Journal of Coastal Conservation 10: 109-118, 2004

Counting of visitors in the Meijendel dunes, The Netherlands

Beunen, Raoul[1]; Jaarsma, Catharinus F.[1,*] & Kramer, Rob N.A.[2]

[1]*Land Use Planning Group, Wageningen University, Gen. Foulkesweg 13, 6703 BJ Wageningen, The Netherlands;*
[2]*Duinwaterbedrijf Zuid-Holland, P.O. Box 34, 2270 AA Voorburg, The Netherlands;*
[*]*Corresponding author; E-mail rinus.jaarsma@wur.nl*

Abstract. Accurate and sufficiently detailed information about recreation-related use of dune areas is necessary for their management. Long-term monitoring can provide this information. This paper presents the visitor counting programme used in the Meijendel dune area since 1992. The data collected during the first ten years are used to evaluate the method. The combination of mechanical vehicle counts and additional visual counts proved to be reliable and produced an accurate data set. Costs could be reduced through eventually reducing the number of counting locations and limiting the number of visual counts.

Keywords: Cost reduction; Cyclist; Monitoring; Motorist; Recreation; Traffic.

Introduction

The Meijendel dune area attracts a large number of visitors. The Dune Water Company of South Holland manages nature and recreational use in this dune area and is combining these functions with the production of drinking water. As early as the 1960s, biologists concluded that the natural values of the area were decreasing because of overcrowding. One of the main problems was the many visitors arriving by car who could drive to the centre of the area. On sunny days long lines of motorists were driving through the area, searching for a parking place. Parking facilities were proposed to deal with these problems. However, regulations pertaining to the parking problem did not meet with much support from the visiting public, and policy makers demanded detailed information about recreational use (Bakker 1997). Although many visitor monitoring projects have been conducted in the area since 1950 (see Bakker & Jaarsma 2000 for an overview), up-to-date information on the number of visitors and their ways of visiting the area was required. This information was needed to support proposals to change entrances and relocate parking places. This information would also allow the proposed measures to be evaluated to determine their impact on the number of visitors and their behaviour. Moreover, information about the number of visitors could contribute to the future development of recreational facilities. Only accurate traffic and visitor counts over a longer period could meet all these demands.

Many coastal areas have similar problems (see for example, Drees 1997; Van der Maarel & Usher 1997). Coastal zones contain some of Europe's most fragile and valuable natural habitats, but at the same time almost half of the European Union's population now lives within 50 km of the sea (Anon. 2001). Dunes and beach vegetation are under severe negative pressure from increasing recreation-related use (Houston 1997; Doody 1997). Along many stretches of the Union's coastline, tourism has developed haphazardly, causing major social and environmental problems. The management plans required to ensure better protection for these sites must deal with these competing socio-economic and environmental interests.

The European Commission (Anon. 2001) argues that good planning and management in coastal zones depends on accurate and sufficiently detailed information. Quantitative data about visitor use should be part of this information (Micallef & Williams 2002). Loomis (2000) argued that data from long-term monitoring are essential for assessing visitor impact on natural resources, planning of facilities, budgeting, calculating the economic contribution of tourism, and estimating the economic value of the recreation experience to the visitor themselves. The demand for information about visitor use data is shared by site-managers all over the world. Cope et al. (2000) have shown that some form of visitor monitoring is undertaken by a wide range of site-managers in many different ways, varying from estimates made by the staff to advanced counting technologies with infrared person counters. Costs, however, are often a reason why long-term data collection receives little attention in everyday management practices (Cessford et al. 2002; Micallef & Williams 2002). Consequently, visitor counting is usually organized without systematical planning and without being able to meet the demand for accurate and detailed information (Reynolds & Elson 1996; Muhar et al. 2002; Loomis 2000).

