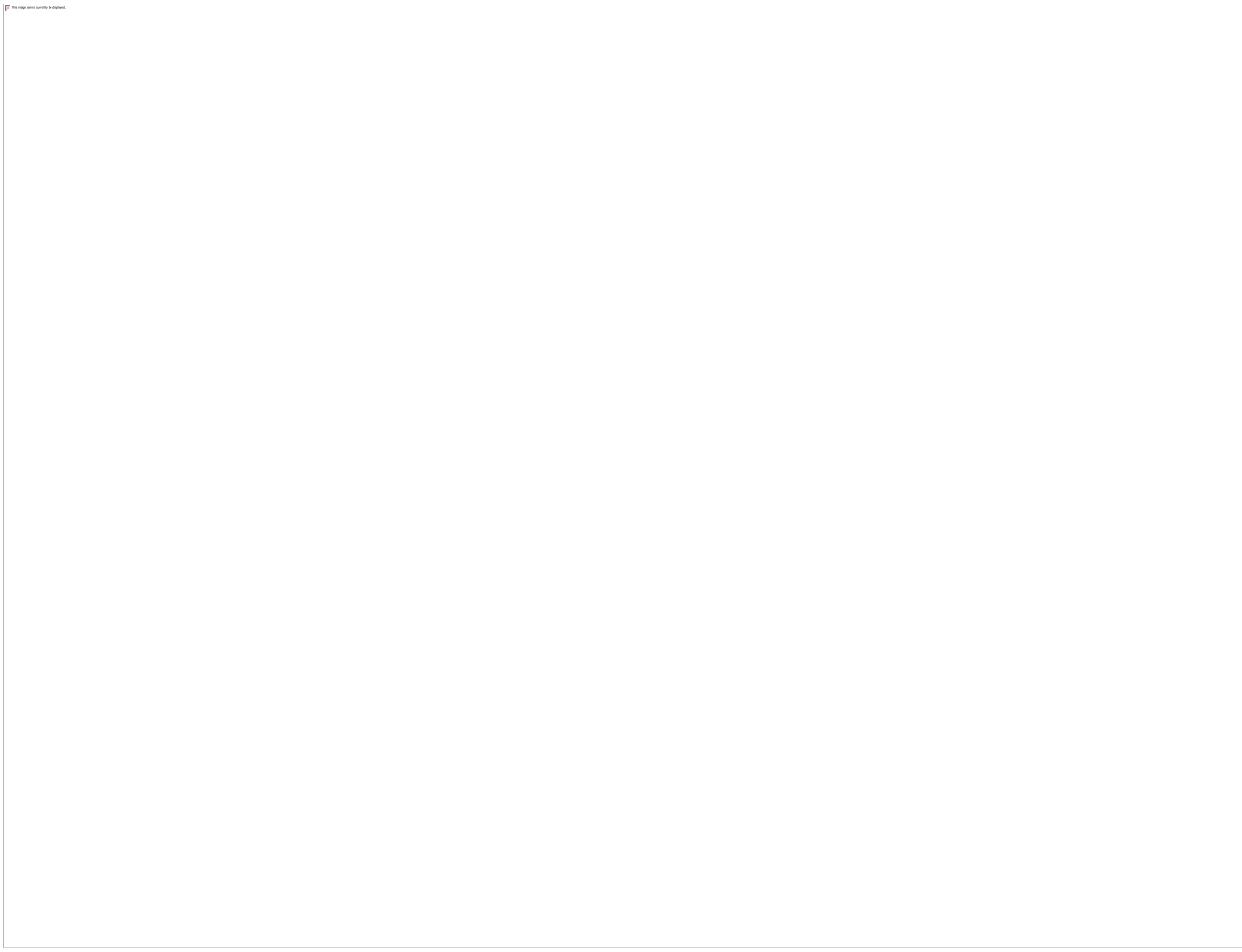


Figure 8. Chart showing the highest educational qualifications of all respondents.

This shows that the hiking and mountain biking group demonstrates the widest variety of educational levels. Mountain biker respondents showed more of a trend towards lower qualifications, having more GCSE and A-level respondents. Percentage-wise, horse riders showed a higher general level of qualification than the other groups. Most respondents answered with A-levels as their highest qualification.

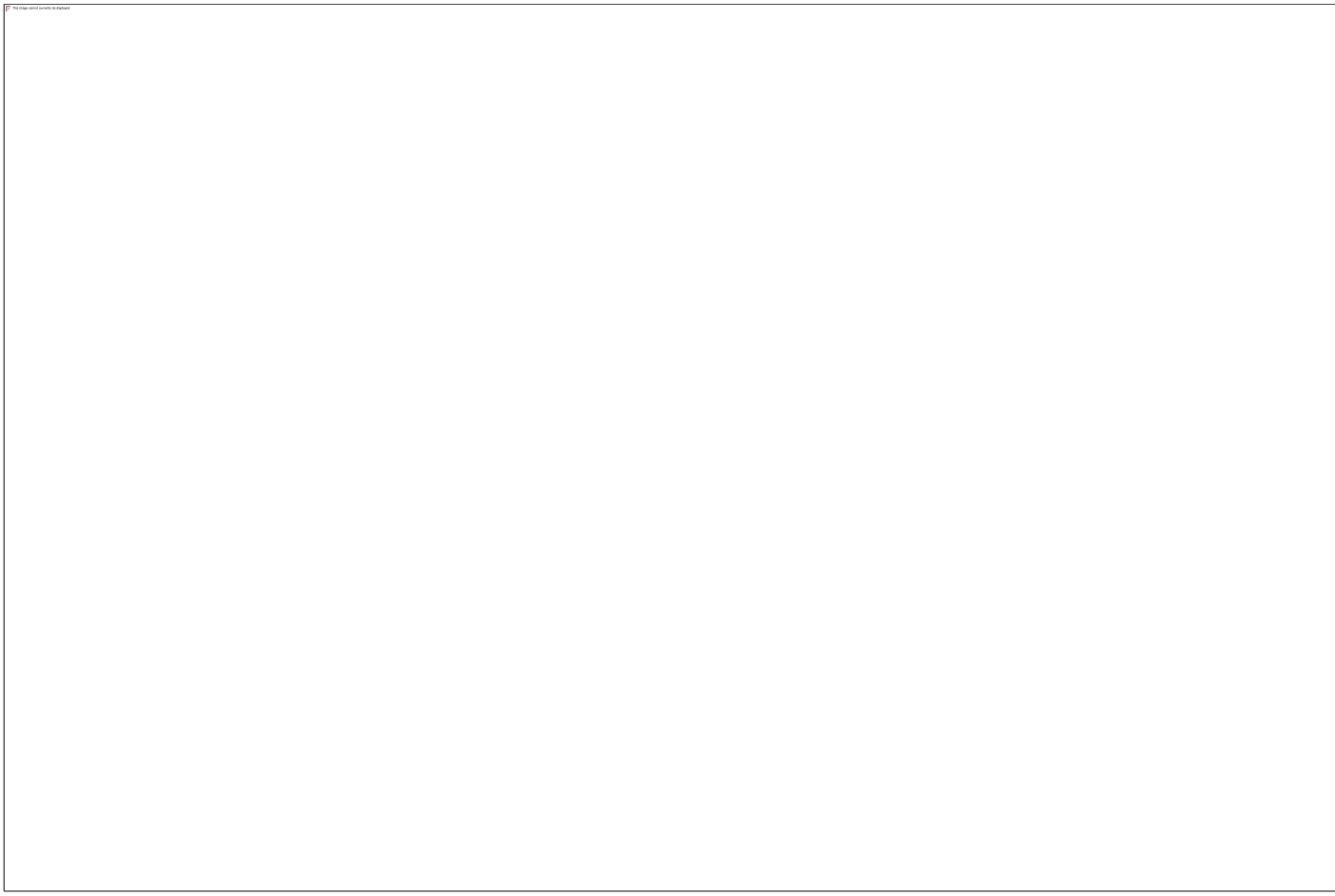
Figure 9. Percentage of respondents in each group that know the landowner or manager of the area where they go most often to carry out their primary activity.



This shows that the horse rider respondents were most likely to know their local landowner or land manager, and mountain bikers were least likely to know the landowner or manager. Hikers were split equally between those who knew the landowner and those that did not.

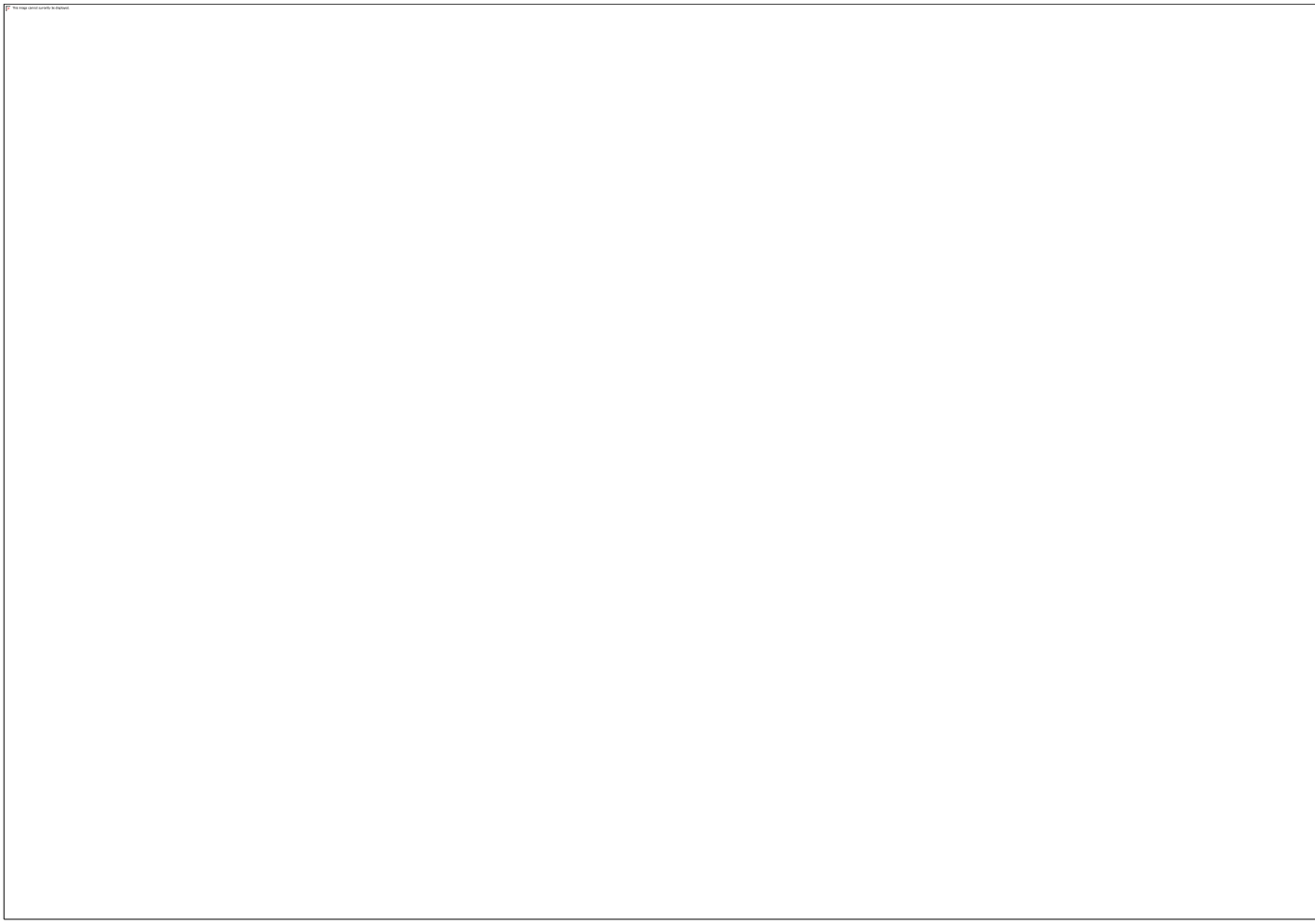
3.4(2) Beliefs and experiences of respondent groups.

Figure 10. Chart showing the answers of respondents to the question: Do you consider mountain bikers to be a danger to other trail users?



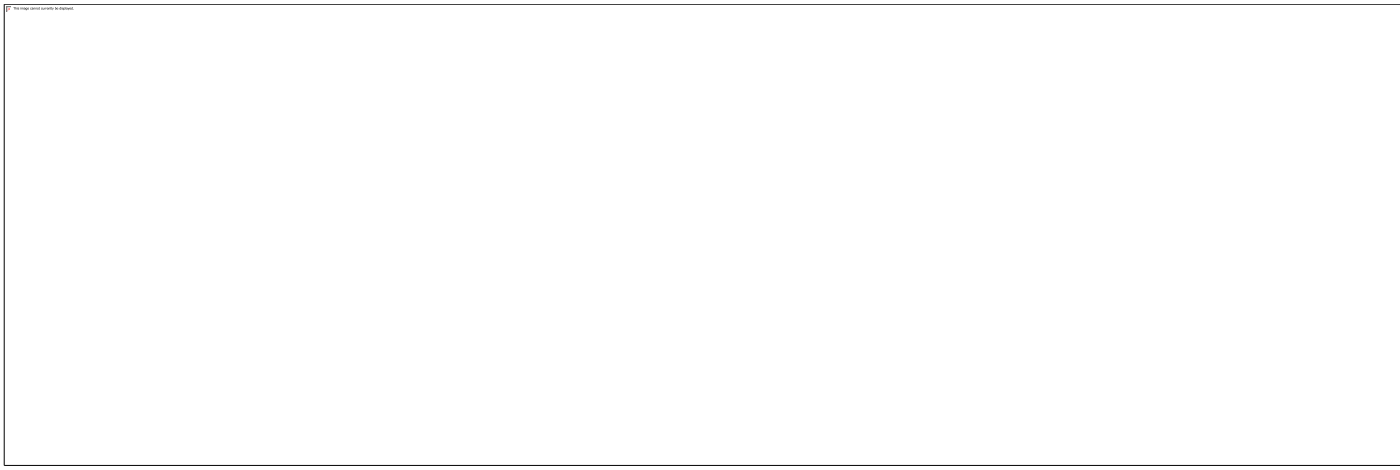
This shows that the different groups were roughly equal in their responses, with hikers and mountain bikers responding almost equally to the question. 36% of mountain bikers believed mountain bikes to be a danger to other trail users. Horse riders were the most concerned, with 60% responding that they believed mountain bikers to be a danger.

