INTERNATIONAL ORIENTEERING FEDERATION

ORIENTEERING
A NATURE SPORT WITH
LOW ECOLOGICAL IMPACT

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Summary

A view expressed by some ecologists is that orienteering, by its off-track nature and often with large numbers of competitors, has the potential for damaging flora and fauna. This potential appears not to be realised in practice. In the many thousands of orienteering events that are held worldwide each year ecological incidents resulting in unacceptable damage are extremely rare, close to zero. This document gives reasons why this is so and tests the expectation that orienteering has low ecological impact against a summary of reported scientific studies.

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1. **Orienteering and ecological impact - two opposed views**

This is a view from within the sport:

Silent runners, light of foot, gliding through the forest shadows, following faint paths or seeking a clear route, feet rustling in dry leaf litter. Navigation is tight: the compass needle fixed on North, the thumb tracing progress across the map; follow a wall, over a ditch, up to the saddle where the trees thin. The quarry is found between the crags; the small, sentinel orange-and-white marker, and the runners hardly pause as they mark their cards and wordlessly disappear into the forest. (Kennedy 2002)

This is a view from outside the sport:

We are particularly concerned that orienteering, more than most other sports, by its very nature causes very considerable disturbance to wildlife and damage to flora over wide areas. (New Forest Review Group 1987)

The first statement was written by an environmentalist orienteer to illustrate the nature of the sport. Although written in a style echoing the works of the German nature poet, Joseph von Eichendorff, it is a not inaccurate description of the fluency achieved in the sport at the highest level of competition. The writer has used words suggestive of orienteering being lightly impacting on the environment, if at all. It could be said that the writer’s environmental knowledge of the sport lends credibility to this interpretation. A disinterested observer might caution against such a conclusion, in that the statement may represent biased opinion rather than established facts, which would need to be supported by reliable evidence.

The second statement was published by a group reviewing sporting access to the New Forest, now a national park in the south of the UK. The writer uses words to indicate that excessive and widespread ecological disturbance and damage by orienteering are established facts. The disinterested observer might remark that such a definite statement needs to be underpinned by firm evidence rather than representing opinion, which could be biased.

The second statement, believed to be the most critical reported about orienteering in any country, was widely circulated. Enquiries investigating the basis for the statement showed that the Review Group had no firm evidence of impact but had taken note of anecdotal evidence, such as a report by a Head Keeper that:

Individual competitors are no respecters of wildlife or plants – young trees are flattened without compunction. (Velecky 1989)

The objectivity of this comment may be compared with research conducted in Sweden reporting that 2400 orienteers crossed a plantation of 15,000 newly-planted spruce saplings and destroyed none. (Kardell 1974).
The credibility of the New Forest Review Group report on orienteering was further eroded when it became evident that the unofficial and unstated purpose of the review was to promote the continuation of the hunting of deer on horseback, now banned by Act of Parliament in the UK, and to do so by diverting attention onto other activities.

The discrediting of this the most damaging statement about the environmental impact of orienteering does not, however, necessarily mean there is no substance in its claim. The disinterested observer might note that orienteering is an off-track sport sometimes involving large numbers of competitors and there is potential for disturbance to wildlife and damage to vegetation.

The true level of ecological impact of orienteering must lie somewhere between the two opposing statements above. The firm scientific evidence available to date is consistent with the sport being very lightly damaging. This paper reviews the evidence for this and explains why the sport, by its very nature, leads to such an outcome.

2. Some definitions

**Orienteering**

It is assumed that readers of this document have an understanding of the general nature of the sport of orienteering in which runners, acting individually, navigate across country from one control point to another, choosing their own routes with the aid of a specially prepared detailed map, and do so at best possible speed. Since the word ‘orienteering’ is not a registered trademark of the International Orienteering Federation or the member national federations, its use is widespread for a range of activities involving navigation. Many of those who claim to have experienced orienteering have actually taken part in a more basic activity of untimed map reading exercises, *often in groups*, sometimes involving grid references (Douglas 1989). This experience of group activity, which can be more visually and aurally intrusive than solo running, may explain why those not familiar with the sport tend to take a harsher view of its potential for causing ecological damage than is justified.

