

The development of a remote-download system for visitor counting

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Abstract: Following the first International Conference on Monitoring and Management of Visitor Flows in Recreational and Protected Areas, English Nature identified a need to implement a system of visitor counting on a selection of the 170 National Nature Reserves which it manages across England. A prime requirement of the system was that it should involve a minimal amount of field staff time to harvest the data. Following a competitive tendering exercise, Teknovisiot were appointed as contractors to develop their GSM-based system for use by English Nature.

This paper will discuss the requirements identified by English Nature and how the system was developed in conjunction with Teknovisiot to meet those requirements. It will include a summary of problems encountered and how these were overcome. The presentation will include examples of data provided by the system.

It is believed that the system now developed by Teknovisiot on behalf of English Nature would have considerable potential for any site manager who has access to a mobile telephone network on their land and an internet modem in their office.

Introduction

English Nature is the government agency that champions the conservation of wildlife and natural features throughout England. There are more than 200 National Nature Reserves (NNRs) in England, of which around three quarters are directly managed by English Nature, and it welcomes over 10 million visitors to them each year.

Teknovisiot oy was founded in 1988. It has specialized in designing and installing datalogging, automation, CCTV and alarm systems, and is engaged in high technology product development for a wide range of customers in the private and public sectors. Today, the company is concentrating most of its resources into developing visitor-counting technology.

Visitor monitoring

Visitor monitoring can be broken into three components (Cope et al. 1999):

- visitor profiling describes the collection of demographic, socio-economic and recreational pursuit participation about users in order to describe visitors to a resource;
- *opinion surveys* are a means of assessing information concerning the attitudes, perceptions and motivations of visitors to a resource, and;

- *visitor counting* describes the collection of quantitative data, indicative of total usage, usage variations or the distribution of visitors to a resource.

While English Nature has engaged in a certain amount of visitor profiling and, somewhat more, opinion surveying; there has been little 'formal' counting of visitors to National Nature Reserves (NNRs) but that is the topic which will be discussed in this paper.

Visitor numbers are quoted in the *NNR Annual Report* but these are based largely on guesstimates and assumptions as only a small number of NNRs have (or have had) counting systems in operation. Reported by the Site Managers, these systems include:

- "Best guess – roadside car counts – cars in car park – averaging the number of people/cars seen in at a certain time"
- "We have access to the data collected by the Yorkshire Dales National Park Authority who have stile counters on the main access routes to Ingleborough (a large upland site)."
- "Sample counts carried out by the Voluntary Warden Team through the year, then expressed for whole year. (ie. counts at busy weekends and quiet midweek combined)."
- "Sample hour-long counts of visitors entering the most-visited component of the NNR by the most-

used entrance during 1992/1993. These took place in all months during daylight hours, and on weekends as well as weekdays. Monthly averages were then calculated. Lots of extrapolation and guesstimating used, hence results not very robust statistically!”

- “Manual step counters used in the past, replaced by pressure-operated data loggers in mid 1990s. Infra-red beam in visitor centre.”
- “at Castor Hanglands, voluntary wardens used to write how many cars they saw parked at the entrance. This provided a very good spread of information through the day/month/year, which was extrapolated to give an annual figure.
- “Later we tried an electronic beam counter across the main entrance. This suffered from many problems to do with maintenance and inaccuracy due to wind and rain movements but still provided some useful data.”
- “at Barnack: All the entrances were manned by voluntary wardens in a sample survey including some weekends, weekdays and evenings. This was multiplied up to give the final figure. Again, out of date.”
- “Automatic system of a focussed beam mounted within a single bollard.”

There has never been any strategic approach to the question of counting the number of visitors to National Nature Reserves and yet they are possibly the second largest of English Nature’s audiences (second only to the TV and media audience) and one that is of considerable economic value. If the statistics reported in English Nature’s annual report (2000) are to be believed, the value of visitors to NNRs during 1999/2000 is calculated as £61,305,000 - a not insubstantial sum when compared to English Nature’s Grant in Aid of £47,083,000 for the same year. This value is based on figures from the *UK Leisure Day Visits Survey, 1998* (National Centre... 1999).

Why count visitors?

The reasons for counting visitors have been well rehearsed elsewhere (eg Cessford, et al. 2002) but can be summarised as:

- Firstly, the collection of sound empirical information enables decision-makers to move away from management practices based on guesswork, and misplaced assumptions.
- Secondly, it offers a valuable means of ensuring public participation, which can in turn engender support for management actions.
- Thirdly, and linked to the last point, monitoring provides valuable feedback about management performance and can help focus attention on key areas of concern.