Figure 11. Answers of respondent to the question: Have you ever had a negative experience or hostile encounter with any other countryside recreationist, and what type of recreationist?



This shows that the hiker respondents had experienced conflict with many types of user, and split almost equally between them. Mountain bikers had also experienced conflict with many types of user, but the most common conflict was towards hikers, with horse riders also a significant issue. Horse riders had not encountered conflict with as many types of user, and their most common conflict was towards mountain bikers. The chart illustrates the asymmetric nature of conflicts between users.

Table 6. Answers of respondents to the question: to what extent would you like to see trail access allowed in your local area?



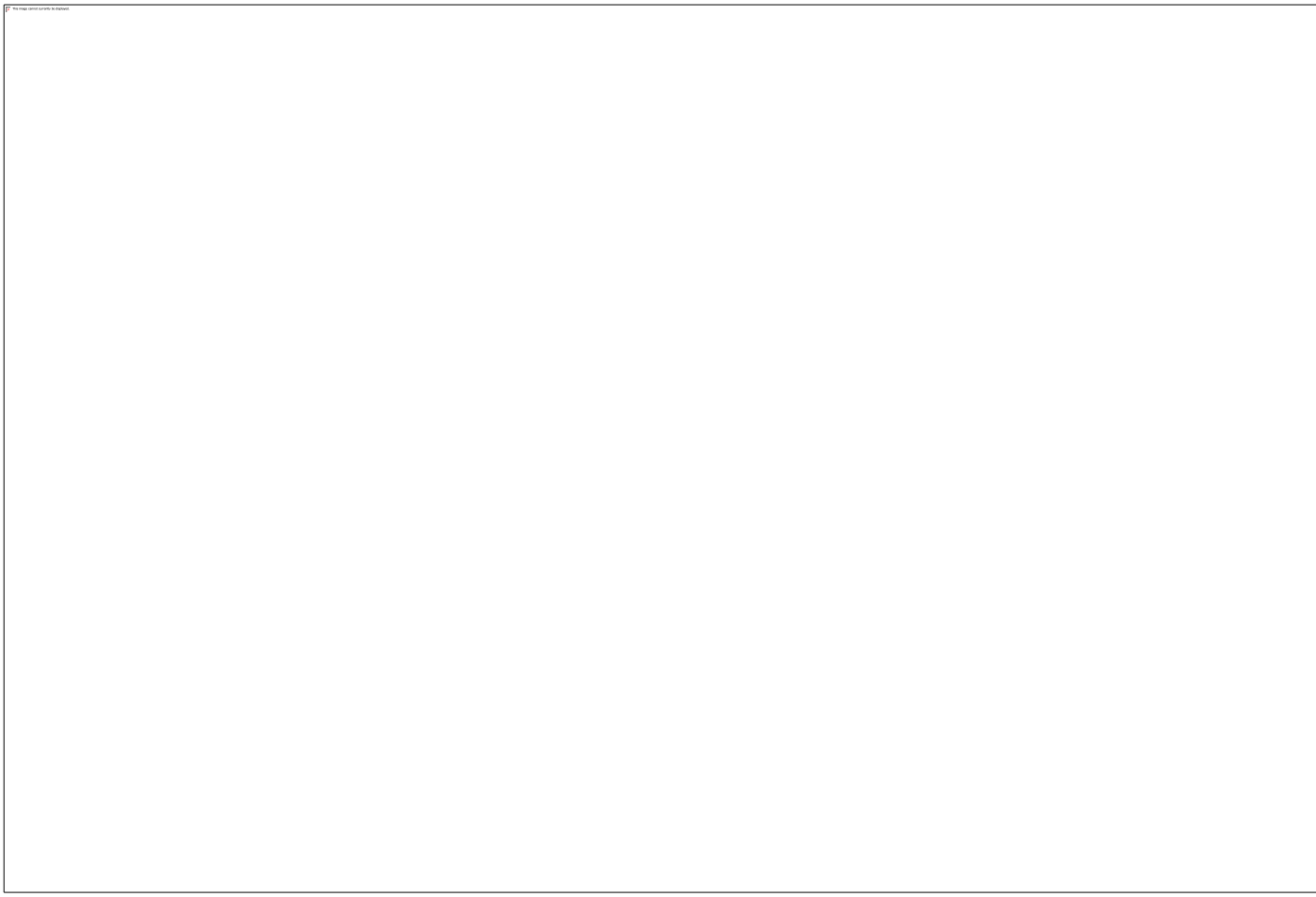
This shows that each user generally wishes to have more access to their type of trail, i.e. mountain bikers want more cycle paths, horse riders want more horse trails, and hikers want more footpaths. The majority of mountain bikers want more cycle trails, but also want more bridleways. 1 respondent wanted more horse trails, while 1 wanted less horse trails. Hikers primarily want more footpaths, but also want to see more cycle paths and bridleways, while only one respondent wanted more horse trails. 2 hiker respondents wanted less cycle paths. The horse rider respondents wanted more footpaths, horse trails, and bridleways equally, but only 1 wanted more cycle paths. The hiker and mountain biker group wanted more of each kind of trail, except for the horse trails, which was around half as important as the other trails.

Figure 12. Respondents impression of the general age of mountain bikers.

Figure 13. Respondents impression of the gender of mountain bikers.

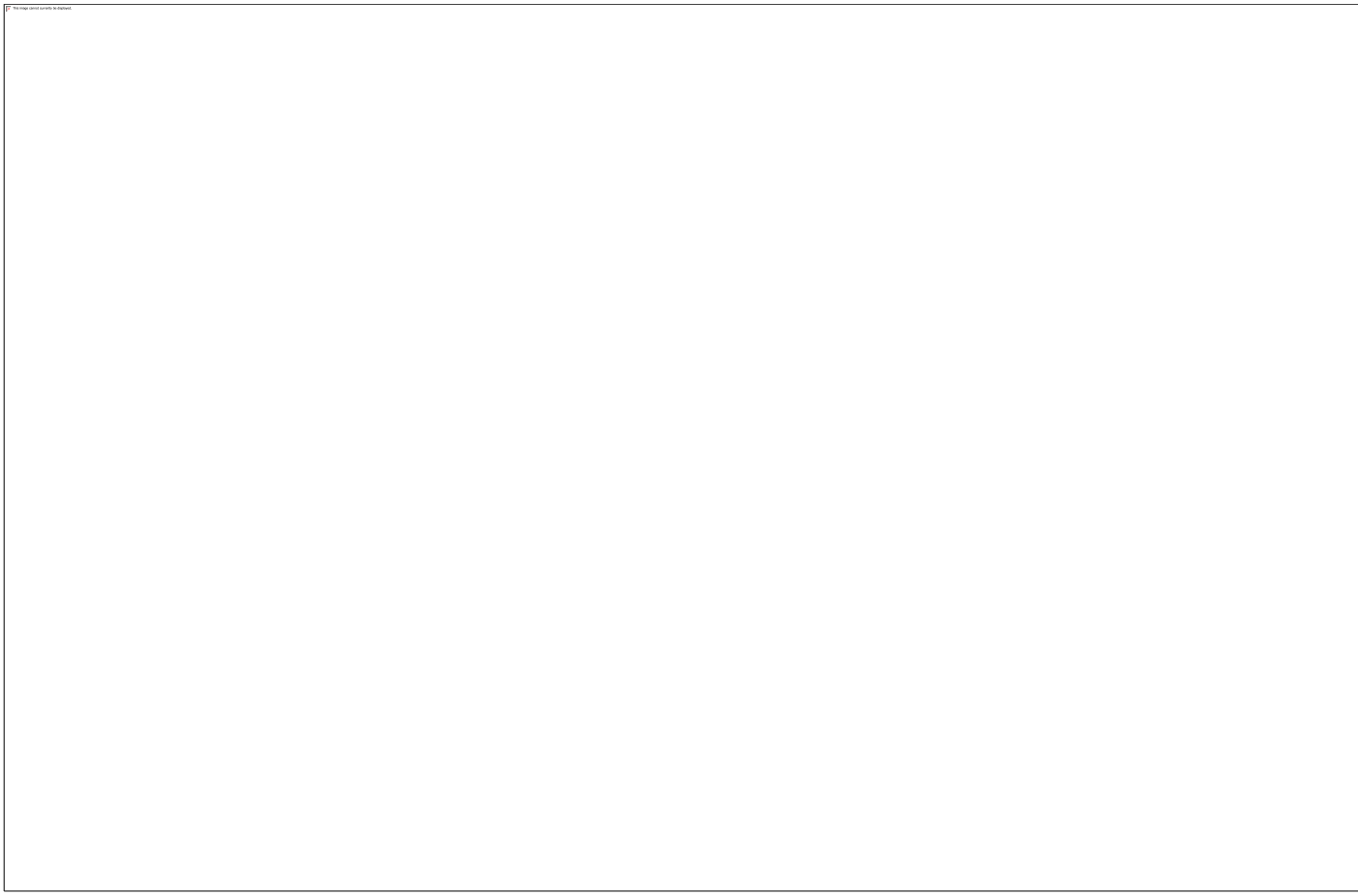
These charts show that the overall impression of mountain bikers is that they are young males. Both the charts are remarkably similar in structure. Mountain bikers tended towards answering that mountain bikers tended to be of mixed age and gender, but a significant number responded that they were young males. Hikers most significantly believe that mountain bikers are young or mixed age males, while most horse riders responded that they believe mountain bikers to be of mixed age and sex. Not surprisingly, there were no respondents who believed that mountain bikers were old or female.

Figure 14. Chart showing respondents answers to the question: Do mountain bikes and mountain bikers detract from your enjoyment of the countryside?



This shows that generally, mountain bikes do not detract from most peoples enjoyment of the countryside. It appears that mountain bikers often enjoy meeting other mountain bikers, while most hikers feel that mountain bikes do not have an effect, but a significant few felt that mountain bikes can detract from their experience. Most horse riders responded that mountain bikes have no effect. The hiker and mountain biker group gave mixed opinions.

Figure 15. Answers of respondents to the question: do you think mountain bikers are provided for in the areas of the country that you most regularly visit?



This shows that almost 50% of mountain bikers believe that they are provided for, while an equal number believe that they are not. Non-mountain bikers appear to believe strongly that mountain bikers are not provided for, while, expectedly, a large number responded that they do not know whether mountain bikers are provided for.

Figure 16. Chart showing the responses of hikers to rate users according to the degree

of damage the users have on the countryside.

This shows that hikers primarily believe both mountain biking and horse riding to be of roughly equal impact on the countryside, with walking the least damaging and hiking only slightly.

Figure 17. Chart showing the responses of horse riders to rate users according to the

degree of damage the users have on the countryside.

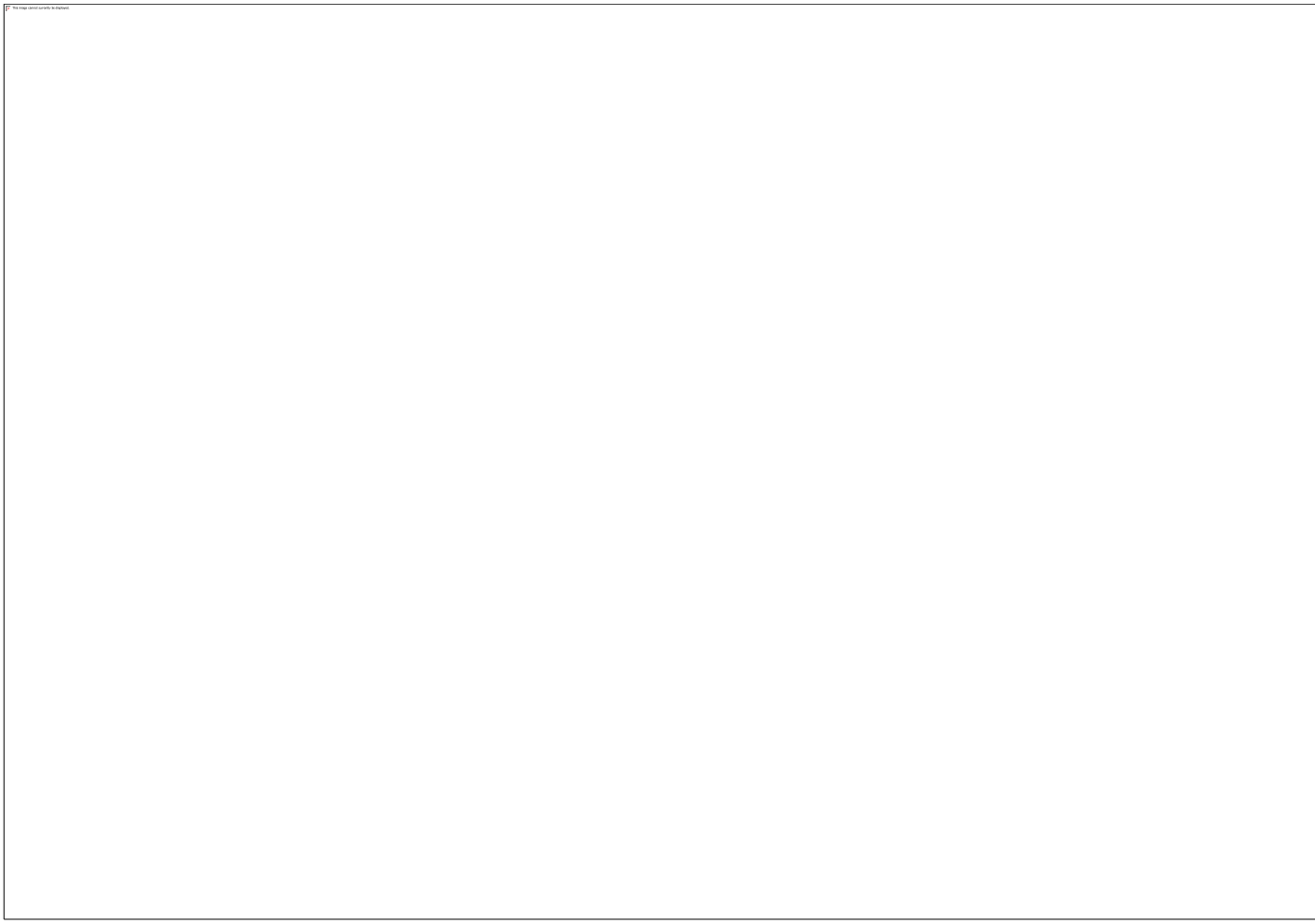
This shows that horse riders believe mountain biking and horse riding to be of equal impact on the countryside – both most or moderately damaging, and hiking and walking to be equally least damaging.