Orienteering is an international sport, which began in northern Europe but is now practised in all five continents. Europe is the area where orienteering participation levels are at their highest and consequently it is where most impact studies have been carried out to date. This document may therefore appear to be Euro-centric but the observations and conclusions apply in principle to all orienteering, everywhere.
Terrain
Orienteering takes place over a wide variety of terrains, from urban streets and parkland to wilder natural and semi-natural countryside. The best terrains offering high technical standards of competition are those with complex ground detail to test map reading and terrain interpretation, reasonable conditions underfoot to allow fluent running, and limited visibility (such as in woodland) to encourage competitors to act independently. The glaciated and forested landforms of Scandinavia with rock and other ground features are regarded as ‘classic’ terrain examples. Among other highly regarded landforms are sand dunes, open or forested, and even areas scarred by the hand of man, such as from early mineral extraction (Figure 1).

Figure 1: Examples of terrains of good orienteering quality; (Left): glaciated terrain in Finland; (Centre): sand dunes in Ukraine; (Right): moorland marked by early tin mining in England.

The terrains of high orienteering quality are, not surprisingly, often those that have high conservation value and it is understandable that there may be concerns about the potential for the larger orienteering events to impact upon flora and fauna.

Event layout
There are three distinct areas associated with an orienteering event: the car park, the competition centre and the competition terrain (Figure 2).
The Car Park provision is often a major factor in arriving at the layout of the event. Sometimes an acceptable orienteering area cannot be used because car parking cannot be found. The car park is usually adjacent to or within a 1km walk of the event. Sometimes the car park is more distantly located and competitors are brought in by minibus or other transport. The car park is located in places considered suitable for the purpose, in terrain of no ecological interest. The Competition Centre contains the administrative services (registration, toilets, results, etc.) and usually the finish to all the courses. This is the area where all the competitors gather before and after their runs. The concentration of many people over several hours gives the competition centre the potential for significant ecological impact. To avert this and also to provide sufficient space for all the arrangements, the competition centre is usually located in an open area adjacent to the competition terrain, often a farmer's field. Ecological problems with the competition centre are, by design, exceptionally rare.

The Competition Terrain is the area for which there may be concern that the competing orienteers could impose unacceptable ecological impact. It may be noted that, in Figure 2 the start is located in this area. There is potential for impact with all the competitors moving to the start but care is taken with the access route to minimise any effect.

**Competitor numbers**

The sizes of event, in terms of competitor numbers, and the frequency with which they are held, have an inverse relationship. There are very many small events, very few large events and only one or two exceptionally large events. A study by Laininen (1999) of orienteering activity in Finland quotes an annual total of over 4600 events, of which only 24 (0.5%) had more than 1000 participants. Over 90% of the events were very small, averaging 61 participants. Outside Scandinavia the frequency of events is considerably reduced. The event sizes also vary substantially from continent to continent but may be very approximately graded as follows:

<table>
<thead>
<tr>
<th>Type of Event</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local events</td>
<td>Up to 100</td>
</tr>
<tr>
<td>Regional events</td>
<td>100 - 500</td>
</tr>
<tr>
<td>National and international events</td>
<td>500 - 2500</td>
</tr>
<tr>
<td>Exceptional events</td>
<td>Over 2500</td>
</tr>
</tbody>
</table>

One or two exceptional events can have very large entries (the seven-leg Jukola relay in Finland with around 10,000 competitors, for example). It might be expected that such events would raise the most serious concern among ecologists, but this appears not to be so. These events are held in Scandinavia, which has a long tradition of large event
orienteering and this has led to a possibly better understanding of the ecological implications of the sport than elsewhere.

**Environmental and ecological impact**

These terms overlap. In the context of orienteering *ecological* impact refers to damage to flora and fauna in the competition area. *Environmental* impact includes that local damage and the more global impacts from carbon emissions by transport to the competition, use of energy and materials, etc. There have been a number of *environmental* studies of orienteering, such as the environmental audit of the World Orienteering Championships in Finland in 2001, which concluded that this event was “the most environmentally-friendly sports event of the year” (World Wide Fund for Nature, et al. 2001). Notwithstanding that complimentary overall conclusion, where concern is expressed about orienteering, it is almost always referring to the *ecological* impact in the competition area and that is the focus of this document.