The present continuous visitor monitoring pro-

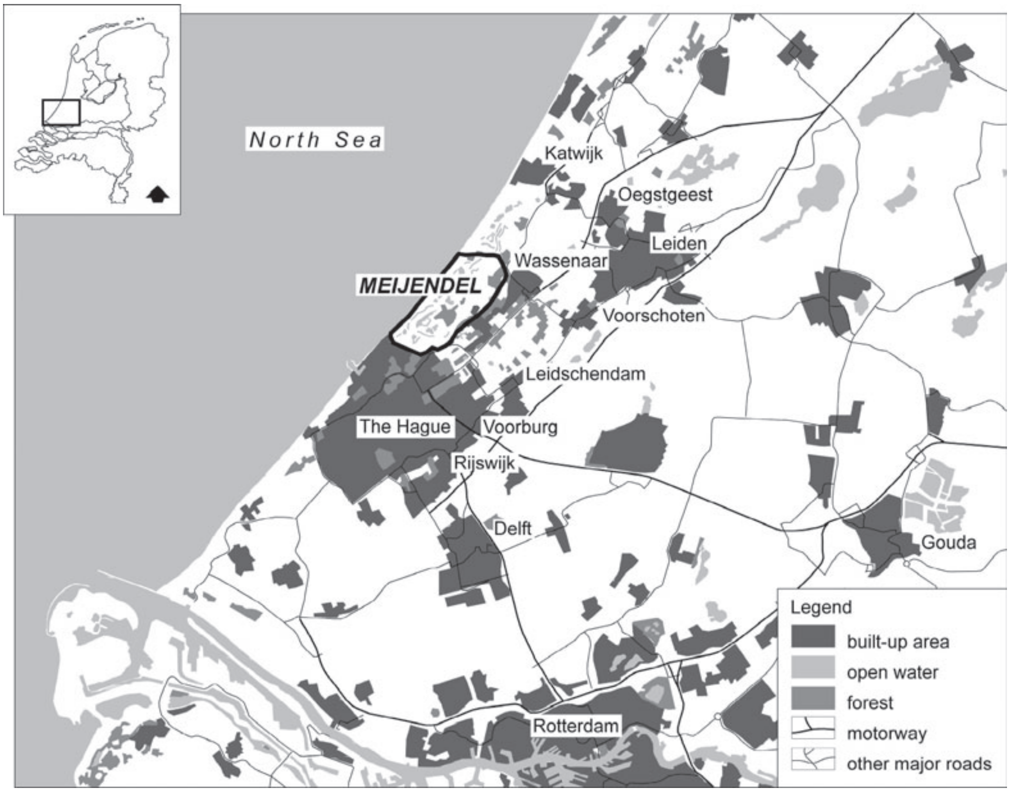


Fig. 1. The Meijendel dunes near The Hague, The Netherlands.

gramme in the Meijendel dunes was started to collect data on the number of visitors and their transport modes. Basically, visitor monitoring consists of three components: visitor counting, visitor profiling, and analysing visitor opinions (Cope et al. 2000; MacGregor 1998; Cope et al. 1999). In this paper we focus on visitor counting.

In the Meijendel dune area the number of visitors has been counted continuously for the past 12 years. During this period, the number of parking spaces and their locations have changed and regulations have developed. This paper presents the implemented visitor counting programme. The observations from this programme are used to discuss vehicle and visitor counting, the quality of the collected data, and possible means of limiting costs.

Visitor counting in the Meijendel dunes

The Meijendel dunes

Meijendel (Fig. 1) is a dune area situated directly north of the city of The Hague with ca. 450 000 inhabitants. The dune area covers ca. 2000 ha, ca. 600 of which are accessible to visitors. To the northwest the area is bordered by the North Sea coast. East of the area lies the town of Wassenaar (ca. 26 000 inhabitants). The road from Wassenaar to the North Sea coast (Wassenaarse Slag) forms the northern boundary.

The area is important for nature conservation, leisure activities, drinking water production, and sea defence (e.g. Bakker & Kramer 1993). The most important place for leisure activities is the Meijendel valley in the centre of the area. This valley measures ca. 200 ha and has ca. 25 km of footpaths and 6 km of bicycle paths. A visitor centre, a restaurant, and a playground are situated here. The Meijendel dune area receives ca. 900 000 visits per year; ca. 30% of the visitors visit the area more than once a week and most visitors live in the surroundings of the area (Jaarsma et al. 2003; Bakker 1997).

There are three major entrances to the Meijendel dunes. The Wassenaar entrance (location 1 in Fig. 2) is the only entrance for cars. Two parking areas are situated within Meijendel, one in the centre of the valley and one close to the Wassenaar entrance; each has ca. 200 parking spaces. The parking area in the Meijendel valley originally had about 400 parking spaces, but in 1995 the number of spaces was reduced in order to restrict traffic through the area. In 1999 100 extra parking spaces were established near the Wassenaar entrance. Entrances for cyclists and pedestrians are found close to The Hague in the south (location 2) and close to Katwijk in the north (location 4). At these entrances, cars must be parked outside the borders of the area. A bicycle path through the area connects The Hague (in the south) with Katwijk (in the north). In addition to this bicycle path, there are several other bicycle routes within the area.