Figure 18. Chart showing the responses of mountain bikers to rate users according to

the degree of damage the users have on the countryside.

This shows that mountain bikers clearly believe that horse riding is the most damaging activity, with mountain biking secondly damaging. Walking was clearly the least damaging, and hiking only slightly. The presence of walking as the most damaging category could be the result of a misinterpretation of the question.

Figure 19. Answers of respondents to the question: would you like to see the use of mountain bikes restricted or banned in areas where all types of non-motorised user are

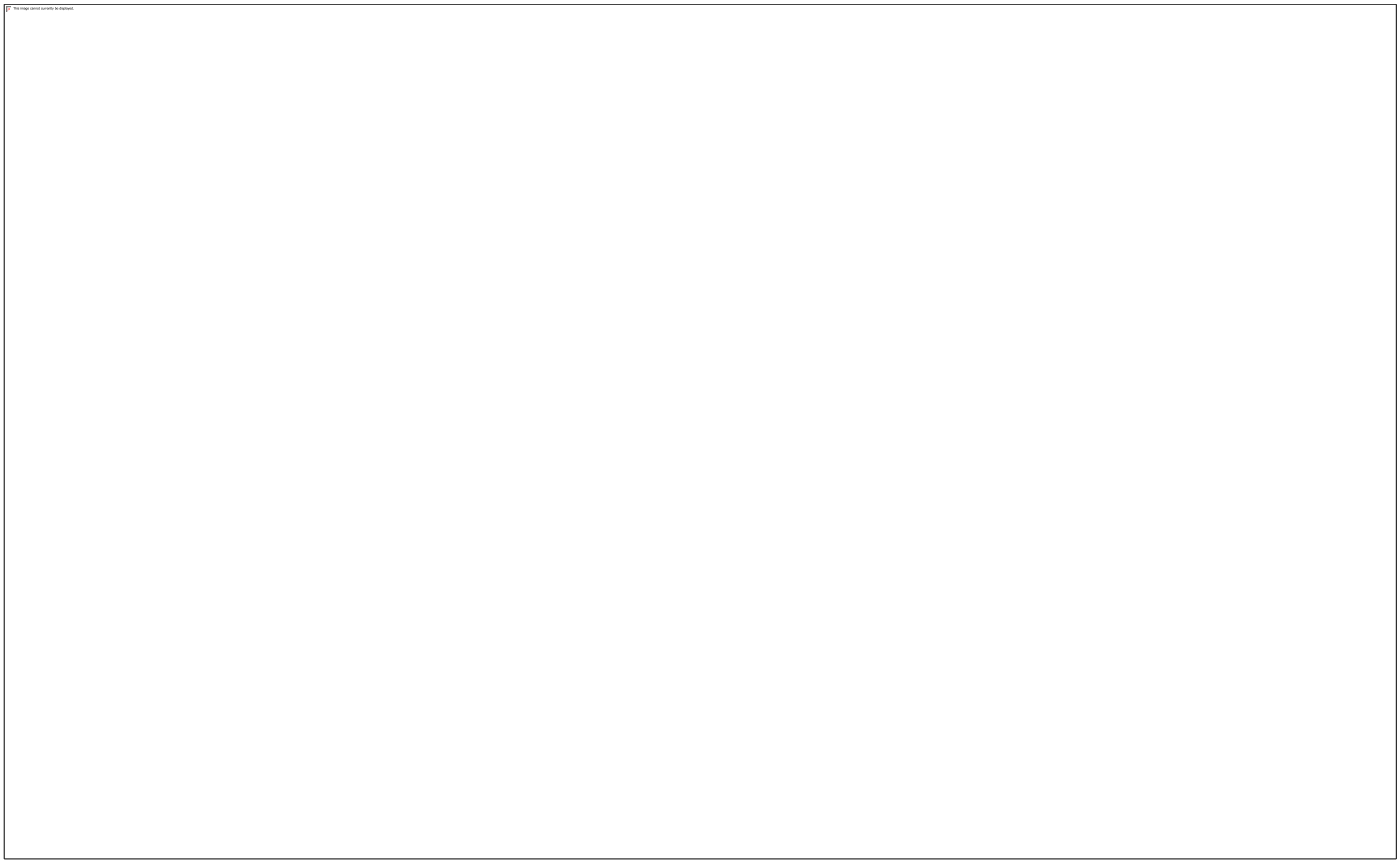


allowed at present?

This shows that all the mountain biker respondents believed no restriction should occur, while 84% of horse riders believed that mountain bikers should be restricted. 36% of hikers believed that mountain bikers should be restricted, and one respondent believed that they should be banned altogether.

3.4(3) Incentives and trail and setting preferences of respondents.

Figure 20. Chart showing types of incentives for mountain biker and hiker group respondents.



This shows that the most important aspects of a countryside activity for the hiker and mountain biker group are firstly the natural beauty of the area, and secondly their participation in an activity that improves their fitness levels. Fun/excitement and relaxation are also important.

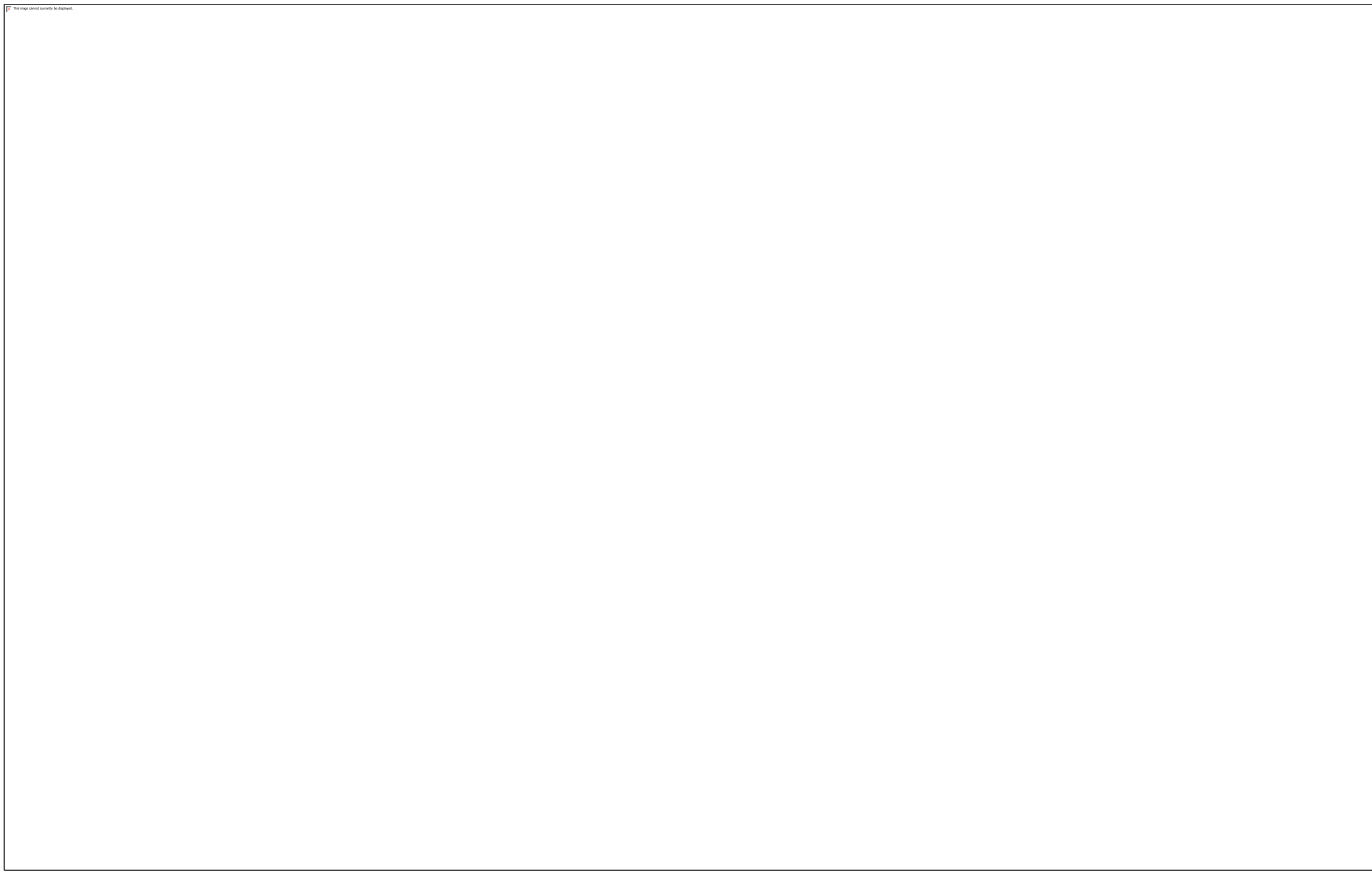


Figure 21. Chart showing types of incentives for hiker respondents.

This shows that, as with the previous group, the natural beauty of an area is very important to the hiker respondents. The second most important reason to go out to the countryside for them is to relax. The fun and excitement is also important to them, while other reasons such as socialising, learning, and fitness are important to some respondents.