- Fourthly, data derived from monitoring can help strengthen the case for organisations seeking funding, for example from European sources or from the National Lottery.

In addition, there are two further points to add:

- the value of visitors to the local economy which, as mentioned above, is not inconsiderable.
- volumetric data about visitors can be used as a performance indicator and an indicator in ‘Best Value’ considerations.

English Nature is currently engaged in a number of major projects to increase the accessibility of its National Nature Reserves and of increasing visitor numbers. It was felt to be essential that some means was put in place to measure the effectiveness of the activities undertaken to achieve these increases. The simplest measure to quantify is the number of visitors to the various sites, and it is to this end that a proposal for funding to install a visitor counting system was made. However, it was also recognized that the data collected should be available to be used for any and each of the purposes outlined above. In particular, there is a need to be able to assess the likely impact that extra people may have on the biodiversity of our NNRs and to put in place management methods which will lessen that impact.

How to count visitors?

Clearly there was already some, but limited, experience amongst English Nature’s Site Managers of different methods of counting. In addition, Scottish Natural Heritage (SNH) (English Nature’s ‘sister organisation’ based in Scotland) had undertaken research into visitor monitoring and, in particular, visitor counting. Their report (1995) describes a variety of automatic recording equipment and details the suppliers.

English Nature’s National Nature Reserves vary widely in their accessibility to visitors. Some have a single footpath and entry point while others have virtually free access from roadsides. Most sites have a number of entrances, some more used than others. For practical purposes it is not possible to count each and every visitor to all of the National Nature Reserves, however it was thought possible to undertake counting at heavily used access points on sites where access is restricted to a small number of ‘gateways’. These data would then be validated by random visual survey, and extrapolated to give a total figure for each Reserve.

What method to use?

Manual counts have certain advantages in that qualitative information can be gathered at the same time as quantitative. For example, direction of travel, age and gender of visitor, whether accompanied by a dog or dogs, whether in a group and so on. However, they are

very costly in staff time and so it is suggested that they should only be used for 'calibration' purposes to assess the operational accuracy of automatic counters.

In recent years, a variety of automatic counters have been developed to include pedestrian counters, bicycle counters, horse counters and car counters and can now be used to give accurate figures of visitor numbers. The equipment includes break beams, pressure and movement sensors. They can produce a variety of data which, in some cases, can be automatically downloaded to computer for analysis.

There are a number of factors to be considered in planning a programme of visitor number monitoring and these include:

- size of the site
- type of recreational use made of the site
- commonly used access points
- perceived intensity of use
- particular attractions: view points and so on
- location of staff relative to the site
- physical constraints of counter installation
- propensity of vandalism

Further parameters which will dictate the selection of the equipment will include:

- cost
- information requirements
- locational constraints
- staff availability, linked to data-harvesting frequency and methods
- the scale of the proposed project

Two of the considerations given particular weight in English Nature's assessment were 'staff availability' and 'propensity of vandalism'. As with many public-funded organisations, English Nature's staffing is always stretched. It was felt that, any new work required of already hard-pressed site staff would be unwelcome and that any visitor counting system should involve as little staff involvement as possible. While, in England, few of the counter sites are particularly remote, the requirement of some systems for regular, relatively frequent visiting to harvest data was considered to be unacceptable for the project.

Secondly, a number of NNRs do suffer from vandalism from time to time and it was considered to be important that any equipment used for the project should be as well sheltered from vandalism as was possible.

From an assessment of potential counting methods it appeared that equipment at two ends of the spectrum were likely to be best fitted to English Nature's requirements but with an acceptance that there was likely to be considerable variety in the quality of the data they provide.

Mechanical, or 'bale' counters such as stile or gate counters are relatively cheap to purchase and install but

only provide 'total count' data and the count data are prone to disruption through interference (ie extra numbers can easily be clocked up by 'trampolining' on a stile step or by swinging a gate to and fro). It was recommended that English Nature should purchase a number of mechanical, 'bale' counters to be used on stiles or gates on sites where visitor numbers were thought to be low. It was suggested that readings should be made from each of these on a quarterly basis, although monthly would be preferable – at least initially. Stile counters are currently used at Stiperstones NNR but the extension of this programme to other sites has not been taken forward as yet – largely because of the staff time input required to harvest data. Also, English Nature is currently engaged in a programme to replace stiles on all of its National Nature Reserves in a drive to increase their accessibility, especially to the elderly, infirm and to families all of whom may have difficulty climbing over stiles.