Method of visitor counting

The visitor counting programme was based on a daily count of the number of cars and bicycles. These were counted at the entrances of the Meijendel dune area (locations 1, 2 and 4 in Fig. 2). Because most recreational use is concentrated in the Meijendel valley, two additional vehicle counters were installed within the dune area to count the traffic to the valley (locations 3 and 5). At all locations the two-way traffic was counted with an automatic counting device and a pressure-sensitive tube across the road. Each time the tube is triggered, a pulse is given to a piezo-electric detector in the device. Because most vehicles have two axles, the detector counts every two pulses as one axle pair. The detector distinguishes between the pulses of cars and bicycles (Jaarsma 1992), information that is relevant for roads with mixed traffic (location 1). Each entrance has a counter that records cars, bicycles, or both (Table 1).

Visual sampling is used to calibrate the data from the counting devices and to collect extra information about the passing vehicles. Therefore four coefficients were determined during visual counts of the entering and departing traffic. These coefficients were applied to the collected data to estimate the number of vehicles and the number of visits (Fig. 3). The coefficients are (1) the counter coefficient, (2) the axle coefficient, (3) vehicle occupancy, and (4) the proportion of pedestrians in relation to bicycles.

The counter coefficient was applied to correct for any inaccuracies made by the detector. For a correctly functioning detector, this coefficient is 1.0. The axle coefficient was used because some vehicles have more than one axle pair, for example cars with a horse trailer. In the Meijendel dune area this coefficient is very close to 1.0.

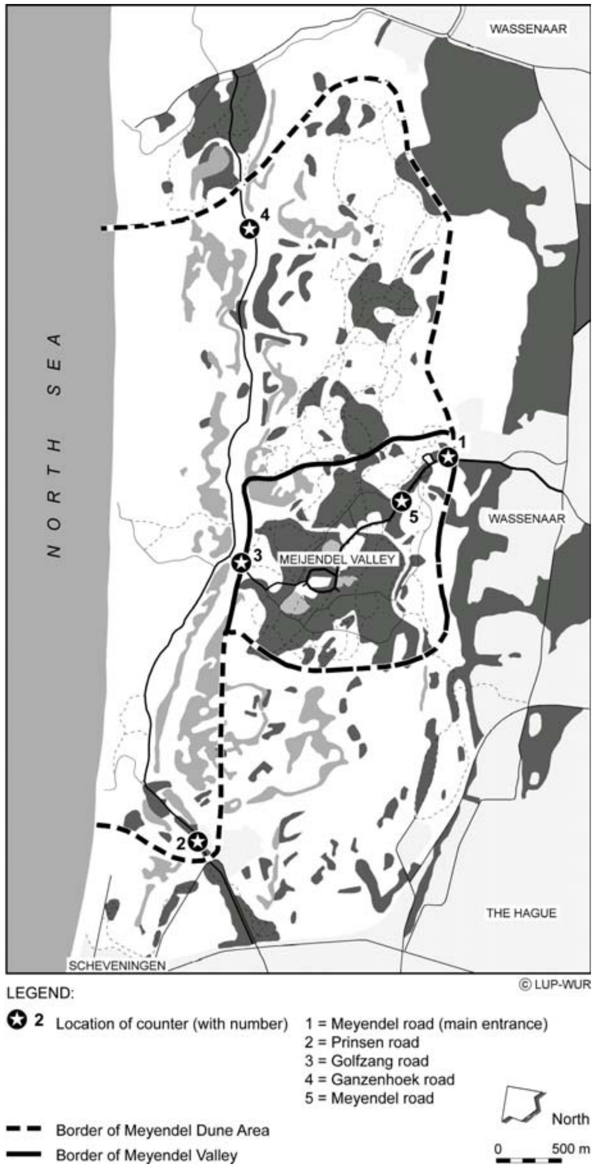
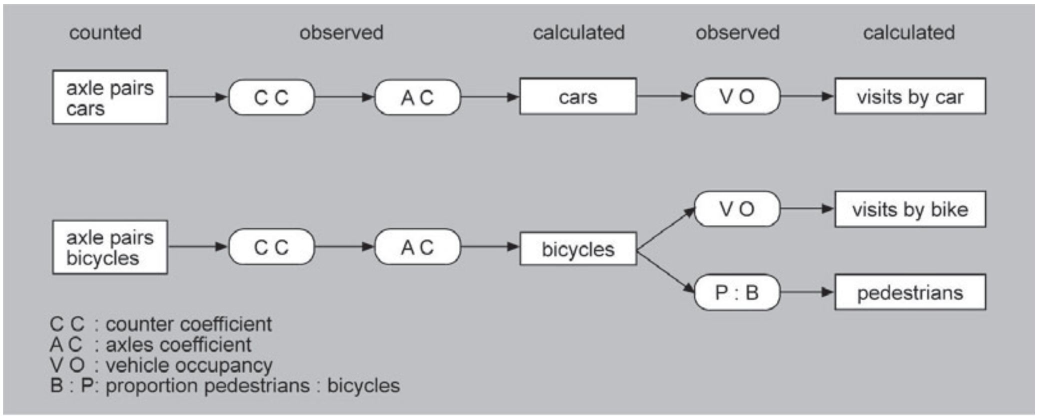


Fig. 2. Counting locations in the Meijendel dunes.