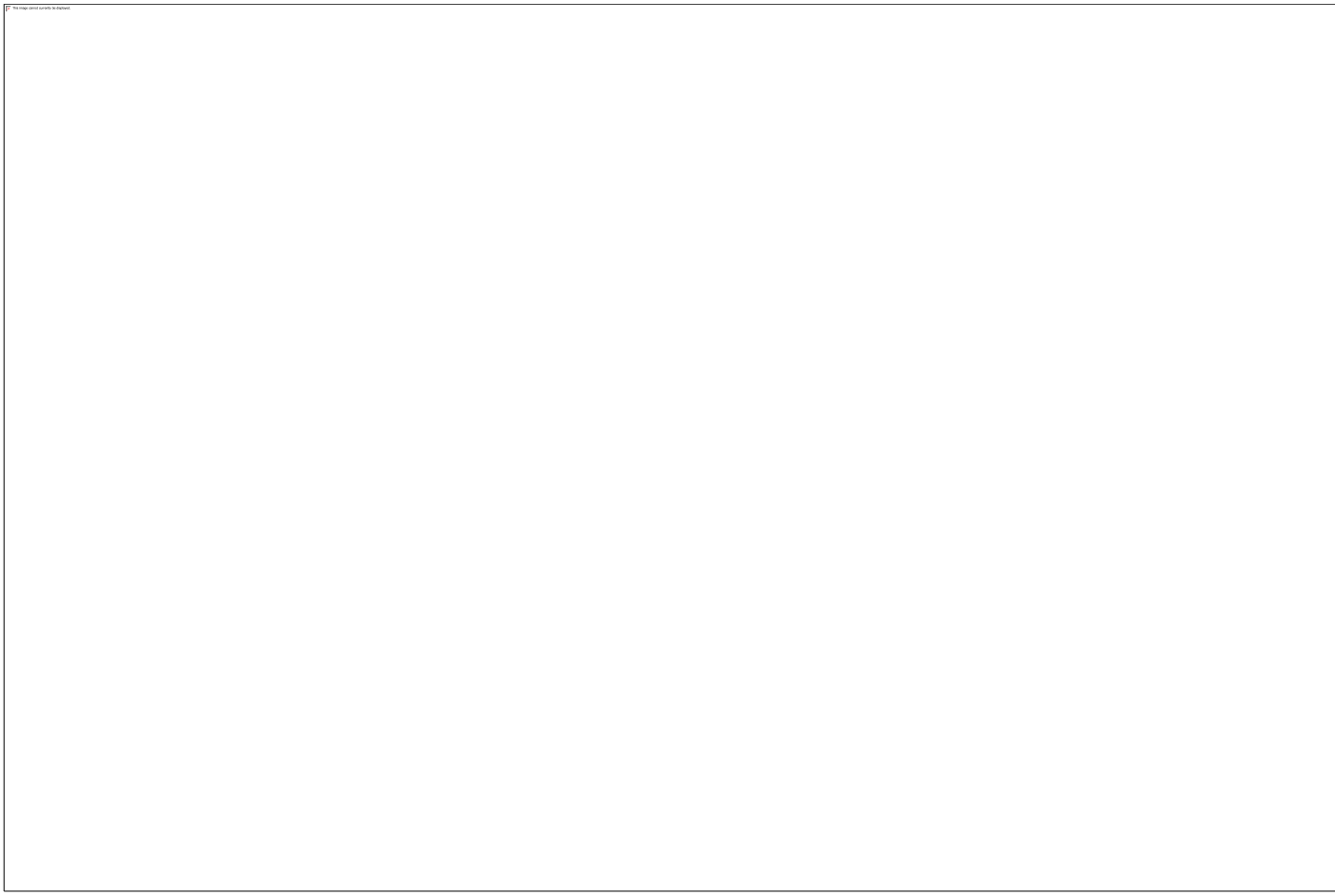
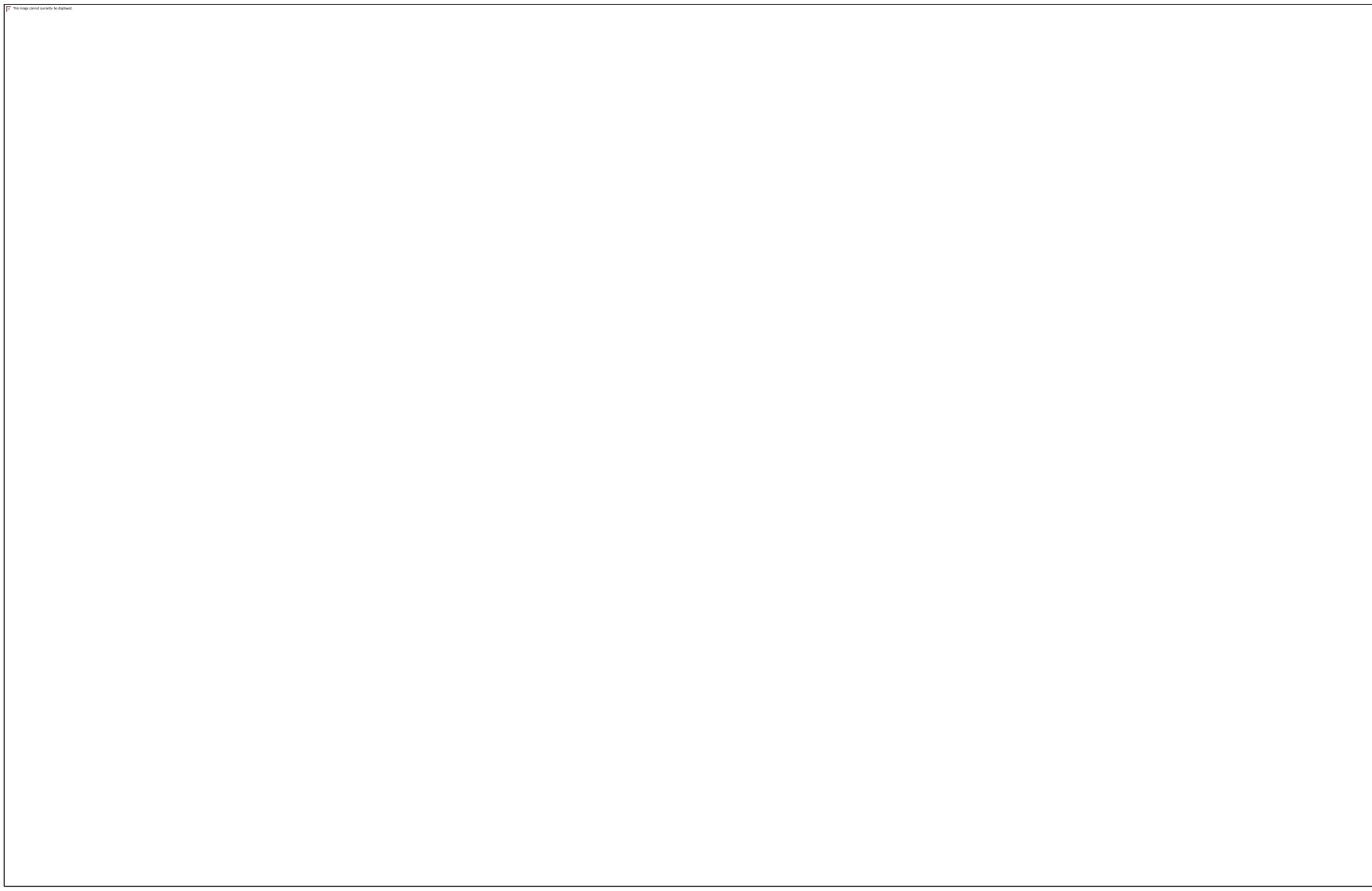


Figure 22. Chart showing types of incentives for horse rider respondents.

This shows that horse riders value the natural beauty of an area highly when considering the important aspects of their activity. The chance to relax is also valued highly, with some respondents valuing the fun and excitement that is brought by their activity.

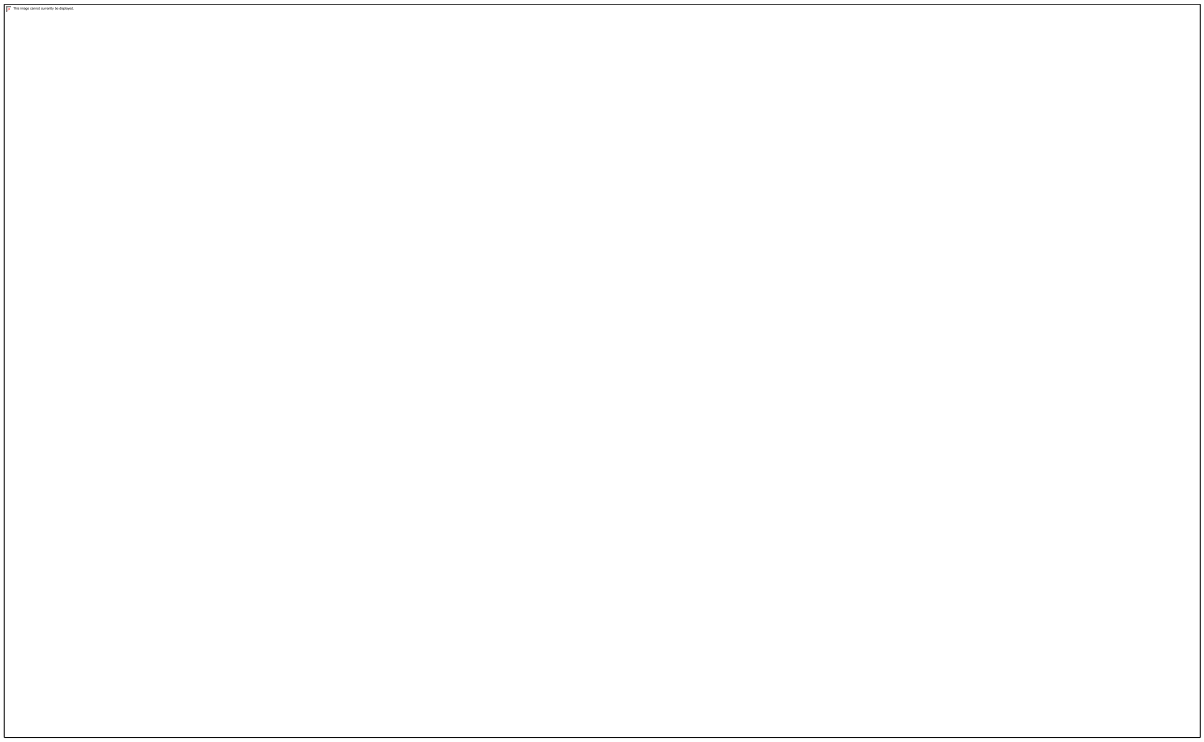
Figure 23. Chart showing types of incentives for mountain biker respondents.



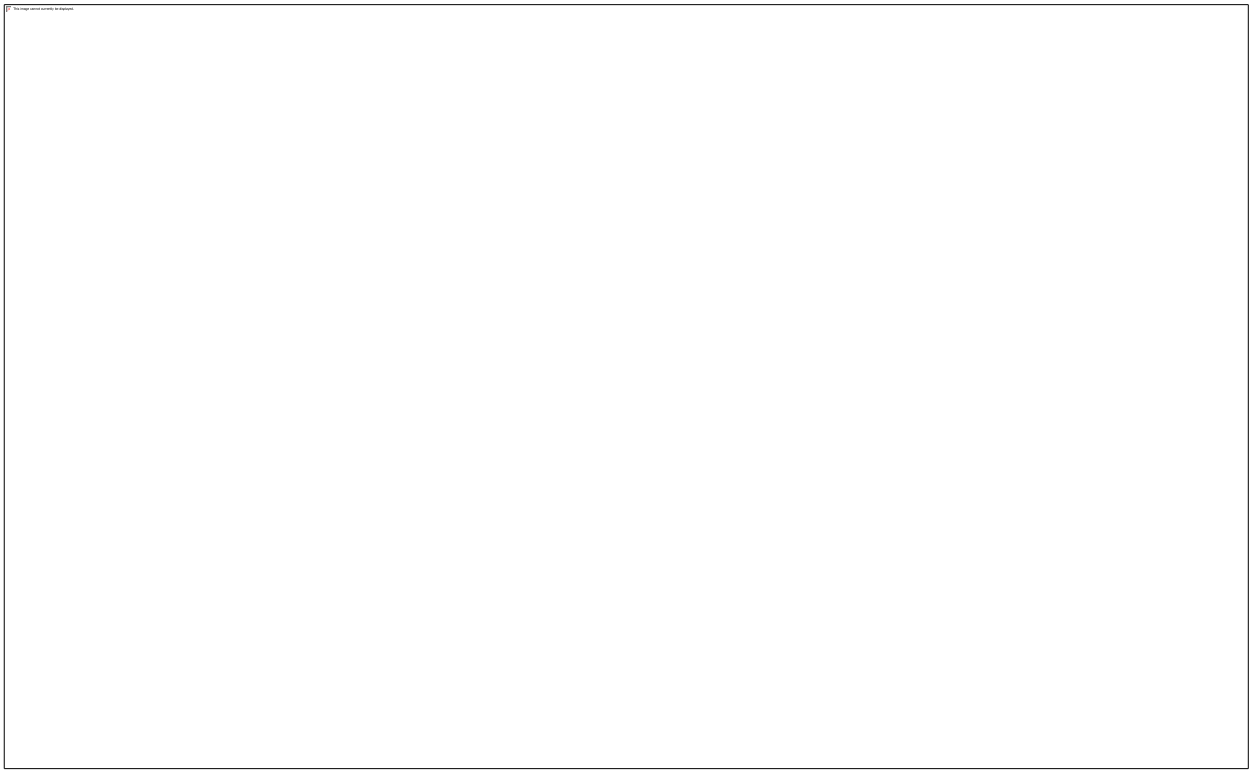
This shows that mountain bikers do not consider the natural beauty of an area to be highly important when taking part in their activity. The fun and excitement experienced when riding was considered the most important aspect, while socialising was the second most important. A desire to exercise was also considered important, while the natural beauty and the ability to relax was also considered important by some respondents.

Figure 24. Chart showing the trail characteristic preferences for all groups of respondents.