At the other end of the scale, it was decided to use *Pressure pad counters* since they could be readily concealed, buried within the path in a manner that cannot be detected. They operate by the weight of the pedestrian compressing the pad, thus triggering a count. For this counter to work effectively, the location of the pad is crucial and one potential drawback is that they may not work effectively when the ground is frozen. However, SNH suggest that "Generally speaking, this is the most reliable type of people counter at present (Scottish Natural Heritage, pers comm 2001) and the one which we would recommend for use on NNRs." The data-logger is located in a separate waterproof container and can be concealed some distance from the path.

Prior to the last conference, in January 2002, it had been intended to download data on site, or through removing the EPROMs (Erasable Programmable Read-only Memory) for it to be taken back to the office to download. However, it was perceived that this approach had a considerable number of potential drawbacks – not least the staff input required to harvest the data on a regular basis regardless of weather and other conditions.

Teknovisiot and Metsähallitus (Forest and Park Service, Finland) gave a poster presentation during the First International Conference on Monitoring and Management of Visitor Flows in Recreational and Protected Areas, in 2002, which indicated that they were developing a remote-download facility which could overcome all of the concerns about on-site data harvesting. While relatively costly in terms of 'capital', the 'revenue' costs were much lower than traditional methods.

The Trial

A trial, or pilot study, was carried out by English Nature on twelve National Nature Reserves in different parts of England and with different habitat

and visitor characteristics. The locations of these sites are shown in Figure 1.

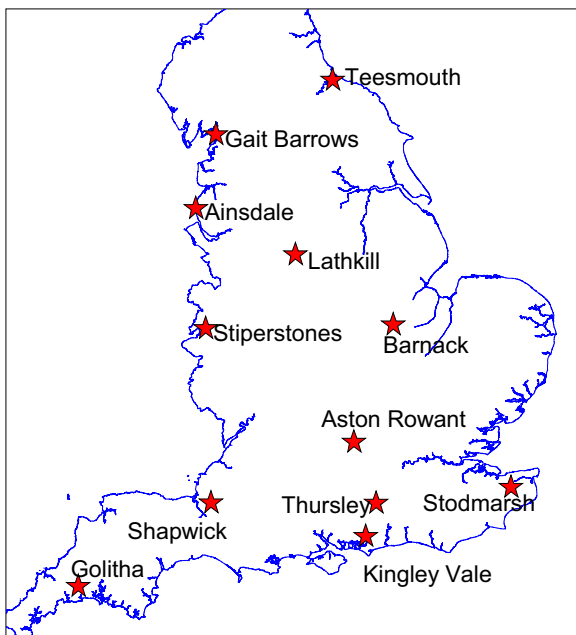


Figure 1. Location of visitor counters in trial.

The equipment involved

A total of 20 VisitLog™ units and 22 VisitMats™ were purchased by English Nature for use in the trials.

VisitLogs are data logging and system control units, developed by Teknovisiot Ltd, which can take inputs from various counting sensors such as VisitMats. More than one sensor (typically a pair) can be connected to a VisitLog to give directional flow data or, as at two of the pilot sites, to record the use of two nearby paths.

VisitMats are constructed of robust vulcanised rubber and are embedded into the ground at a suitable depth. The sensitivity of the VisitMat can be adjusted according to the dynamic pressure on the mat's surface through the ground layer.

VisitMats can be supplied in a variety of lengths, typically from 1 to 10 metres, but for the purposes of this trial were bought in lengths from 1.5 to 2.5 metres dependant on the width of path under which they were to be placed. They were buried to a depth of c 10 cm and, where the ground was stoney, placed onto a 2–3 cm bed of sand as shown in Figure 2. A further, similar layer of sand was placed above the mat before the replacement of the original path surface material. The VisitMats were connected by cable to the VisitLogs which were buried, together with a power source, in a waterproof container a short distance from the path. The cable was led through a length of 25mm diameter water pipe, or similar, to give it some protection.



Figure 2. VisitMat *in situ* before path surface restoration.

The power source used in the initial tests was a 'leisure' type 12 volt battery sufficient to give a low power output over a long period. It was suggested that such batteries might need recharging on an annual basis because of the very low power use of the equipment. Following the initial tests, a further development has been to install a small solar panel at one location to test the possibility of powering the units this way. To date, this seems to have been successful, in which case, after a further period, such units might be installed at other suitable locations meaning that they might practically never need to be visited for maintenance (one of English Nature's prime considerations in the decision of which system to install).