Table 1. Counting locations and observed traffic modes with mechanical and visual counts.

Location (see also Fig. 2)	Traffic mode	Mechanical count Cars	Mechanical count Bicycles	Visual count Cars	Visual count Bicycles	Visual count Pedestrians
1. Meijendel road, entrance	Mixed traffic	x	x	x	x	x
2. Prinsen road	Bicycle path		x		x	
3. Golfzang road	Bicycle path		x		x	
4. Ganzenhoek road	Bicycle path		x		x	
5. Meyendel road*	Cars only	x		x		

* Location installed in 1998 to monitor the effects of reallocation of parking spaces.



©WUR-LUP

Fig. 3. Schematic overview of the process of data recalculation.

The counters do not count pedestrians. Because only a few visitors enter the Meijendel dune area on foot, the number of pedestrians was related to the number of bicycles. The proportion of pedestrians to bicycles, found during the visual counts was applied to estimate the number of pedestrians for the total period.

Of the coefficients used, only the counter coefficient will be constant in time, since it only depends on the detector. The other coefficients, especially vehicle occupancy, heavily depend on the day of the week and on the season. It is, however, impractical to carry out visual counts every day in order to monitor these changes. Therefore, de Bruin et al. (1988) advised executing visual counts in each season on at least one week day, one Saturday and one Sunday, thereby allowing 12 types of days to be distinguished. For each season and type of day, the daily numbers of cars and bicycles are multiplied by the related vehicle occupancy; this gives the daily number of visitors by car and bicycle.

Reliability and accuracy of mechanical counts

After the counters were installed in 1992, they were inspected weekly by park employees and every three months by an employee of Wageningen University. These regular inspections ensured that the counters continued to function properly with as little interruption as possible . The number of observation days together with any interruptions and their causes in the first ten years of the visitor counting programme in the Meijendel dunes are shown in Table 2.

The considerable interruption in 1994 was caused by a human mistake while downloading the data from the

Table 2. Number and causes of interruptions (in days) in the automatic traffic-counting devices during ten years of research in the Meijendel dunes (Jaarsma et al. 2003).

	No. of observation days	Interruption by cause (days)							%
		(1)	(2)	(3)	(4)	(5)	(6)	Total	disorder
1992	1825						1	1	0.1%
1993	2190	19						19	0.9 %
1994	2190	22		9		246	56	333	15.2%
1995	2196	7		7	43	70		127	5.8%
1996	2190	54		132	6			192	8.8%
1997	2190			129			56	185	8.4%
1998	1095			7	66			73	6.7%
1999	1098				7			7	0.6%
2000	1460				61		37	98	6.7%
2001	1460							0	0%
total	18 624	102	0	284	184	316	149	1035	5.6%

(1) = tube failure, caused by vandalism; (2) = equipment failure, caused by vandalism; (3) = road reconstruction; (4) = technical failure of the equipment; (5) = human mistake; (6) = cause unknown

Table 3. Counter coefficients for cars at location 1, the Meijendel road, per type by year and by season for week days, Saturdays and Sundays.

	Spring			Summer			Autumn			Winter		
	Week	Sa	Su	Week	Sa	Su	Week	Sa	Su	Week	Sa	Su
1992	0.96		1	0.97		0.98	0.97		1.02	0.97		1
1993		0.99			0.94			0.98		0.97	0.98	
1994		0.92			0.99			0.98		1	0.98	
1995		0.99	0.99		0.99			0.99		1	0.93	1
1996	0.93		1	0.99		0.99	0.88		1	0.96		0.93

devices. The counters at locations 2 and 3 were out of order for a long time due to road-reconstruction in 1996 and 1997. Only a small amount of interruption was caused by technical failure. During the ten years of counting, only 6% of the days were lost due to any form of interruption. Thus, we conclude that the automatic counting devices function very reliably, having produced a data set for 94% of all observation days. The weekly inspections by local employees shortened the duration of interruptions, especially those caused by tube failure.

Another important question to answer is whether the devices actually count the correct number of passing axle pairs. This can be checked with the counter coefficient. As already explained, for a correctly functioning detector, this coefficient is 1.0. Table 3 gives an overview of the counter coefficients for cars. Similar results were found for bicycles.