1. **Trail width.**

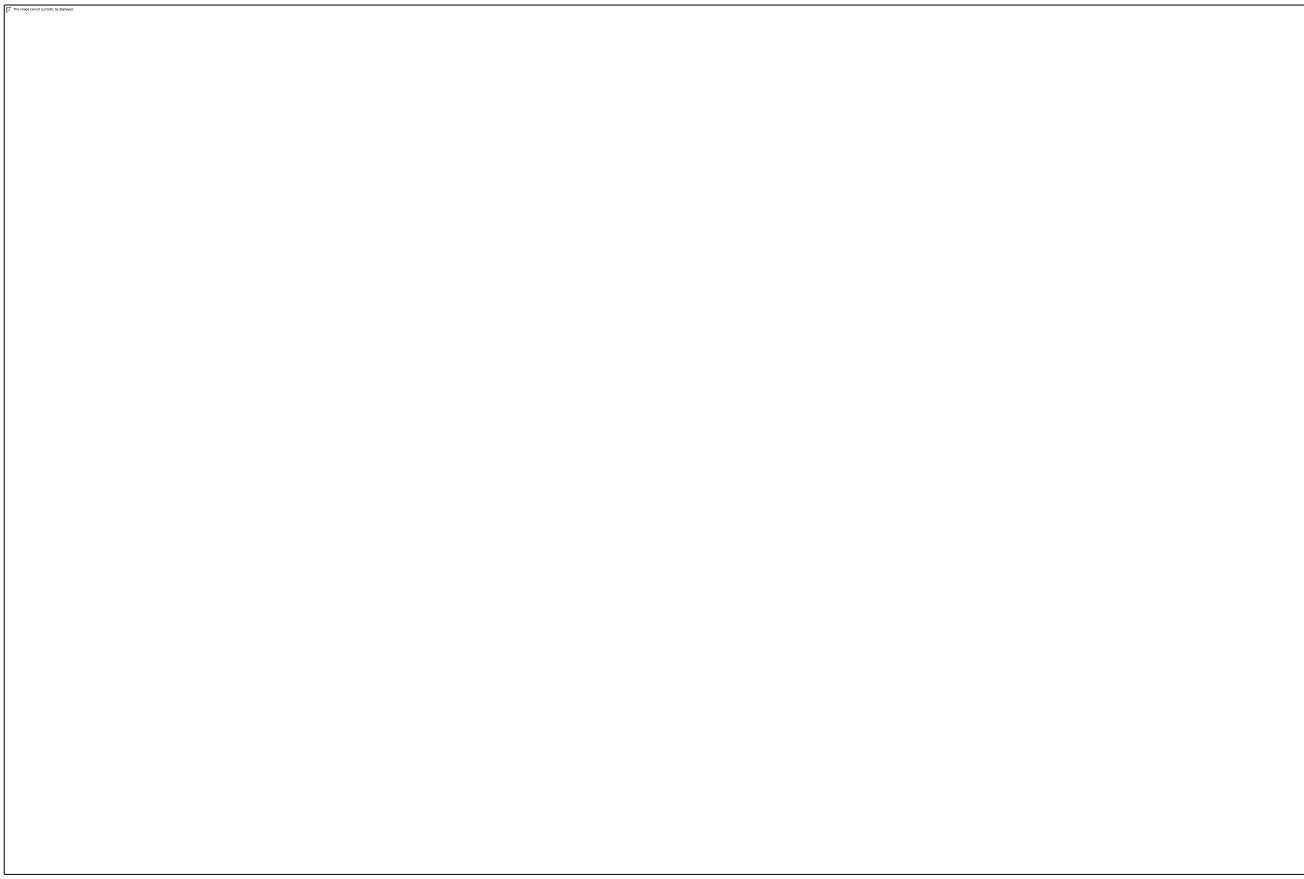


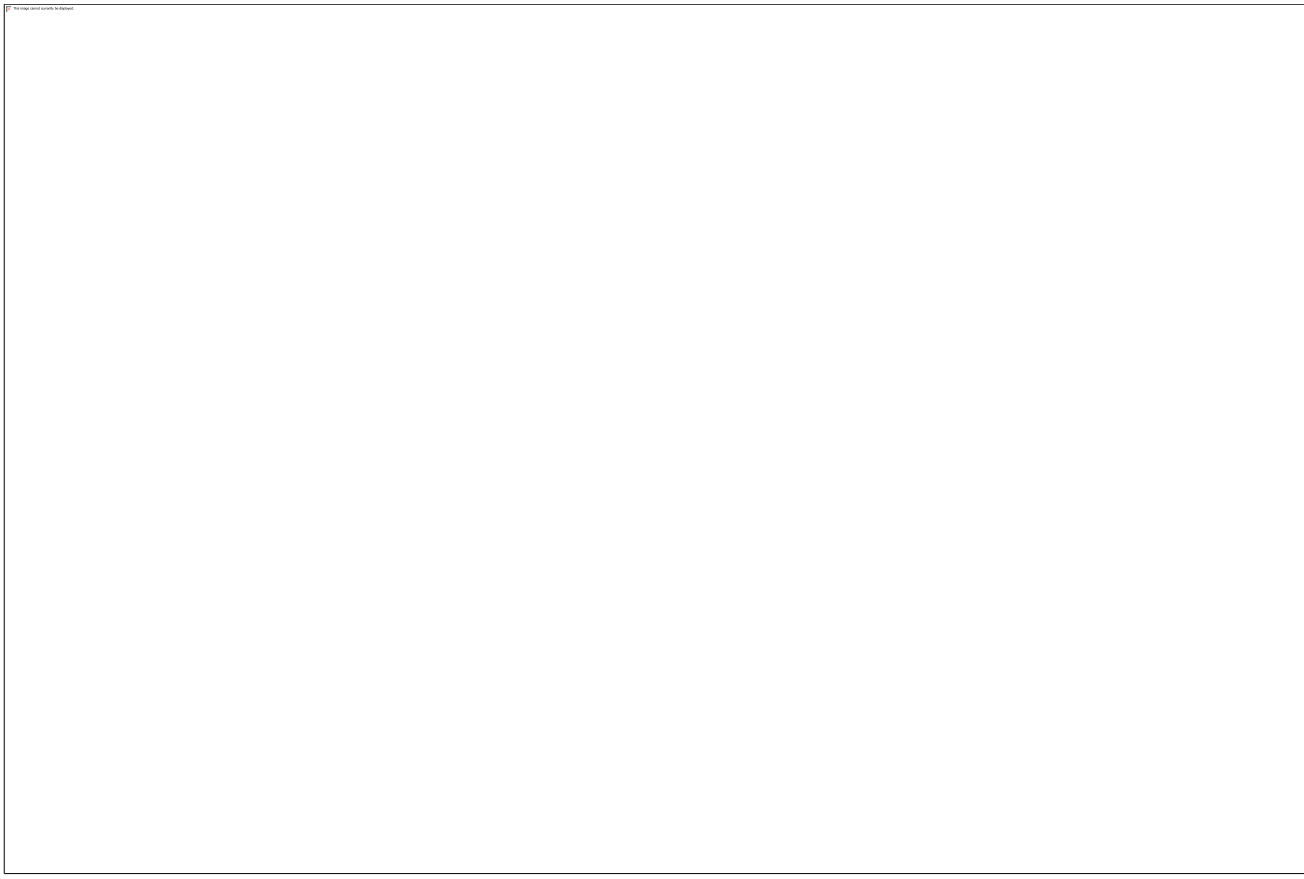
This shows that mountain bikers prefer narrow trails to wide trails, while horse riders prefer wider trails. Hikers prefer narrow trails, but a significant number also prefer wide trails.

2. 

Angle/steepness.

This shows that horse riders prefer long, less steep trails, while other users prefer a mix of steep and no-steep trails.

3. 
4. **Openness.**



This shows that horse riders prefer open type trails, while mountain bikers tend to prefer secluded trails, though a significant number responded otherwise. Hikers tend to prefer a mix of trails.

5. **Trail "windiness"**

This shows that horse riders prefer straight trails, while mountain bikers and hikers prefer trails that wind and turn.

3.4(4) Mountain biker-specific questions.

Table 7. Responses to: Have you ever received a negative response from non-mountain bikers that you have met while riding?

This shows that most mountain bikers have received negative responses from other countryside users.

Table 8. Responses to: Have you ever had trails restricted from you, or areas filled in or knocked down (to prevent you from riding)?

- And why do you think this was?

Trails restricted?	*legal*	*old*	*hostility*	*danger*	*conservation*

yes	15	4	2	6	5	4
no	7					

The available reasons (tick boxes) were:

- **Landowner / ranger hostile to MTB's**
- **Landowner / ranger too old to understand**
- **Landowner / ranger worried that MTB's are dangerous to yourselves or other users**
- **Conservation issues**
- **Administrative / legal issues**

This shows that most mountain bikers have experienced trail restrictions at some point, and that the perceived reasons for this are varied.

Table 9. Responses to: Have you ever built, created or altered trails without the express permission of the landowner, and did you consider this to be damaging, beneficial, or neither beneficial nor damaging to the local habitat, or did you not take it into consideration?

This shows that 50% of the mountain biker respondents had built or altered trails themselves, and while almost half did not consider the impact of their actions, only one respondent considered that their actions were damaging to the local habitat.

4. Discussion.

4.1 Visitor types at Bestwood Park.

From the visitor count, (see figure 1) it can be seen that the majority of users (63%) at Bestwood are on foot, while mountain bikers make up a smaller but significant proportion of the visitors (28%). Horse riders were much less frequently observed (9%), but should of course be considered and provided for. The fact that the majority of visitors are walkers should indicate that trails might need to be primarily designed for walkers, but does not mean that cyclists or horse riders can be ignored. A much more comprehensive visitor count carried out on numerous trails and entry points, preferably over a long time span, needs to be carried out.

4.2 Erosional impacts of different users.

One of the most immediate observations to be made from the erosional study results was that the horse trail substrate was much looser than any other trail. The soil was very sandy and was easily shifted under foot pressure. It was also far deeper than

footpath trails, at 24cm deep compared to 16cm and 5cm. This reflects findings in studies such as Wilson and Seney (1994) and Weaver and Dale (1978) that horses' hooves made more sediment available than feet or wheels, and that this effect was more pronounced on pre-wetted trails. The markers placed on the horse trail were almost destroyed during the first week, while the other trails took much longer to reach the same level of erosion. The sloped horse trail actually took longer to fully erode the marker, but this may be due to the sloped trail being at least twice as wide as the lesser sloped trail, and therefore dispersing the impact of horse hooves over a larger area.

The footpath trail showed a clear distinction in level of erosion between the sloped and unsloped trail. The sloped trail became more eroded more rapidly than the unsloped trail. There was no distinct evidence of trampling or erosion caused directly by foot impacts, but there was distinct evidence of a gully forming due to water runoff. The gully was far more pronounced on the sloped section of trail. The gully became most apparent on week three, after a heavy rainfall period. This gully caused the centre of the trail to become significantly deeper and exposed large rocks. The edges of the trail and the erosion marker at the edges did not appear to be affected by the runoff. This would indicate that the main factor influencing the erosion of this footpath was rainfall and resulting runoff. The heavy rainfall also appeared to affect the horse trail, in that the depth of the trail increased significantly. At week five, the depth of the horse trail decreased - sediment was deposited onto the trail. It could be assumed that this sediment was made available from further up the trail and was washed down by rainfall until it was deposited onto a level section where water flow velocity was decreased. This mechanism could be investigated by the use of tracers placed in the sediment and tracking their movement along the trail. During this last week, the rainfall gauge was disturbed and a measurement of rainfall cannot therefore be determined.

After an initial dramatic level of erosion, the cycle trail eroded only gradually, and the trail depth did not change significantly during the study. This may indicate that the methods employed for this study are inadequate, since the initial level of erosion is recorded as high for all trails, which then erode gradually. The difficulty in finding a trail only used by mountain bikers should be addressed in further studies.

The maximum temperatures increased steadily from week to week in the study period, which may also indicate that more visitors used the trails each week, but this cannot be confirmed, and many other variables would affect the number of visitors to the area.

Some conclusions can be drawn from this study, initially that horse hooves make significantly more sediment available than the feet of walkers and hikers. This finding confirms those by Weaver and Dale (1978) and Wilson and Seney (1994). Weaver and Dale also found that trail depths tend to be greater on sloped trails, and that erosion per user decreases when the cumulative number of passes on the trail increases. This study appears to correlate with these findings. Weaver and Dale (1978) also commented that damage was generally greater on slopes than on level ground, and these findings appear to match that expectation well.

Heavy rainfall distinctly caused a high degree of erosion during the study period, on both the footpath and the horse trail, but in significantly different ways. The horse trail did not appear at first sight to be affected by the level of rainfall, but the presence of a

large amount of loose sediment at the base of the trail and the increase in sediment during part of the study shows that rainfall is a significant factor.

Previous studies (Helgath, 1975; Dale and Weaver, 1974) have shown that trails depths depend on compaction and erosion, and therefore on climate, vegetation type, soil and substrate type, slope and type of user.

4.3 Erosional impact characteristics of mountain biking.

Previous studies (Weaver and Dale, 1978; Smith and Dickson, 1990) have shown that wheeled vehicles such as bicycles have less impact on downhill slopes due to exerting lesser downward forces than horses or hikers. This assumes though that the wheels continue to turn rather than skid as with hard braking or cornering. Keller (1990) noted that downhill mountain bike travel has the greatest potential for environmental impact to the trail (caused by skidding and poorly executed braking) and also commented that land managers often observe that bicycles can create a linear track in the trail. This linear track can promote the channelling of water, which as observed earlier, can contribute significantly to trail erosion and damage.

It is clearly seen from Table 2 that significantly more erosion occurs when weight is shifted on the bike, such as on a corner, before a corner, or under braking. Very little erosion was seen when the trail was straight, and the rider had no need to shift their weight, brake, or accelerate. On corners, most erosion was observed on the outside edge of the turn, which indicates that over time, a trail may change shape and direction due to the erosion of the turning points. It also means that if a trail is to be designed, surfaced, or repaired, attention should be given to the design and surface of any corners in the trail, especially if the trail is downhill and may therefore be ridden at high speed. Heavy erosion was seen to occur under braking, and it was also observed on other trails that sections of trail that induced heavy braking were often rutted and heavily eroded. Significant levels of erosion were observed immediately before corners, where riders were braking to achieve the correct cornering speed. It has also been observed on heavy use cycle trails that the sections of trail immediately before a turn or corner can become heavily eroded and that roots and rocks may become exposed after prolonged use.

Figures 2 and 3 demonstrate how the angle of the trail affects the degree of erosion. Steeper trails are more susceptible to erosion than less steep trails. (Weaver and Dale, 1978; Wilson and Seney, 1994) A steep trail may for example be more susceptible to shearing forces due to gravity and water runoff, though it is more likely that it is the speed and action of the bicycle that is the crucial factor. A steep downhill trail will of course increase the speed of the bike and rider, which will in turn increase the possibility of erosion and trail damage. A trail that follows the slope of the area directly will demand more braking and skidding from the rider, whereas a trail that runs more across the slope will not demand much braking from the rider and therefore the degree of erosion will be less. Trails that follow the slope also channel water down the trail and increase erosion compared to trails running across the slope. (Bratton *et al*, 1979)

Comparison with the uphill study (Table 3) shows that turns in the trail did not affect the level of erosion caused by the bicycle. This contrasts with the findings of the

downhill study, and is probably due to the speed of the bicycle. On an uphill trail, the bicycle is moving far slower than on a downhill trail, and the erosion is not caused by cornering or braking, but by the continual "acceleration" of the bicycle and the shearing forces produced by the rider. On a downhill trail, a cornering bicycle is fighting the momentum of the bicycle and rider, and this extra force is exerted onto the trail substrate. On an uphill trail, due to the decrease in speed, the momentum of the bike plus rider is far less, therefore the weight shift and change in velocity will not result in much force exerted onto the trail substrate. The same would apply to a slow moving rider on level ground. Interestingly though, an uphill rider still exerts a significant force onto the trail even when the trail is straight; and this force is greater when the angle of the trail is greater. Figure 3 shows how the angle of the trail affects the degree of erosion - again the steeper the trail, the greater the erosion. The correlation is much better for the uphill trail results, which could be due to fewer variables (such as corners and obstacles) affecting the results.

It can be seen from table 2 that any rooty or rough sections in the trail did not suffer significantly more erosion than smooth sections. A slight increase was apparent, which could be due to the experimental method - as a section is more rough, it is more difficult to apply the erosion marker as evenly as on a smoother section. It was apparent though that some riders were braking before the rough sections, presumably to achieve better control over the section. This braking may be the cause of some erosion before sections such as this.