**Disturbance and damage**

Damage to plants is easy to comprehend. It refers to visible deterioration, either immediate or delayed. The threshold for visible damage is usefully defined by Swedish ecologists as Damage Class 1, set so that a person not focussing on specific sites would not register vegetation damage in the terrain and would not be aware that an activity had taken place. Damaged flora can recover quickly, usually within one growing season, but sometimes more slowly, returning to pre-event condition within three seasons. Orienteering studies use this time scale for assessing recovery, although general ecological practice is for a ten-year interval before damage is declared permanent.

Disturbance to fauna requires more careful definition. Disturbance does not necessarily equate to damage, although it may do so. Consider the disturbance of deer. When disturbed, deer will move away, often at speed, to a place where they are not disturbed. Such disturbance does not constitute damage. However, if that disturbance and fleeing results in the deer coming to harm, then damage has occurred. Similar considerations apply to birds. A bird incubating eggs may be disturbed and leave the nest but, if permitted to return in good time, damage has not occurred. Similarly, if birds feeding young can return to the nest often enough, their survival is not put at risk.

Any disturbance and damage by orienteering (or other recreational activity) should not be viewed in isolation. It is generally understood that, except in relatively rare circumstances, the natural environment is very resilient to short-term damage (from, for example, fire, flooding, management activities), and that vegetation impacts in particular, whether from humans or animals in the terrain, should be viewed in this context.
Seed and disease dispersal

The possibility of seeds being transferred from one biogeographical region to another in the mud retained on running shoes is given serious consideration in Australasia, where ecologists have an understandable sensitivity about imported species. The cleaning of orienteering footwear is a common practice and requirement in that region but not, at present, insisted upon elsewhere.

The possibility of disease being transferred from site to site on running shoes is sometimes a reason for precautionary measures. These occur when the diseases of animal or plant are particularly virulent. Examples are past outbreaks of Foot and Mouth Disease (FMD) in cattle and the current so-called Sudden Oak Death affecting several species of tree and shrub caused by the pathogen *Phytophthora ramorum*.

3. Inherent characteristics of orienteering which lessen ecological impact

There are a number of ecologically-friendly features of the sport; some arise naturally from its inherent characteristics, others are specifically adopted in order to minimise ecological impact.

Dispersal in space

Since orienteering offers athletic sport for all ages and abilities (the youngest age group is under 10 and the oldest is over 90), it is necessary to provide a wide range of courses of different physical and technical standards. To plan these, a number of controls are placed strategically in the terrain and interconnected in different ways, as shown in Figure 3, to make up the different distances and technical standards required. Although the specified controls on a course have to be visited, the routes between them are not fixed and competitors choose the routes which best suit themselves, sometimes with widely differing results. The combination of many control points and inter-control route choice results in the competitors being spread out in the terrain and not concentrated as in a cross-country race or in a marathon. This is the dispersal in space.
Dispersal in time

In its most common form competitive orienteering is solo running across country, with competitors making their own decisions about route choice and navigation. To facilitate this, competitors on the same course do not start together but are set off at intervals of one minute or more. This disperses them in time. Figure 4 shows the proportion of competitors present in time in the competition terrain at a typical event in which the starts were spread over a two-hour start interval.

The times taken on the courses are not uniform. They vary because shorter times are planned for the youngest and oldest competitors and there is a natural spread of times
within any course, due to ability. The competition time averaged over all the competitors in the event monitored was approximately one hour. It is somewhat less in local events and more in championship events. If the competitors each took exactly one hour and they started at even intervals over the space of 2, 3 or 4 hours, then the percentages present in the terrain with time would be as in Figure 5.

![Figure 5](image)

Figure 5. Proportion of competitors present in the competition terrain with time, assuming that each competitor takes exactly one hour and the start rate is uniform.

The mechanism which gives rise to these graphs is simply explained by considering the purple line for competitors starting over a two-hour period. After one hour the first starters are finishing. For the next hour the numbers starting are balanced by those finishing and the graph shows a plateau. At two hours all the competitors have started and the numbers fall until the last starter comes in at the three-hour mark. The event monitored in Figure 3 had 12 courses with 500 competitors starting over a two-hour period. The actual percentages show a broad peak at 55% about one hour wide, in approximate agreement with prediction, then a rather longer tail, as would be expected. Other studies (Anderson et al. 1986) show approximate plateaux for other start windows consistent with Figure 5.