Most observations give a counter coefficient close to 1.0 (Table 3). Slight differences can be explained by tube failure (leakage), by two cars passing the tube at exactly the same time, by cars passing the tube too slowly, or by cars hitting the tube more than twice (for instance when turning). Because the differences are rarely more than 5% (Table 3), we can conclude that the counters provided accurate data on the number of axles passing the devices.

Table 4. Yearly number of bicycles on the Meijendel road as a percentage of the yearly number of bicycles in the total area and in the Meijendel valley.

Year	Total area	Meijendel Valley
1992	22%	50%
1993	21%	49%
1994	21%	47%
1995	22%	48%
1996	21%	47%
1997	22%	47%
1998	-	-
1999	-	-
2000	-	47%
2001	-	46%
Average	21.5%	47.6%

Adaptations of the counting programme

When the programme was set up in 1992, some agreements were made to limit its costs. Visual counts, necessary to collect the data for the 12 types of days, were spread out over five years. In 2002, a few visual counts were carried out at the main entrance road (location 1) to check whether the vehicle occupancies had changed during the years. After several years, the number of counting locations was reduced.

To determine the total number of bicycles in the Meijendel dune area and the Meijendel valley, the numbers of passing bicycles had to be counted at three and two locations, respectively. Data from the first six years of the monitoring programme showed that, for both areas, the annual number of bicycles passing at one of these locations was a constant part of the total number: 22% of all bicycles in the Meijendel dune area and 47% of all bicycles in the Meijendel valley entered via the Meijendel road (Table 4). As a result of this information, the number of counting locations was reduced during some of the following years, and only the bicycles entering at the Meijendel road were counted. The numbers counted at this location were used to determine the total numbers of bicycles. Since 2000, the number of bicycles at location 3 was counted again to check whether the relationship was still valid. The proportion of bicycles entering for the Meijendel valley had not changed (Table 4).

The proportions in Table 4 are valid if the total number of bicycles for a whole year is taken into consideration. A comparison of these percentages per type of day and per season shows that, for the different types of days, the percentages are about the same.

Some results

The coefficients determined by visual counts of car occupancy, axle coefficients, and the proportion of pedestrians in relation to bicycles depend on the type of day and season and are likely to change in time. Of these coefficients, car occupancy has the greatest impact since it differs most from 1.0. Table 5 shows the car occupancy per type of day and per season as collected during the programme.

There are only small differences in car occupancy from year to year (Table 5). These small differences allow car occupancy data from visual counts to be reused if no new visual counts are conducted. Since few changes in car occupancy are expected, for instance, changes caused by demographic characteristics, a regular check, perhaps every five years, is advised. The update in the Meijendel dune area in 2002, for instance, shows a slight increase in car occupancy on most of the days.

Originally, 12 types of days were distinguished based on the idea that car occupancy may differ from one day to the next or one season to the next. The data collected during the visual counts was used to review this classification into 12 types of days. The average car occupancy per type of day is presented in Fig. 4. The averages are ordered from lowest to highest. The extremely low value found on Sunday in the winter of 1992 was excluded from this analysis.

The average vehicle occupancy varied from 1.63 to 2.58, with a standard deviation of ca. 0.1 person per car. The vehicle occupancy differed greatly depending on the day of the week (Fig. 4). The average vehicle occupancy on weekdays was 1.81, on Saterdays 2.17, and on Sundays 2.51. Differences between the seasons were smaller (Fig. 4). The average vehicle occupancy in spring was 2.21, in summer 2.26, in autumn 2.32, and in winter 2.03. Based on the small differences in the averages for similar days of the week in some sequential seasons, the results for these seasons could be combined per day of the week, leading to the following pairs: weekdays in winter and spring; weekdays in autumn and summer; Saturdays in spring and summer; and Sundays in summer and spring. In future visual counts, these comparable averages can be clustered to reduce the number of visual counts from 12 to 8 days.

Discussion

Method

Among the methods available for collecting information about the number of visits are mechanical counts, records kept by a visitor information centre, and records of ticket sales or admission fees (Cope et al. 1999; Cessford et al. 2002; Muhar et al. 2002; Rauhala et al. 2002). The most suitable method depends, among other things, on the characteristics of the area, the required information, and the type of recreational use (Cope et al. 1999). In the Meijendel dune area, we used traffic counts with additional visual counts to determine the number of visits. Such a method was also used in other areas in The Netherlands and in other countries (Visschedijk & Henkens 2002; Cessford et al. 2002). "Also most use-level estimates in the US National Park Service now come from vehicle counters located on key access roads" (Street 2000). The advantage of such an approach is that information about the number of cars and the number of visitors is collected

Table 5. Car occupancy determined at location 1, the Meijendel road, by year and by season for week days, Saturdays and Sundays.