Table 4 shows the results of a second downhill trail study which concentrated on a much older, and more frequently used trail. The trail had developed banked corners, probably due to the effect described previously of the erosion mostly occurring on the outside edge of the trail. The level of erosion on this trail was significantly less after the same number of passes, which confirms findings by Weaver and Dale (1978) that the erosion per pass decreases as the number of passes increases. The banked corners suffered much less erosion than the non-banked corners in the previous trail. This would indicate that a banked corner lessens the shearing forces applied by the bicycle as it passes. This subsequently may indicate that, under the correct conditions, an old and well-developed trail may not require maintenance or repair, even under high use.

The water content of the trail was not considered in this study, but as Weaver and Dale (1978) and Bratton *et al* (1979) demonstrated, there is a strong correlation between soil moisture and a soil's ability to bear a moving load. Weaver and Dale (1978) also noted that trails located on poorly drained soils are usually deeper, wider and less uniform than trails on well drained sites. Bestwood Park contains a variety of soil types and a wide variation in the drainage capacities of sites. These must be taken into account when designing or maintaining trails.

These results demonstrate that effective trail design and management techniques could drastically reduce the physical impacts of mountain biking. The use of banked corners can reduce the immediate impact on the trail but may increase the average speed of the biker. This is evident at trails such as the man-made downhill course in the Crimea Plantation, where erosion levels are very low compared to the number of riders on the trail, but the speed of the mountain bikers is far higher than on other trails. Trails need to be designed therefore to match the needs of the user - if it is a multi-user trail then it clearly cannot be designed for high speed mountain biking. It can also be seen from

both table 2 and table 4 that where there is an obstacle (a "drop off", which is much like a large step, in this case) the level of erosion is not significantly higher. Slight compaction effects were observed immediately after the drop off, where the wheels of the bicycle were impacting the ground, and a few riders were seen to brake immediately before the drop off. The drop off in this study consisted of a square boulder protruding from the trail, forming a step around 6 inches high. An object such as this is extremely resistant to erosion and could therefore be extremely useful in trail design.

4.4 Discussion of questionnaire findings.

As figure 4 shows, mountain bikers are generally younger than other countryside users, with all but one respondent being under 30 years old, out of 16 who answered the question. Horn (1994) also found that the majority of mountain bikers were aged between 20 and 29, while other non-mountain bikers were usually middle aged or older. The hiker respondents in this study show the most diverse age groups, with some respondents aged 50-60. This indicates that many of the mountain bikers have grown up with mountain bikes while to a number of other users, mountain bikes may be considered a "new" technology, which may account for some of the conflict between users.

The vast majority of mountain biker respondents were male, which correlates well with the findings in Horn (1994). The hiker respondents were split equally between male and female, which was again a replication of the results of Horn (1994) where the walker respondents were split equally. The fact that all the horse rider respondents were female is notable, since the survey was conducted in a number of different ways, and even the internet based survey produced no male horse rider respondents. It is possible to conclude that the high conflict between mountain bikers and horse riders (see figure 11) may be in part due to the intimidation felt by female horse riders when encountering a group of young male mountain bikers.

The fact that most of the mountain biker respondents in the survey were young and male is reflected by the opinion of the respondents in the survey (see figures 13 and 14.) When asked whether they think mountain bikers are young, old, male, or female, the overall response was that they were young males, although a significant number responded that they believed mountain bikers to be of mixed gender and age.

Figure 6 shows that there is a remarkable similarity in the proportions of respondents in each group that belong to environmental organisations, and figure 7 shows that all groups are very similar in their response to being asked whether they would volunteer to help maintain and improve trails. Previous studies have shown that conflict can occur due to perceived differences between different groups values; i.e. hikers believe that the majority of mountain bikers do not value the environment that they use as much as the hikers value it. This has been shown not to be the case in this study and in others such as Horn (1994) and Watson *et al* (1991), where it was found that there was no significant difference between user groups on whether they belong to environmental organisations, education, income, and occupation. Figure 8 shows that there was not a marked difference between the groups when it came to the highest qualifications that they possessed. Mountain bikers clearly showed a trend towards lower qualifications, but

this could be entirely due to the lower average age of the mountain biker respondents. It must be remembered that due to the low sample size and large number of categories, these results are not very significant.

Whether or not you know the landowner of a particular recreation or countryside site can greatly influence your ability to use that place, since users who can and do contact the land owners or managers can quickly get their opinions and concerns heard, and action can be taken. When a particular user group cannot or do not contact the landowner or manager, it is possible that that user group may become disadvantaged with respect to trail allocation and facilities. Figure 9 demonstrates clearly how mountain bikers are less likely to know the local landowner or manager, whereas horse riders are most likely. There may be a number of reasons for this distinction, such as average age and social class of the groups. Younger recreationists are less likely to be involved in political activity, due to want or ability.

Previous studies (Keller, 1990; Coughlan, 1994; and Horn, 1994) have shown a major perception among other users that mountain bikes present a significant safety hazard. Although a belief about the majority may be caused by the actions of a minority, the concern that mountain bikes may pose a hazard is legitimate. Figure 10 shows that more horse riders believe mountain bikers to be a hazard more than other groups, although mountain bikers and hikers believe to the same extent that mountain bikes can pose a danger to other users. It would be interesting to find whether the mountain biker respondents believed themselves or other mountain bikers to be the hazard to other users, and whether mountain bikers may pose a danger to other mountain bikers. Many horse riders in the survey responded that although they believed mountain bikers to be a danger, the danger was actually towards walkers and mountain bikers themselves rather than the horse riders.

Some of the concerns voiced over mountain bikers included:

- **Mountain bikers riding too fast for the conditions, such as on crowded, multiple user trails.**
- **Mountain bikers not slowing or stopping when encountering other users or on blind corners.**
- **The rapid and silent movement of mountain bikes can surprise hikers and equestrians on trails.**

Many of these concerns are legitimate and must be addressed when managing or designing trail systems. It was even observed during interviews with horse riders at Bestwood that mountain bikers frequently scare the horses, due to riding rapidly towards them from behind. Horses were seen to bolt due to mountain bikers exiting a downhill trail at speed. In the Los Padres study, Grost (1989) observed that most of the concerns over danger to other users result from a minority of riders who ride the downhill trails at speed. In this case, management methods were able to solve the problem by education and trail design using rocks and other natural objects as speed barriers.

It must be remembered however that although potential hazards do exist from irresponsible riding, cases of actual accidents or injuries are not common. (Cessford, 1995) The threat of an accident can often be different depending upon the user, i.e. an

older walker, with less rapid reactions and who may be less able to hear the bike coming will be more likely to be concerned about a meeting with a mountain biker; while younger users with more rapid reactions will be less concerned, especially if they are familiar with mountain bikes. (Horn, 1994). Keller (1990) noted that a hiker might think "boy, that was close" while the cyclist felt in control of both the bike and the situation. (Cessford, 1995) This situation is similar to the feelings of mountain bikers who ride on the road and in the city, where their lack of control over the situation causes them to dislike riding in the city. Possibly the best methods to deal with the safety hazards are education of the mountain bikers and the use of trail management techniques and design. Trail signs such as "Mountain bikers, please give way to walkers" may provide an effective method of reducing conflict and the risk of accidents. A sign such as this has two effects: it firstly tells mountain bikers to be careful and courteous, and secondly prepares walkers for the eventuality of meeting mountain bikers on the trails (Kennet and Hughes, 1994). On horse trails, it may be necessary to alter the sign to indicate horse riders instead of walkers.

Conflict between users is a major component of recreation management, and can be a difficult thing to quantify and identify. Figure 11 shows that mountain bikers have experienced conflict with all types of user given. This is presumably because the mountain bike allows access to nearly all types of place, and mountain bikers may encounter many types of person when visiting these places. Hikers had experienced conflict with all types of user except for landowners, which could be due to hikers and walkers being more "accepted" generally than other types of user. The majority of conflicts experienced by mountain bikers were with hikers. This finding does not match previous studies (Horn, 1994; Basiliere, 1999). These studies have indicated that mountain bikers are increasingly concerned about the political activity and pressure of some hiking and walking groups that attempt and often succeed in closing trails to mountain bikes. Horn (1994) stated that many respondents cited the attitude of walkers and the associated anti-riding advocacy as a major cause of conflict between the groups. This evidence may be an example of this conflict in action, or may simply be due to the types of area that these mountain bikers visit being mostly visited by hikers and few other users, or a result of the questionnaire technique.

Mountain biker respondents also reported a significant amount of conflict with horse riders, and these respondents were mainly those that rode frequently at Bestwood Park. The horse rider respondents cited mountain bikers as the main source of conflict, with the details usually related to the danger that the mountain bikers present and the irresponsibility of riders. Many of the horse riders complained of mountain bikers riding on the horse trails, and that this combined with their speed and silent movement, caused situations in which the horse would get extremely alarmed, and potentially ruin the horse rider's excursion. The mountain bikers in question possibly do not fully understand the extent of their actions, although many mountain bikers, when asked, replied that they were aware of the difficulties that horse riders experience when in this kind of situation, but also stated that they do not ride on the horse trails. Both groups however stated that many horse trails are not marked or signed in places and that this can cause problems because the horse riders believe that the mountain bikers are on the wrong trail, and the mountain bikers likewise think the same of the horse riders.

Table 5 shows that the majority of mountain biker respondents have experienced negative responses from other non-mountain bikers. Most of the responses involved

situations where other users had complained about the presence of mountain bikes in that area, and the majority of complaints were about excessive speed and resulting danger, and the damage that the mountain bikers were assumed to have caused. Many of the respondents stated that they believed that they themselves were not the direct cause of the conflict, but that a small minority cause a problem, which then gets blamed on the majority. A small proportion did admit that their behaviour was most probably the cause of the conflict, but they believed that they "had a right" to behave in that manner and that other users should not "interfere". Some respondents did not know or could not understand why they received a negative response from other users.

Many of the horse riders stated that more trails would solve many of the conflict problems between them and mountain bikers. Figure 12 shows however that more cycle trails are not believed by horse riders to be the answer, the most popular responses to the questionnaire by horse riders were to have more horse only trails, more bridleways, and more footpaths. Mountain bikers conversely believed that more cycle trails should be provided, along with more bridleways. The allocation of bridleways however would not seem to be the answer to reducing conflict between horse riders and mountain bikers, since they would still come into contact with each other regularly. The hiker respondents tended to state that they wanted more footpaths, along with some requesting more bridleways, and a minority requesting more cycle trails. A clear pattern emerges that each user group would like to see more of "their" kind of trail, while both hikers and mountain bikers did not request more horse only trails, but did request both footpaths and cycle trails. As mountain bikers are likely at some time to be hikers themselves, it can be seen that they may be sympathetic to wanting more footpaths, and possibly hoping that by reducing the density of hikers on the multi-user trails, the multi-user trails will be better for mountain biking. The same explanation would of course work for hikers requesting more cycle trails - to reduce the number of cyclists on the multi-user trails. Horse riders may not consider more cycle trails to be the answer because they do not share their trails at present, and any such measure would be unlikely to have a significant effect.

The majority (83%) of horse riders in the study believed that the use of mountain bikes should be restricted (see figure 20). A significant number of hikers also believed that the use of mountain bikes should be restricted, and one hiker believed that they should be banned altogether. This certainly indicates that there are strong feelings that mountain bikes need to be controlled in certain areas or at certain times. Interestingly, two respondents who both rode mountain bikes and hiked believed that mountain biking should be restricted, while none of the mountain biker alone respondents believed that the use of mountain bikes should be restricted. Many mountain biker respondents believed that there were simply not enough trails, and that restrictions would just increase the impact on other trails.

Figure 16 shows the percentages of respondents who believe that mountain bikers are provided for in these areas of the countryside. The mountain biker respondents were split equally between those that believed they were provided for and those that believed they were not. The interesting result is that of the other users, the vast majority believed that mountain bikers were not provided for, though a large proportion expectedly also responded that they did not know whether mountain bikers were provided for. When asked, many respondents stated that there were not enough places for the mountain bikers to ride without affecting other users, and many believed that mountain bikers

were not happy with the areas that they had at present. This implies a reasonable amount of previous thought by these respondents on the matter, and that the issue may be more significant than previously thought. Many mountain bikers, when asked, stated that they "do not expect" any more than they already have, and many feel that it is up to themselves as mountain bikers to push for more trails.

Previous studies (Watson *et al*, 1991; Horn, 1994; Bjorkman, 1998) have shown that in general, hikers and walkers do not like meeting mountain bikers on trails and that the presence of mountain bikers can often detract from their experience. Figure 15 shows that the vast majority of respondents do not believe that mountain bikers detract from their enjoyment of the countryside, but 20% of hikers and 10% of horse riders do believe that mountain bikes detract from their enjoyment. They were not asked whether the presence of other hikers or horse riders detracted from their enjoyment, which if the case would simply show that these particular users value the wilderness feel of the countryside and that the presence of any other user may detract from their experience. 50% of mountain bikers stated that the presence of other mountain bikers could improve their enjoyment of the area, which may show that a certain amount of crowding may be tolerated more easily by mountain bikers. This can be confirmed by the incentives that were described by mountain bikers. From the survey (figure 24), it can be seen that socialising is the second most important incentive for mountain bikers, with the thrill and excitement of the experience the primary incentive. This contrasts with figure 22 - the incentives for hikers. Hikers placed the appreciation of the natural beauty of the area and the chance to relax as the primary incentives. The horse rider respondents were very similar and more specific in their responses. While some hikers did place the thrill and excitement high, together with a few responses of socialising, fitness, and to learn, horse riders only responded with three categories in total. These differing incentives and reasons for the activity may be a crucial factor in determining conflict between users. An interesting result from the survey is that the respondents that did both mountain biking and hiking as primary activities rated fitness as the second most important incentive for these activities. This could indicate that this type of person chose these activities primarily because of the exercise involved rather than as a leisure activity, which in turn may affect their attitudes towards other aspects such as conflict or trail preferences.