The standard procedure, when events are held with larger entries, is to plan more courses and extend the starting interval. With longer start intervals the fraction of the total entry present in the competition terrain at any one time is approximately that given by the reciprocal of the start interval in hours.

**Low competitor density**

The dispersal in space and time results in a low competitor density at any point in the competition terrain, far less than might be envisaged by those not familiar with the conduct of the sport. A low competitor density is a requirement for competitive purposes, which is to minimise competitor-to-competitor disturbance, in order to promote solo-navigation and solo running. This procedure has the coincident effect of minimising ecological disturbance.
The actual low average density of competitors in the terrain is not reflected in typical action photographs, such as that of Figure 6.

![Figure 6. Competitors approaching a control point on a small hill in an international orienteering event in Scandinavia. (IOF Picture Library)](image)

This shows a moderately busy scene with two competitors closing on the control and a distant third. However, such a photograph is not representative, since it was likely to be a rare opportunity for an ‘action shot’ selected by the photographer between intervals with no competitor, or only one, in sight. It is possible to support this conclusion by calculation. Visual estimation, supported by photogrammetry, indicates that the third runner in the distance is some 50m from the control. At this level of competition, in the runnable terrain visible, the competitors’ speed is approximately 5 min km\(^{-1}\) and the distant runner will reach the control in around 15 seconds. If three runners were to pass through the control every 15 seconds, the hourly rate would be 720 runners. This is far in excess, by many times, of the maximum rate normally to be expected. A more accurate impression of competitor density, were it required, would be given by a photograph showing just one runner.

This apparent scarcity of competitors is invariably commented upon by environmentalists, who are aware of the total entry for the event, when they are escorted into the competition area to view high use control sites (Viti 2005). This difference between perceived and actual density of competitors in the terrain is an important factor in responding to ecological concerns about the sport.
The extent to which orienteering is an off-track activity

Orienteering is categorised as an off-track activity. This statement requires qualification. The least technical courses are mainly along tracks. The normal technical courses are very substantially off-track but cannot be entirely so, unless, exceptionally, the terrain is largely without tracks and paths. Since paths generally permit faster movement over the ground, they often offer valid route choices.

Paths are more numerous and widespread in orienteering terrain than might be expected. These can be seen in the map segment from Tampere, Finland in Figure 7.

It is necessary to understand what the map does and does not show, with respect to tracks and paths. The map has a number of substantial tracks, which are used as ski trails in winter. In addition there are many small paths, which are prominent enough to be marked on the map. There are also very many faint trails made by animals which are not marked on the map. These and the small paths, if going in the right direction, will be used by competitors in preference to making slower progress over rougher terrain.

Figure 7. Part of the Kauppi, Tampere, Finland 2001 map.

So, in consideration of trampling of vegetation and disturbing ground- and low-nesting birds, orienteering is less of an off-track activity than initial impression suggests. Studies of the proportion of path running in an orienteering course have been carried in Denmark in a number of events in working forests with networks of tracks and paths (Andersen, et al. 1986). They concluded that, on average, 50% of the distance covered by the
competitors in an event is on forest roads, tracks or paths, and 50% is off-track, with less than 0.5% being through very dense forest. The 50% off-track figure will likely be reduced by having a proportion along unmapped animal trails, where present.

These figures may be compared with the extent to which walkers move off the paths in moorland terrain. A study in the UK by Anderson (1990) reported that this averaged at 23.4% from the range 5.2% to 41.8%. Although these figures are given with grossly exaggerated precision, they show that orienteering is not the only recreational activity with a significant off-track element.

**An episodic, short-period activity**

Orienteering is episodic, it is infrequent. An area cannot be used week after week, as with a sports pitch, because competitors would become over-familiar with the terrain, resulting in less interest and giving them an unfair advantage over others who are less frequent visitors. There is normally a long interval between orienteering events in the same terrain, typically a year, perhaps less for small events, much longer for important terrain used for national and international championships. Although the main reason for long intervals between events in the same terrain is to retain competitive interest, there is obvious ecological benefit in allowing any damaged vegetation to recover and displaced fauna to return to normal stands.