	Spring			Summer			Autumn			Winter		
	Week	Sa	Su	Week	Sa	Su	Week	Sa	Su	Week	Sa	Su
1992	1.69		2.3	1.98		2.3	1.85		2.34	1.55		1.68[a]
1993		2.27			2.23			2.14			1.93	
1994		2.18			2.09			2.3			1.75	
1995		2.07	2.45		2.26	2,56		2.37	2.59		2.13	2.52
1996	1.71		2.54	1.95		2.58	2.07		2.59	1.70		2.63
1997												
1998												
1999												
2000												
2001												
2002		2.24	2.59		2.24	2.38		2.32	2.66			
Average	1.7	2.19	2.49	1.96	2.21	2.46	1.96	2.28	2.55	1.63	1.94	2.58
Standard dev.	0.01	0.09	0.09	0.02	0.08	0.14	0.16	0.10	0.14	0.11	0.19	0.08

[a] Observations in 1992 were infrequent and therefore excluded from further analysis.

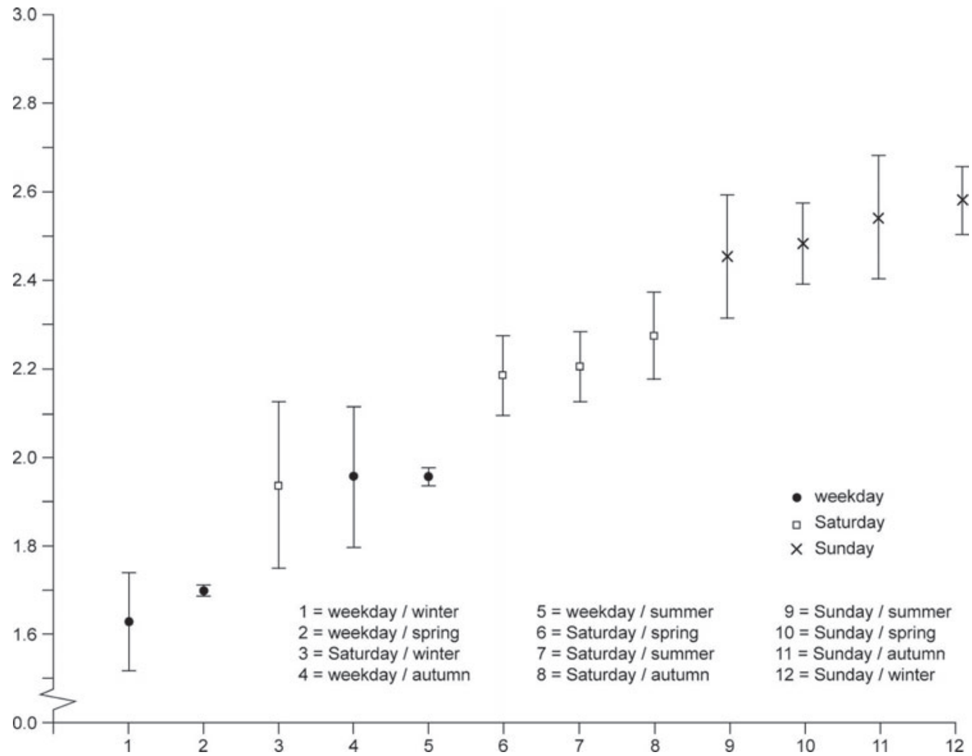


Fig. 4. Averages and standard deviations of vehicle occupancy per type of day.

at the same time. Information about the number of cars is especially important if cars cause major problems. The method works very well if there are only a few access roads with a few parking places in the area. Coastal areas bordered by the sea on one side often meet these requirements, contrary to nature areas that can be accessed from all directions.

Quality of the data

The quality of the data is an important aspect of visitor monitoring (Cessford et al. 2002; Loomis 2000). This quality depends on the accurate and reliable performance of the detectors. Literature about data collection gives little information about the quality of the data and shows a wide range of results. Some counters, for instance, proved to be very reliable (Rauhala et al. 2002) whereas others lost data because of interruptions (Ploner & Brandenburg 2002).

The detectors we used in the Meijendel dune area produced accurate data. We have had similar experiences with these detectors on other projects (Jaarsma 2001). We concluded that the counting equipment was reliable because it functioned well and produced an accurate data set. It was not so much the counting devices as other factors, for instance the frequency of servicing or vandalism, that seemed to be most influential in defining reliability. Maintenance was very important. Similar conclusions were found by Rauhala et al. (2002) who performed visitor counting in nine national parks in Finland. The attitude of the personnel involved is also crucial for the success of visitor counting because regular maintenance is in their hands.