The fact that hikers and horse riders cite appreciation of the natural beauty as a primary incentive for using the countryside may mean that they place more value upon it than do many mountain bikers. Some mountain bikers did however place appreciation of the natural beauty as the two top reasons, which indicates that it is of high importance to some. It must be remembered that the age and experience of the respondents will have much to do with their incentives. It was clear that the older mountain bikers valued the natural beauty higher than did the younger mountain bikers. It must also be considered that simply because the natural beauty of an area is not a great incentive for the user, it does not necessarily follow that they value the environment and natural beauty any less than another user.

Figures 17 to 20 show the beliefs of respondents about the damage that specific users have on the countryside. It appears that hikers believe mountain biking and horse riding to be of roughly equal impact on the countryside, with hiking and walking least. Previous studies have shown that many hikers object to mountain bikers on trails due to the impact that they have on the environment, but if this data is considered, the impacts

and conflicts due to horse riders should also be investigated in order to develop a fully comprehensive multi-user management plan. Horse riders also showed roughly the same pattern of responses as hikers to this question, although many horse riders stated that although they believe that horses' hooves might cause more trail damage than other users, they believed that mountain bikers to be more damaging due to their behaviour, and the fact that mountain bikers often concentrate in one area. This view is certainly valid, and it has been observed in some areas where mountain bikers and BMX riders concentrate that severe vegetation loss can occur, together with litter problems and, in extreme cases, vandalism.

The mountain biker responses were clearly different however; the vast majority of respondents stated that horse riders caused the most damage, and also stated that mountain bikers were the second most damaging out of the options available. When asked, most responded that it was trail erosion that was the main problem resulting from horse riding on trails, and when asked about problems of litter and vandalism, many stated that that was the result of a rogue minority, who were also the causes of many other problems. Many mountain bikers considered this rogue minority type of rider not to be a "true" mountain biker, and also stated that many of the problems attributed to mountain bikers in these areas were often not due to mountain bikers at all, but local youths and children who abused the site, and generally did not even use bicycles on the site at all.

There has been very little research to date on what types of trail and settings different users prefer, and previously, managers have had to design trail systems without any knowledge of what the users want from the system. Many existing cycle paths are placed on existing off-road vehicle tracks or old farm trails that are wide, straight and open. Figure 25 shows that this sort of action can be pointless and detrimental to a user's experience. At Bestwood, the horse trails consist largely of narrow, steep trails; while from these results it is obvious that the majority of horse riders prefer wide, long, less steep, straight and open trails. Many horse riders commented that since many riding schools are located nearby, the type of trail at Bestwood is inappropriate. Most inexperienced riders (and horses) cannot traverse steep trails, especially when they are as loose and as sandy as Bestwood; and long, straighter, open trails are preferred because they are significantly easier. Many horse riders commented that they prefer to canter or gallop in places, but this is impossible in Bestwood Park due to the types of trail that are available.

The horse rider trail preferences therefore contrast greatly with the type of trail presently provided, and when compared to the trail preferences of mountain bikers, it can be seen why a significant number of mountain bikers ride the horse trails. Mountain bikers, although frequently expressing that a variety of trails is best in any situation, appear to prefer narrow, winding trails, with a mix of preferences about angle and openness. It has been shown in numerous studies (Cessford, 1995; Horn, 1994) that mountain bikers often prefer challenging, technical trails, and that the degree of experience of the biker will influence the type of trail that is preferred. Horn (1994) stated that bikers, like walkers, have a wide range of tastes and preferences and, in general, like variety.

The hiker respondents clearly preferred winding trails, and many preferred narrow trails, though there was a definite mix of preferences between slope of trail and degree

of openness. This would indicate that hikers prefer more of a mix of trails than other users, possibly because they are the most varied types of user with respect to age, gender, and experience. Mountain bikers have been known to prefer narrow "singletrack" trails that are secluded and windy, due to the enhanced feeling of speed and the demand for rapid reactions due to decreased visibility.

The majority of mountain biker respondents in the survey had experienced trail restrictions, and all felt hostile towards anyone responsible for doing so. Table 6 shows that the assumed reasons for the trail restrictions are wide ranging - from legal problems such as insurance and liability to conservation issues. Many respondents believed that the landowner or manager was simply hostile to mountain bikers. 50% of respondents had at some point built or created their own trails without the permission of the landowner, and while 50% of these did not consider the impact of their actions, only one respondent thought that the creation of these illegal trails may be damaging to the local habitat. This aspect of behaviour was illustrated when some mountain bikers built trails at Bestwood Park. Unfortunately, the area that they had chosen consisted of ancient woodland that was a remnant of Sherwood Forest. These mountain bikers were asked about their actions and stated that, at the time, they did not consider the ecological impact of their actions but they had subsequently realised that their actions may have impacted significantly.

It is probable that illegal trails would not get created, and less (if any) conflicts would occur between users if an effective and comprehensive trail system was designed and managed properly.

4.5 Experimental critique.

Due to lack of time and resources, much of the study was not as comprehensive as was hoped. Ideally, many more replicates of the mountain bike trail erosion would be carried out to obtain fully significant results. Comparative erosion studies should ideally be conducted for at least one year, to take into account the abiotic effects and different visitor densities during the seasons. The method of measuring erosion could be considered rather crude and, to some extent, subjective. A more accurate study would measure compaction, soil water content, vegetation cover, soil particle size, and would involve a much larger number of passes with many different riders. A study on a pre-designed and constructed trail would provide useful data, but was impossible to perform in this study for a number of reasons.

The survey of different users should ideally sample many more people from many more backgrounds, ages, and locations. This study largely consisted of respondents that were easy to contact, and many were at university at the time of the survey. A more comprehensive study would be much larger and sample many more people using Bestwood Park throughout the year.

The issues, problems and management strategies at other sites should be investigated, and while other areas were looked at in the observational data collection, the managers of other areas were not interviewed.

4.6 Conclusions.

- **Mountain biking in itself is no more damaging to the environment than other countryside recreation activities.**

- **The trail erosion characteristics of mountain biking are very different to other activities, and trails should be designed with these characteristics in mind.**

- **On downhill trails, corners erode rapidly; uphill trails show a continuous pattern of erosion, and places where mountain bikers are forced to brake hard are subject to high levels of erosion.**

- **It is more the actions of the minority of careless or inconsiderate mountain bikers that cause the majority of problems. Attention to this minority may prove more fruitful than attempting to change the behaviour of the majority of mountain bikers.**

- **Mountain bikers are indeed young males, as is believed by most users, but also appear to care for the environment just as much as other users; although the natural beauty of the settings and environment is not a primary incentive for the activity.**

- **There are substantial conflict issues between users, which are asymmetrical in nature, and need to be managed subsequently.**

- **Existing perceptions of mountain bikers, held by other users, are at times inaccurate and form a base for some of the conflict experienced. If these perceptions can be altered, then so can the levels of conflict.**

- **Different users desire different types of settings and experiences from their activity. Different users also hold different incentives for their activity. Existing and future trails and settings should match the needs and desires of the user(s) that will use those trails.**

5. Management recommendations.

Whilst the landscape has changed dramatically during the past fifty or so years to accommodate changes in farming and forestry practises, we have continued to try and squeeze leisure onto the old footpaths, existing forest and parkland, and wonder why this causes conflict. (Gordon, 1991) The network of existing cycleways and footpaths is increasing, which instead of lessening the pressure upon existing rights of way, may well increase the overall number of users. These users need to be accommodated, and many of these users will be using mountain bikes to utilise these newly provided facilities. Along with these users will emerge many more "serious" mountain bikers, and management of these will need to take a different form than existing methods.

5.1 General management techniques.

- **The horse trails present in Bestwood Park today are inappropriately designed for the particular users. Many are inappropriate for any type of user, and are**

severely degraded; some should therefore be temporarily closed for repair and regeneration.

- **The trail preferences shown by mountain bikers show that some horse trails would be better designated as cycle trails, and some footpaths may be more suited to being designated as horse trails. Strategic designation and placement of a small number of cycle trails may significantly reduce the conflict between all users. Monitoring of trails should be carried out to identify the primary user on each trail; trails may then be designated correspondingly. It must be remembered that freedom, including freedom of choice, is essential for quality outdoor recreation. Restriction of use should therefore be limited to essential situations.**
- **The provision of a "honeypot" to concentrate mountain bikers in one area of the Park may be considered. The siting of the honeypot will depend on factors too numerous to consider in this report. The honeypot should use encouragement rather than enforcement to attract the mountain bikers to that area and dissuade them from using other areas. Monitoring would be essential to prevent excessive degradation of the site.**
- **Large, wooden signs such as those already used in the park should be used at trailheads, designating the trail and providing other information.**
- **A speed limit should be put to use in the park. A mandatory, park-wide speed limit would be impossible to enforce and difficult to quantify. A single speed limit based on sight and stopping distances is far more reasonable. A speed limit requiring that riders are able to stop in one-half the distance they can see would be sensible and illustrate to the rider why the speed limit exists. This may also make the rider more aware of their impact upon other users.**
- **A code of conduct should be provided at entry points to the park. This may be designed by the park authorities, or the existing Countryside Commission code may be used and amended as necessary.**
- **Other users should be made aware of the presence of mountain bikers. This could take the form of signs in the park, or at car parks and entry points. A sign consisting of a simple image of a cycle may suffice, or could read: "Cyclists, please give way to walkers and horse riders." It must be remembered that a more intrusive sign will be more susceptible to vandalism and may cause resentment among users. Experiments with different signs should be carried out, maybe in the form of a survey, or by use of temporary signs in the park to gauge responses.**
- **Certain areas could be closed to mountain bikers during busy seasons or at times when the trails are most susceptible to damage. This would be an extreme measure, which may yield resentment among users and should only be performed if absolutely necessary.**
- **Rangers at the park should employ the use of mountain bikes as transport more frequently at the park. Communication with mountain bikers and other bicycle users should take place, emphasising the fact that those in authority may be mountain bikers too and hold many of the same values as those users.**
- **Mountain bikers at the park should be strongly encouraged to aid in trail maintenance and construction. These events could coincide with events concentrating on riding, such as the teaching of riding techniques by a highly experienced rider.**

5.2 Trail design and management.

- **One of the most obvious and worrying problems at Bestwood is that of degradation of the surface of trails. Some trails in particular are severely degraded due the heavy use of mountain bikes. One solution to partial trail degradation may be resurfacing; the addition of clay granules, gravel, cement or a combination of these may aid in preventing erosion and providing a more durable surface. It must be remembered that artificial surfaces can look very out of place and can significantly reduce the feeling of wildness of an area.**
- **One way travel on certain bike trails should be encouraged, but the direction of travel should be carefully considered.**
- **Bike trails should include many twists and turns to keep the riders' speed at a minimum and also because this appears to be preferred by the majority of mountain bikers. Other trails may not be suited to lots of turns due to visibility and the perceived or actual safety of other users.**
- **Switchback turns can significantly reduce the speed of a bike and can increase the length of a trail without taking up too much space. Switchbacks must be designed properly and screened effectively to prevent riders cutting the corner.**
- **Steep grades must be avoided in most situations. A small (<10 metres) steep section may be suitable in some situations as long as there is no need for heavy braking and a sufficient run-out is provided.**
- **Trails should be sited across the line of the slope, not parallel to it. Full bench construction (full trail tread supported by undisturbed soil rather than fill)* should be used as opposed to partial bench construction.**
- **Corners can be surfaced differently to the rest of the trail, since this is where more erosion can occur. A rough surface may slow down riders and prevent erosion; a smooth surface may encourage skidding.**
- **Rock and log barriers should mark the edge of the trail to prevent cutting and widening.**

***A full bench cut trail is fully cut into the slope, so that the trail is supported by established and hard packed soil; a partial bench cut is partially cut into the slope, with the rest of the trail supported by the matter that has been removed. A partial bench cut trail is more susceptible to erosion and will need to be retained on the outer edge with cribbing made from branches and sticks laid against growing trees or stakes.**

- **Barriers and obstacles (e.g. rocks, roots, bumps, downed trees, logs, and waterbars) should in appropriate places, be left on the trail. This will slow riders and also keep a natural feel to the area. These obstacles must not create a safety hazard.**
- **The use of drop-offs built into the trail using large rocks and boulders will add interest to the trail and slow down mountain bikers. An alternative route over the drop-off should be provided, but in a position that requires the rider to slow down to reach it; i.e. on the inside of a corner, with the drop-off on the outside. Drop-offs should not be less than 10 metres apart.**
- **Trail intersections should occur at angles to encourage one-way traffic, and reduce the danger from bikers crossing trails at speed. Trails should not join at right angles. Visibility must be kept high at trail intersections to avoid accidents.**
- **All trails must be well drained and kept free of standing water. Well-drained trails erode far less than poorly drained trails. Drainage mechanisms can be employed to slow traffic on the trail.**

- **Older trails appear to be less susceptible to erosion than new trails, therefore, the use of existing trails should be encouraged where possible instead of designing and creating new trails that require extensive maintenance and monitoring.**

APPENDIX

Name (Optional) ……

Contact (optional; email preferable, or phone)

……..

Where do you usually go to experience the countryside or take part in your favourite activity (e.g. hiking, at Bestwood country park)

……..

And about how often?

……..

Q1) Please put a tick in the box next to the activities you regularly take part in.

- **Hiking**
- **Mountain biking (MTB)**
- **Walking**
- **Horse Riding**
- **Off-road motor vehicle driving**
- **Motocross**
- **Road biking**
- **Fitness classes / working out etc.**
- **Other……**

Q2) How old are you?

- **Between 10 – 20**
- **20 – 30**
- **30 – 40**

- **40 – 50**
- **50 – 60**
- **60 +**

Q3) Are you…

- **Male**
- **Female?**

Q4) Do you belong to any environmental organisations or charities?

- **Yes**
- **No**

Q5) What is your highest qualification?