Orienteering is also short in duration, an event completing in a few hours. Experience is that short-period disturbance at a higher intensity, but not too high, has less effect on fauna than day-on-day disturbance of low intensity. This is demonstrated by the presence of nesting birds in terrain that has off-track recreational activity, sometimes passing close to the nests, but their absence near paths, which have low level prolonged use (Anderson 1990).

**Refuges for large mammals**

When disturbed above ground, smaller mammals, such as rabbits (Fam. *Leporidae*) can take refuge below ground. Larger mammals, such as deer (Fam. *Cervidae*) move to refuges away from the disturbance. These may be thickets in the near vicinity or more distant ground. It is common practice in orienteering in terrains, which contain large mammals, to identify areas in the competition terrain, or adjacent to it, which can act as refuges. The courses are planned to avoid the refuge areas. Thickets are the preferred refuge, as these are usually impassable to orienteers.

An earlier example of wildlife refuge allocation in Denmark is shown in Figure 8 (Anderson et al. 1986). A quarter of a century later, essentially the same procedures are followed.
Figure 8. Wildlife refuges (Danish: Vildtlommer) at an orienteering event in Denmark.

Avoidance of sensitive areas

If sensitive areas are notified to the planners, they will place controls not only outside the notified areas but also in such positions that the logical route choices do not pass through them. This can be done without the competitors being made aware of the existence of the sensitivity, if secrecy is required by the ecologists responsible for the area. Nor is it necessary for the planners to know the precise reason for the out-of-bounds, the request of the ecologists is sufficient.

More usually, the sensitivity is within public knowledge and the areas, if large enough, can be marked as out-of-bounds on the map, in addition to careful control positioning.

An example from Finland of the general nature of a course-planning outline used by planners, with the reasons for the different prohibitions, is given in Figure 9.
Figure 9. A generalised course setter’s planning map from Finland (Laininen 2003)

The prohibited areas refer to new plantings (1), an orchid (2), deer refuges (3), a capercaillie courtship stand (4), a rare butterfly area (5), streams (6) and springs (7). Certain streams and springs have protection under Finnish forest legislation.

The arrows show the general flow of the courses. In any particular part of the terrain these are broadly unidirectional so that any deer are steered towards refuges or outside the competition area. In some large events the deer are moved by teams beating the area just prior to the competition.

4. **Comparison of expectations with research into ecological impact**

The previous section details reasons why the ecological impact of orienteering is, in general, expected to be light. This expectation is now tested against the known studies of this subject reported in the literature. This is a summary of a fuller review, with more comprehensive analyses, listed in the IOF on-line document library (Parker 2005) plus later material (Mendoza 2007).

In carrying out this comparison, evidence is sought to support the alternate hypothesis that orienteering does result in significant long-term ecological impact.
**Trampling of vegetation**

In the main reference, 10 studies are reported, in which 4 focus on a specific site and the remaining 6 take more general observations of the competition area.

The conclusion to be drawn from the general vegetation impact studies is that orienteering, for events with up to approximately 2500 entrants, has very low impact with rapid recovery. For very large events there is more significant general vegetation impact with sometimes an additional growing season or part season necessary for full recovery to be achieved at the more heavily used sites within the competition terrain. However, given that long-term damage is defined as that persisting for more than ten years, none is reported from any of the studies, including those events with exceptionally large entries. A monitored 10,000 runners event, the Jukola relay, showed visible signs of trampling on 0.5% of the competition terrain immediately after the event, recovering to 0.1% after 1.5 years, and to pre-event condition after a further growing season (Myllyvrtta et al. 1998). Therefore, with respect to general vegetation impact, the hypothesis that orienteering does cause significant long-term damage is rejected.

In addition to the general vegetation impact on the competition terrain there may be localised areas of more sensitive vegetation sites, such as marshes and lichen-covered rock. The protection of such areas is normally secured by standard planning procedures which route courses away from them or ensure that carrying capacities are not exceeded. The two studies of lichen in the review, in Australia and Sweden, both indicated low impact, confirming that allowing competitor access for research purposes but restricting the numbers (to 30 and 102) had proved successful. These studies on sensitive vegetation found no significant long-term damage from orienteering to enable the hypothesis to be accepted.