From their experiences in Finland, Rauhala et al. (2002) concluded that determining the correction coefficients of the counters proved to be the most difficult aspect of using the counters and estimating the number of visits. The main reason for this was a lack of clear instructions. Our experiences, however, show that visual counts on 12 types of days produced accurate coefficients that could be used in the following years. An analysis of the data showed that a reduction to eight different types of days is possible, but these eight types are a minimum because vehicle occupancy differs greatly between some types of days (Fig. 4). These results confirm the advice given by de Bruin et al. (1988) that it is necessary to separate types of day by day of the week and by season if a small number of visual counts are used to determine the different coefficients.

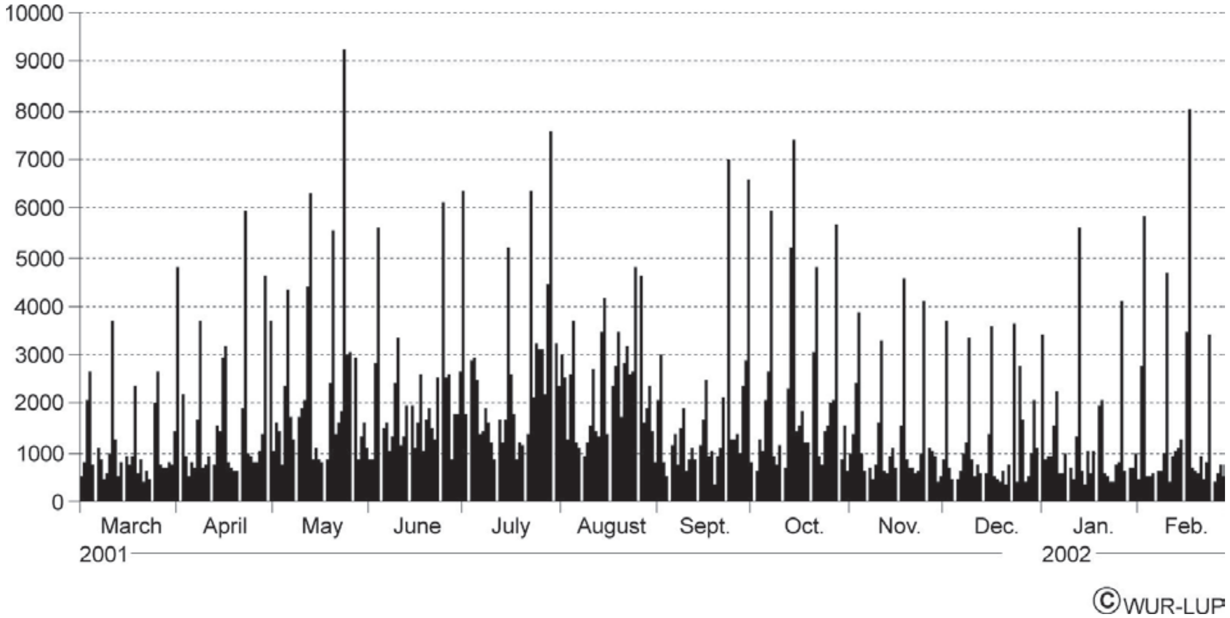


Fig. 5. Daily fluctuations in the number of visits to the Meijendel dune area, March 2001 - February 2002.

Usefulness of counting

The visitor counts in the Meijendel dune area showed that the daily number of visitors fluctuates considerably (Fig. 5). Ca. 70-80% of these fluctuations can be explained by differences between the days of the week, by holiday periods, and by weather conditions (Jaarsma 1990). The consequence of these fluctuations is the necessity to monitor numbers of visits for a longer period of time. Only then it is possible to understand the dynamics of recreational use and to distinguish 'normal' fluctuations from trends and the effects of management measures, as indicated by Loomis (2000).

The data collected in the Meijendel dune area give an overview of the dynamics of the daily visits throughout the years (Jaarsma et al. 2003). Trends, 'normal' fluctuations, and changes related to management could be distinguished. This information was used to evaluate measures taken during the past ten years (Jaarsma et al. 1998, 2003).

Costs and costs reduction

The costs of visitor counting heavily depend on the characteristics of the area and the method used to count visitors. The method we used, counting vehicles and using coefficients to determine the number of visits, is relatively cheap. Simple traffic counters can be used for many years with just a little maintenance. The collected data can be used and analysed very easily. Limiting the number of counting locations can reduce costs to some extent. Visual counts are relatively expensive because they are very labour-intensive. Our experience in the Meijendel dune area shows that some types of days can be clustered, allowing the number of visual counts to be reduced. Reducing the number of counting locations also reduces the number of visual counts.