(Or equivalent)

- **GCSE's**
- **NVQ/BTEC (British)**
- **A-levels**
- **HND**
- **First Degree**
- **Masters Degree**
- **PhD or higher**

And what is it in?

……

Q6) If you ride MTB's, have you ever had a negative response from other non-MTBers that you have met while riding?

- **Yes**
- **No**
- **Don't know**

Q7) Do you consider MTBers to be a danger to other trail users?

- **Yes**
- **No**
- **Don't know**

Q8) Have you ever had a negative experience or hostile encounter with any other countryside recreationist, and what type of recreationist?

(Tick all relevant answers)

- **Hiker**
- **Biker (Mountain)**
- **Walker**
- **Horse Rider**
- **Off-road motor vehicle driver**
- **Motocrosser**
- **Other**

Q9) If you answered yes to any of the options in Q8, please briefly describe the incident(s).

Q10) To what extent would you like to see trail access allowed in your local area?

(Tick all relevant answers, leave blank if you think it should stay the same)

- **More footpaths**
- **Less footpaths**
- **More bridleways**
- **Less bridleways**
- **More horse – only trails**
- **Less horse – only trails**
- **More bike – only trails**
- **Less bike – only trails**
- **Less trails overall**
- **Don't know**

Q11) What is your general impression of mountain bikers?

- **Young**
- **Old**
- **Mixed age**

- **Male**
- **Female**
- **Mixed sex**

Other comments?

……..

Q12) What is your general impression of Hikers and walkers?

Q13) What is your general impression of horse riders?

Q14) Do you feel that MTB's and MTBers detract from your enjoyment of the countryside or not?

- **Detract**
- **Improve**
- **No effect**

Q15) For the activity that you take part in most often, or feel most strongly about, do you feel that your needs are provided for?

Activity: ……

Provided for?

- **Yes**
- **No**
- **Don't know**

Q16) Do you think MTB riders are provided for in the areas of countryside that you most regularly visit?

- **Yes**
- **No**
- **Don't know**

Q17) Out of the following types of recreationist, rate them for the amount of <u>overall</u> damage that you think they do to the countryside. (1 being lowest, 4 being highest)

- **Hiking**
- **Biking (Mountain)**
- **Walking**
- **Horse Riding**

Q18) What kind of trails do you prefer? (Tick one in each section if applicable.)

- **Wide, open "fire-road" trails**
- **Narrow "singletrack" trails**

- **Short, steep trails**

- **Long, less steep trails**

- **Straight trails**
- **Winding trails**

- **Secluded, over-covered trails**
- **Open, light, non-covered trails**

Q19) Would you like to see the use of MTB's restricted or banned in woodland where all types of non-motorised user are allowed at present?

- **Restricted**
- **Banned**
- **No action**

Q20) Do you know who owns and maintains the area where you ride / walk most often?

- **Yes**
- **No**

Q21) Do you know how to contact them?

- **Yes**
- **No**

Q22) Have you ever met them, or a representative of them?

- **Yes**
- **No**

Q23) If you ride MTB's, have you ever had trails restricted from you or Riding areas filled in / knocked down?

- **Yes**
- **No**

Q24) Why do you think this was?

- **Landowner / ranger hostile to MTB's**
- **Landowner / ranger too old to understand**
- **Landowner / ranger worried that MTB's are dangerous to yourselves**
- **Landowner / ranger worried that you are a danger to other users**
- **Conservation issues**
- **Administrative / legal issues**

Q25) If asked, would you spend time maintaining trails and helping conserve the natural value of your favourite area?

- **Yes**

- **No**

Q26) If you answered no to the last question, then why not?

……

Q27) What are the two most important reasons for you to go out to the countryside?

- **To appreciate the natural beauty**
- **To get fit**
- **For the thrill / fun / excitement**
- **To relax**
- **To socialise**
- **To learn.**
- **Other……..**

Q28) If you ride MTB's, what would you like to see provided at your local woodland / park area?

Q29) If you do not ride MTB's, what would you like to see provided at your local woodland / park area?

Q30) If you ride MTB's, what type of riding do you do?

(Tick all that apply)

- **Dirt jumping**
- **Street**
- **Cross country**
- **Downhill**
- **Enduro**
- **Long distance**
- **Leisure only**
- **"Freeride"**
- **Only used as transport**
- **Trail riding / "exploring"**
- **Trials**
- **Flatland**
- **BMX**
- **Other**

Q31) If you ride MTB's or BMX, have you ever (with or without help) built, created, or altered trails without the express permission of the landowner?

- **Yes**
- **No**

Q32) Did you believe this to be damaging to the local habitat, or did you not take it into consideration?

- **Believed it to be damaging**
- **Believed it to be beneficial**

- **Neither beneficial nor damaging**
- **Did not consider the impact**
- **Other (please state):**

……..

Question rationale.

1. **To determine the activities that the respondent regularly takes part in – i.e. mountain biking or hiking.**
2. **To determine the age of the respondent.**
3. **To determine the gender of the respondent.**
4. **To determine whether the respondent belongs to any environmental organisations or charities – this would give an idea of how environmentally aware the respondent was.**
5. **To determine the educational status of the respondent, however this question is linked somewhat to age. Many respondents were studying at university when surveyed.**
6. **To determine if mountain bikers feel they receive negative responses from other users.**
7. **To determine the respondents perceptions of danger due to mountain biking.**
8. **To compare different users experiences of conflict with different users, or the same type of user if applicable.**
9. **To acquire details of conflict given in question 8.**
10. **To determine the beliefs and wants of the respondent about trail access and other users.**
11. **To determine whether the respondents' views of mountain bikers match with actual figures.**
12. **To give the respondent a chance to give their opinion on hikers.**
13. **To give the respondent a chance to give their opinion on horse riders.**
14. **To determine whether the presence of mountain bikers in the countryside setting detracts from the respondents experience.**
15. **To determine whether the respondent feels that their needs are realised and provided for in the countryside area that they most regularly use.**
16. **To determine whether the respondent feels that mountain bikers are provided for in the same area – this question would then be compared with the previous answer.**
17. **To determine which users the respondent feels are the most damaging to the countryside in all respects.**
18. **To determine the trail type and setting preferences that the respondent prefers.**
19. **To determine whether the respondent feels that mountain bikers should be restricted or banned from certain areas or whether no action should be taken.**
20. **21. 22. To determine how well the respondent knows the local landowners and managers and whether they have been in contact with them, or knows how to contact them. This would indicate how aware the respondent is in trail issues and also how active they are in the management process.**

23. **To determine whether (if a mountain biker) the respondent has experienced trail restriction or has had trails destroyed or closed to them.**
24. **To determine what the respondent feels the reason for this was.**
25. **A hypothetical question on whether the respondent would help maintain or build trails – this question was largely to put the respondent more at ease for the end of the questionnaire.**
26. **To carry on from the last question – if they answered no, then why not?**
27. **To determine what the most important reasons are for the respondent to use the countryside for recreation.**
28. **To determine what mountain bikers feel are needed to provide them with a better experience in the area they most usually use.**
29. **To determine what other users feel are needed for a better experience – two questions are used for respondents who mountain bike and perform other activities to separate their answers for each activity.**
30. **To determine what kind of riding, and to what degree, the respondent (if a mountain biker) prefers to do.**
31. **A filter question to determine whether the respondent has built any trails without the permission of the landowner.**
32. **To determine the environmental awareness of the respondent if they did build their own trails.**

References.

- **Adelman, B.J.E. Heberlein, T.A. and Bonnickson, T.M. (1982) Social psychological explanations for the persistence of a conflict between paddling canoeists and motorcraft users in the boundary waters canoe area. *Leisure sciences* 5(1): 45-61**

- **Anon. (Unknown date) Bestwood Country Park Management Plan. Gedling Borough Council and Nottinghamshire County council.**

- **Anon. (1999) Bikers in ban threat. Article in *The Nottingham Recorder*, July 15, p.6.**

- **Barlow, D. (unknown date) Effects of mountain biking in upland areas. Unpublished M.Sc. thesis, Nottingham Trent University, Nottingham, England.**

- **Basiliere, M. (1999) The asymmetrical nature of hiker - mountain biker conflicts. Unpublished undergraduate thesis, Lyndon State College, Vermont.**

- **Bjorkman, A.W. (1996) Off-road bicycle and hiking trail user interactions: A report to the Wisconsin natural resources board. Wisconsin dept. of natural resources bureau of research.**

- **Bjorkman, A.W. (1998) Biophysical impacts on and user interactions with mountain bicycle off-road trail corridors. Unpublished PhD thesis, University of Wisconsin, Madison.**

- **Bratton, S.P. Hickler, M.G. and Graves, J.H. (1979) Trail erosion patterns in the Great Smoky Mountain National Park. *Environmental Management* 3: 431-445**

- **Cessford, G.R. (1995) Off-road mountain biking: a profile of riders and their recreation setting and experience preferences. *Science and research series 93*. Dept. of conservation, Wellington.**

- **Cessford, G.R. (1995) Off-road impacts of mountain bikes. A review of literature submitted to the New Zealand Dept of conservation.**

- **Chavez, D.J., Winter, P.L. and Baas, J.M. (1993). Recreational Mountain Biking: A Management Perspective. *Journal of Parks and Recreation Administration*, 11(3): 29-36.**

- **Cole, D.N. and Bayfield, N.G. (1993). Recreational Trampling of Vegetation: Standard Experimental Procedures. *Biological Conservation* 63: 209-215.**

- **Coughlan, D.P. (1994). Recreation Resource Conflict, Utilisation and Allocation. Unpublished Postgraduate Diploma in Tourism Dissertation. University of Otago, Dunedin, New Zealand.**

- **Dale, D.R. and Weaver, T. (1974). Trampling Effects on Vegetation of the Trail Corridors of North Rocky Mountain Forests. *Journal of Applied Ecology* 11(2): 761-772.**

- **Devall, W. and Harry, J. (1981). Who hates whom in the great outdoors: The impact of recreational specialisation on technologies of play. *Leisure Sciences* 4(4): 399-418.**

- **Dixon, C.J. and Leach, B. (Unknown date) Questionnaires and interviews in geographical research. Pamphlet in series titled: Concepts And Techniques in Modern Geography.**

- **Gordon, C. (1991) Sustainable leisure. *Ecos*. 12 (1) (Unknown page nos.)**

- **Grost, R. (1989) Managing the mountain bike. *American Forests* 95: 50-53, 75-77.**

- **Gobster, P.H. (1988) Urban bicycle trails: use pattern and user preferences. *Trends* 25(3): 21-25.**

- **Helgath, S. (1975) Trail deterioration in the Selway-Bitterroot wilderness. USDA forest service research note INT. 193. Intermountain forest and range experimental station, Ogden, Utah. 15pp**

- **Horn, C. (1994) Conflict in Recreation: the Case of mountain bikers and Trampers. Unpublished masterate thesis, Dept of Parks, recreation and tourism, Lincoln University, Canterbury, New Zealand.**

- **Jacoby, J. (1990) Mountain bikes: a new dilemma for wildland recreation managers? *Western Wildlands* (16) 25-28**

- **Jackson, E.L. and Wong, R.A.G (1982) Perceived conflict between urban cross-country skiers and snowmobilers in Alberta. *Journal of leisure research* 12(4): 368-360**

- **Keller K.J.D. (1990) Mountain bikes on public lands: a manager's guide to the state of practice. *Bicycle Federation of America.* Washington DC.**

- **Kennet, J. and Hughes, P. (1994) Cycling in the wilderness – legitimate or not? Federated Mountain Clubs (FMC) newsletter, 1995. FMC, New Zealand.**

- **Kohlbrenner, W. (1999) Trail maintenance handbook for trail co-operators in the Lee ranger district of the George Washington National Forest.**

- **McKown, S. Ourston, T. and Frost, J. (1995) A synthesis of the literature and state of the practice. Federal U.S. report. National Bicycle and Pedestrian Clearinghouse.**

- **Robinson, A. (1987) Bestwood, The story of an Estate. Dalebrook publications.**

- **Ruff, A. and Mellors, O. (1993) The mountain bike – the dream machine? *Landscape Research* 18(3) 104-109.**

- **Sharpe, G.W. Odegaard, C.H. and Sharpe, W.F. (1983) Park Management. 1st ed. John Wiley and sons.**

- **Smith, D.L.O. and Dickson, J.W. (1990) Contributions of vehicle weight and ground pressure to soil compaction. *Journal of Agricultural Engineering Research* 46: 13-29.**

- **Soane, B.D. Blackwell, P.S. Dickson, J.W. and Painter, D.J. (1981) Compaction by agricultural vehicles: A review of compaction under tyres and other running gear. *Soil and Tillage Research* 1: 373-400**

- **Watson, A.E. Niccolucci, M.J. and Williams, D.R. (1993) The nature of conflict between hikers and recreational stock users in the John Muir wilderness. *Journal of Leisure Research* 26(4): 373-385**

- **Watson, A.E., Williams, D.R. and Daigle, J.J. 1991. Sources of conflict between hikers and mountain biker riders in the rattlesnake NRA. *Journal of Parks and Recreation Administration* 9(3): 59-71**

- **Weaver, T. and Dale, D. (1978) Trampling effects of hikers, motorcycles and horses in meadows and forests. *Journal of Applied Ecology* 15: 451-457**

- **Weaver, T. Dale, D. and Hartley, E. (1979) The relationship of trail condition to use, vegetation, user, slope season and time. Pp 94-100 in Ittner, R. Potter, D.R., Agee, J.K. and Anschell, S. (Ed's)** ***Recreational impact on wildlands conference.*** **October 27-28, 1978, Seattle.**

- **Wilson, J.P. and Seney, J.P. (1994) Erosional impact of hikers, horses, motorcycles and off-road bicycles on mountain trails in Montana.** ***Mountain Research and Development*** **14(1): 77-88**