The later report by Mendoza (2007) examined vegetation trampling and recovery from an event with 1313 competitor runs in Alberta, Canada. The damaged vegetation attributable to the event took longer to recover, three growing seasons, compared with previously reported studies. However, it was noted that, in the years following the event, the damage at some sites increased. Reference to the experimental control plots, not visited by the orienteers, shows some damage over the event and post-event periods, this damage arising from a number of large wild mammals in the terrain. It may be concluded that the competitor plots were subject to additional trampling by mammals. An approximate calculation from comparing the levels of damage in the test and non-competitor plots suggests that the concentrated trampling damage at the orienteering control sites was only about 100% more than the general level of damage over the whole area by large
mammals. The significance of this last observation leads to the caution of not viewing any trampling damage from orienteering in isolation but to do so in comparison with other natural impacts in the terrain.

An issue that sometimes arises in connection with trampling is that of edaphic changes, the compression or loosening of soils. Anecdotal reports of the trails near control sites sometimes being visible because the re-growth in them is more vigorous than the surrounding vegetation suggest that soil disturbance could result in permanent changes. However, a study of control sites in a soft sandy soil in Germany (Breckle, Breckle and Breckle, 1989) over three years showed regrowth at different rates for different species but with the balance between them restoring to pre-event condition by the end of the period.

Trampling is conventionally regarded as having adverse or neutral effect but there are examples of edaphic change being beneficial. These are found in sand dune terrains that have become over-vegetated from a reduction in natural grazers, such as rabbits, resulting in the bare sand cover decreasing, to the detriment of certain plant species. In the Braunton Burrows Nature Reserve in South West England the bare sand is substantially less than the minimum 10% required to secure the conservation of species such as Sea Stock Matthiola sinuata (Ministry of Defence 1998). Measures to increase bare sand cover include allowing recreational access (including orienteering) and the introduction of cattle, the latter to both graze and trample. The contribution of the orienteers needs to be placed in perspective. Calculation shows that a single cow present in the area for most of the year is the trampling equivalent of an orienteering event with 15000 adult orienteers (Parker 2009).

**Disturbance of large mammals**

Two carefully conducted studies of the disturbance of deer by orienteering have been reported. Both showed that deer readily flee from a disturbance and, if refuge zones are available within or adjacent to the competition area, they will take cover in these and then quickly return to a lowered anxiety level and their normal range after the event (Cederlund et al. 1981, Douglas 1989). The Cederlund study noted a difference between the large deer (elk) and the smaller deer, the former moving longer distances to outside the competition area and the latter taking refuge in thick vegetation within the area. A further observation by Jeppeson (1987) in Denmark was that radio-tagged deer in the competition areas had returned to pre-event locations within 24 to 48 hours, confirming similar observations from the other studies.
Whilst disturbance of deer can expose them to risk, there are extremely few reported examples of deer suffering injury or death as a result of orienteering (Konring 1987, Henderson 1992). These one or two examples may be set against the number of deer killed in road traffic accidents of over 40,000 annually in the United Kingdom alone (Deer Collisions 2003) out of a deer population estimated at 500,000 to 600,000 (Deer Initiative Council 2002).

From the exceptionally low instance of injury or death to large mammals due to disturbance from orienteering, compared with other disturbances, it does appear that the procedures adopted at orienteering events, where appropriate, are effective. It is concluded that, for practical purposes, the hypothesis that the sport is damaging to large mammals is unsupported.

**Disturbance of breeding birds**

The study of the impact of orienteering on birds is a more complex issue. Two scientific studies of bird populations during the breeding season have been reported, both in the UK. A comprehensive study of high scientific quality (Goodall and Gregory 1991), at a forest park event with 500 competitors, showed no impact on 54 species. A further retrospective study (Parker 2005), of an event in moorland terrain with twice the number of competitors showed that an additional species, the ground-nesting *wheatear Oenanthe oenanthe*, was tolerant of disturbance levels of more than 200 competitors per hour passing within 25m of the nests and that the low-nesting *stonechat Saxicola torquata* is at least as tolerant.