The pits containing the battery and logger were lined with concrete blocks and either covered by a paving slab or by a steel manhole cover. The latter method made the unit look like a standard utilities inspection pit. In some installations, the battery and VisitLog were placed into a covered plastic box within the pit to give some protection from moisture or high water-tables (Figure 3).



Figure 3. VisitLog and battery in a plastic-box lined.

The only part of the system which remained exposed to view was a small aerial attached to a nearby tree or fence post. This meant that the whole installation was virtually invisible to the casual visitor, as can be seen from Figure 4, and so, that the system was more or less vandal-proof (another of the original important considerations).



Figure 4. Aerial attached to tree trunk.

The UK is generally well served with GSM signals although, in some of the remoter parts, signal strength may be variable. Consideration was given to installing a local radio set-up at one location where the VisitMat was situated at the bottom of a gorge. However, testing on site prior to the actual installation established that even in this location it was possible to obtain a GSM signal and so the radio link trial was

abandoned. It is, however, quite possible that a workable link could be set up to 'bounce' the data from a location where a GSM signal is unobtainable to another where a signal is available.

An advantage of using a 'foreign' SIM card in the VisitLog units is that they will search for almost any network signal that is available in the UK and they are not restricted to, for example, a Vodafone signal or an Orange signal in the way that a UK-purchased Vodafone or Orange SIM card would be. This means that, where signal coverage by a particular network is poor, it may still be quite possible to install a GSM system if another network signal is of sufficient strength.

The data harvesting and data-transfer arrangements

Where this particular system differs from other similar 'pressure pad' visitor counters is in the manner of data harvesting and data transfer (see Figure 5).

The VisitLog unit contains a GSM modem which transmits the data via 'mobile telephone' technology to Teknovisiot's computer system in Pargas, southern Finland. This means that there is no need for staff ever to visit the counting site for the purpose of data harvesting.

The download from the collection points is controlled by Teknovisiot's computer based database system, where the collected data is stored. The VisitLog contains a memory buffer which will store up to 60 days worth of data in case contact cannot be made for some reason. The system also records the GSM signal strength and residual battery power and so can alert staff to potential problems.

From Teknovisiot, the data is available via the internet to authorised users (including the site managers and other English Nature staff) using reporting software. This provides the data in both tabular and graphical formats with the ability to download selected data into Excel spreadsheets or as PDF format files.

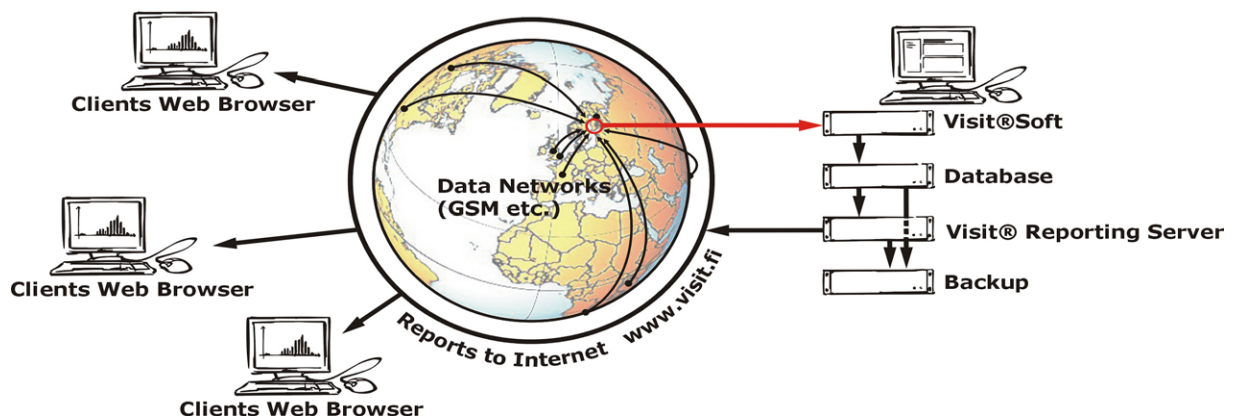


Figure 5. The systems operating principle.

The structure and timing of these reports can be modified according to the requirements of the user. The automatic reports are typically generated daily but the data can be shown on other periodical bases. It is also possible to integrate the data from other databases to produce optimization tools.

Examples of data collected and how it may be used

The VisitLog records data at 6 minute intervals throughout the day. However, for English Nature's purposes data is reported on an hourly basis. This provides a wealth of data in a variety of standard report formats which were developed to meet English Nature's requirements.