A third study (Brackenridge 1988) was conducted by an ornithologist at an event with 1000 competitors in Scotland. Concern had been expressed about the possible impact on ground-nesting birds and the ornithologist was commissioned to undertake a common bird census over a three-month period containing the event. Unfortunately, the survey was not conducted to an adequate scientific standard and was fundamentally flawed. Brackenridge reported that “torrential rain” occurred during the event and acknowledged that this was a serious stress factor. Over the survey period the starting total of 132 territories held by 22 species was reduced to 120, the most significant reduction being in *redstart Phoenicurus phoenicurus* territories, from 10 to two or three. Since no experimental control sites were set up before the event, nor any attempt made to correlate the known abandoned territories with orienteering activity, it cannot be speculated whether the losses were due to the exceptional weather, the orienteering or natural wastage over the period (or a combination of these factors). Furthermore, the redstart is not ground-
nesting but hole-nesting and considered to be tolerant of disturbance (Stastny 1995), suggesting that the orienteering was not a cause of its reduction.

The Brackenridge study shows the pitfalls that beset bird surveys. These require very great skills in identifying bird species and understanding their behaviour. But equally, ascribing cause and effect to changes in bird populations requires scientific skills, missing from this study and others.

Given the above evidence on the possible impact of orienteering on breeding birds, some land managers might take the view that the restrictions they place on orienteering during bird nesting seasons could be eased. Others might consider that, despite the clear results of the two scientific studies, uncertainty remains and they would continue to apply restrictions as a precautionary measure.

Reviewing the hypothesis set in the introduction to this section that orienteering causes significant long-term damage to birds; there is no reliable evidence to support it. As to whether there is sufficient evidence to reject the hypothesis is a matter of subjective judgement. Given that the limited evidence so far available indicates that 56 breeding species were, at a particular time and place, unaffected by orienteers, the starting point for any discussion should be that the sport, conducted in accordance with its own environmental procedures, appears to be non-damaging to breeding birds.

It could be argued that further research on the effect of orienteering on breeding birds would be of benefit in helping to reduce uncertainties. Perhaps surprisingly, such research is not welcomed by bird conservation scientists, who find the impact of an episodic activity difficult to correlate with their long-term status studies on bird populations. Additionally, the research would be likely, if existing experience is repeated, to give a nil result. Without official backing, bird studies, which are particularly demanding in skills, time and money, are difficult to conduct.

5. Conclusions

One of the opening statements, by the New Forest Review Group, that orienteering, “by its very nature causes very considerable disturbance to wildlife and damage to flora over wide areas” has been shown to be unsupported by firm evidence. It has also been shown that the reason for this is that orienteering, by its very nature, and by additional procedures of good practice, is a sport of low ecological impact.
It appears, therefore, that the truth about the effect of orienteering on flora and fauna is much closer to the first of the opposing statements in the introduction. Inevitably, uncertainties remain, particularly with respect to nesting birds.

The confirmation, based on the evidence available, that orienteering has low ecological impact will be welcomed by ecologists and orienteers alike. It is natural that ecologists with interests in the flora and fauna of a particular area will be sensitive about the potential for larger events to cause damage and the conclusions here offer reassurance. Equally, those taking part in a nature sport are also sensitive about its ecological credentials and are determined that their sport shall be conducted in such a way as to eliminate or minimise any ecological damage. A number of surveys (cited in Parker 2005a) have shown that many orienteers assert that they would not take part in the sport, were they to believe that it caused significant damage.

This document has examined, from a scientific standpoint, the characteristics lessening the ecological impact of orienteering. There is one further important characteristic, which is not a matter of objective science, but contributes to the same effect. This is the established practice, particularly with the larger events, of seeking cooperation in the planning stages between the orienteers and those with an interest in the competition area, such as the local landowners, environmental authorities, hunters and environmental groups. Such cooperation makes it possible to take a proactive approach in the conservation of nature in the competition area. The procedures adopted in the WOC 2001 World Championships, mentioned earlier, act as a template, which has been used many times since.

A final comment about this document is that it has been prepared with the best efforts of balanced scientific objectivity, without bias in one direction or over-compensation in the other. To do otherwise would be a disservice to the Sport in the long term.

6. Communication

Comment to the author on this document and any information about scientific studies on the ecological impact of orienteering that are not included here or in the IOF reference list are welcomed. Contact information is on the IOF website www.orienteering.org.
7. References

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