The data shown in Figure 6 comes from a, currently little used, entrance to the Aston Rowant NNR in southern England. There is an objective to raise awareness and visitor levels at this Reserve over the next 24 months. The purpose of placing counters at the location now is to establish the datum from which it will be possible to see if the objective has been met.

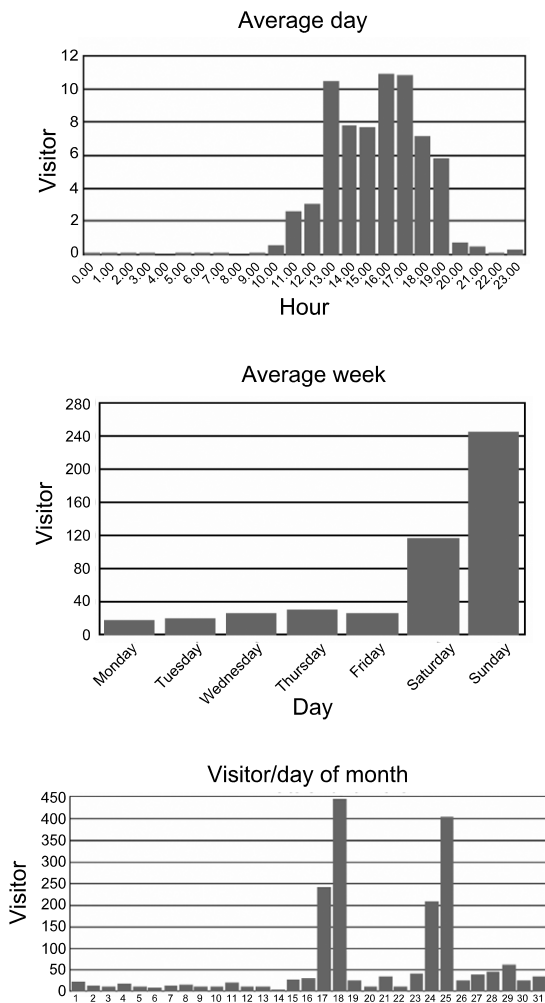


Figure 6. Examples of data collected. (NB the time of day is shown as GMT+2 and is yet to be corrected.)

Summary of problems encountered

The trials were not conducted without encountering a number of problems. These ranged from administrative matters such as lengthy discussions with other government agencies over the need for radio-telecommunications licences for the 'local radio link' which, in the event, was never installed; to a subcontractor making alterations in the specification of the VisitMats which led to the need to redesign part of the software in the VisitLog.

There were some problems thought to have been associated with dampness affecting the electronics of the VisitLog units which caused unusually high counts followed by failure of the system until it could be re-booted. In two cases, complete flooding of the count locations caused short-circuiting of the battery with the result that the counters were relocated to higher ground. In addition, more consideration has been also given to providing waterproof enclosures for the VisitLogs and batteries and for further waterproofing of the plugs and connectors.

Calibration of the amplifier in the VisitLog also caused some problems, as can be seen in the 'Visitors/Day of month' chart above. The unit mis-recorded for the first half of the month until it was properly adjusted.

The greatest problems were in establishing any lasting GSM communication between the VisitLogs on sites in the UK and Teknovisiot's computer in Finland. However, perseverance paid off in the end and, after a number of software upgrades carried out both in Finland and on site visits in England, a fully working network of counters has now been established.

Conclusions

We believe that, for simply counting numbers of 'visitations' or to establish the patterns of use of particular paths in more or less remote locations, a system based on that developed and trialled by English Nature and Teknovisiot is a perfectly viable option.

The system relies on the availability of a GSM network signal but these are becoming more and more widespread as mobile telephones become ubiquitous. We believe that the data can be 'bounced' from locations without GSM coverage to others that do and so can still be harvested in much the same way.

The system, once installed, never needs to be visited for data harvesting and rarely needs to be visited for routine maintenance – especially if it is linked to a solar or other similar local power source.

The system trialled is virtually invisible – particularly to the majority of visitors – and so the likelihood of vandalism or tampering is considerably reduced when compared to some other systems.

The system is 'capital expensive' but 'revenue cheap'. However, the cost of data manipulation

software licences associated with some other commercially available systems makes their overall costs comparable to the capital costs of this system.

Data is made available to all authorised users concurrently through secure internet connection. Data is pre-formatted into pre-determined graphical formats as well as being presented in a raw numerical state.

The system counts 'visitations'. There has, as yet, been no attempt to convert these figures into real 'visitor' numbers.

References

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Further information is also available at:

www.english-nature.org.uk

www.teknovisio.com/visit/eng