Reducing the number of counting locations and visual counts can be done as long as no measures are taken that might affect the distribution of the number of bicycles at the different locations, for instance a new entrance or a new bicycle path. External influences, such as demographic changes, can also affect the coefficients. A regular check of these coefficients, perhaps every fifth year, is therefore advised.

Conclusions

From our ten years of experience with the visitor counting programme in the Meijendel dune area we can conclude that counting vehicles and using visual counts to determine the number of visitors to a certain area can provide reliable and accurate data necessary for management. During visual counts four different coefficients are determined. The counter coefficient and the axle coefficient are used to weight the data collected by the counting device and to determine the number of cars and bicycles. Vehicle occupancy and the proportion of bicycles to pedestrians are applied to the count data to calculate visitor numbers.

In an evaluation the samples in time (visual counts) and place (fewer counter locations) proved accurate. Vehicle occupancy shows some variation by day and season. An analysis of the differences between the different types of days and seasons shows that the original 12 categories can be reduced to 8. This allows a reduction in the number of visual counts in future updates. The applied variables and proportions were fairly constant during time and could therefore be used for a longer period. Nevertheless a regular check, perhaps every five years, is advised. A reduced number of counting locations was possible after some years because proportions between the number of bicycles at different locations proved to be very constant in time.

Acknowledgements. The authors thank Chris Baltjes, research fellow at the Land Use Planning Group of Wageningen University, for his statistical work on the data. We also thank three anonymous referees for their suggestions for improving the paper.

References

Anon. 2001. *EU focus on coastal zones: turning the tide for Europe's coastal zones*. European Commission Directorate-General. Environment, Nuclear Safety and Civil Protection, Office for Official Publications of the European Communities, Luxembourg, LX.

Bakker, J.G. & Jaarsma, C.F. 2000. Half a century of research on recreation in the Meijdendel Dunes. *Recreatie en Toerisme* 10/5: 6-9 (in Dutch.)

Bakker, T.W.M. 1997. Fifty years of recreational planning in the Meijendel dunes near The Hague. In: Drees, J.M. (ed.) *Coastal dunes, recreation and planning*. Proceedings of the European Seminar held in Castricum, NL, November 1-4, 1995.

Bakker, T.W.M. & Kramer, R.N.A. 1993. Meijendel, a dune area in a densely populated part of the Netherlands. *Coastline* 3: 14-24.

Cessford, G., Cockburn, S. & Douglas, M. 2002. Developing new visitor counters and their applications for management. In: Arnberger, A., Brandenburg, C. & Muhar, A. (eds.) *Monitoring and management of visitor flows in recreational and protected areas,* pp. 14-20. Conference Proceedings 2002.

Cope, A., Doxford, D. & Millar, G. 1999. Counting users of informal recreation facilities. *Managing Leisure* 4: 229-244.

Cope, A., Doxford, D. & Probert, C. 2000. Monitoring visitors to UK countryside resources. The approaches of land and recreation resource management organisations to visitor monitoring. *Land Use Policy* 17: 59-66.

de Bruin, A.H., van Hoorn, A. & Jaarsma, C.F. 1988. *Methode bepaling gebruik openluchtrecreatie-projecten*. (Method for calculating visits to outdoor recreation projects; in Dutch). The Winand Staring Centre, Wageningen, NL.

Doody, P. 1997. Coastal dunes of Europe – Recreational impacts and nature conservation. In Drees, J.M. (ed.)1997. *Coastal dunes, recreation and planning*. Proceedings of European Seminar held in Castricum, ML, November 1-4, 1995.

Houston, J. 1997. Dune recreation management: experience and trends in the UK. In Drees, J.M. (ed.) *Coastal dunes, recreation and planning*. Proceedings of European Seminar held in Castricum, NL, November 1-4, 1995.

Jaarsma, C.F. 1990. Temporal variation of bicycle traffic flows in The Netherlands. In: Koshi, M. (ed.) *Transportation and traffic theory*, pp. 443-459. Proceedings 11th International Symposium on Transportation and Traffic Theory, Yokohama, 18-20 July, Elsevier Science Publishing Co., New York, NY, US.

Jaarsma, C.F. 1992. *Trouble shooting for cycling on rural road networks, based on a quick and reliable building of volume data files*. Proceedings Managing Traffic and Transportation Conference, Amsterdam, NL, April 13-15, pp. 348-349.

Jaarsma, C.F. 2001. *Monitoring van de recreatie-mobiliteit: 'meten is weten' bij natuurgebieden*. 11e Verkeerskundige werkdagen CROW, Ede, NL, pp. 191-202. (In Dutch.)

Jaarsma, C.F., Webster, M.J. & Bakker, J.G. 1998. *Monitoringsonderzoek recreatie duingebied Meijendel – Trendrapport, deel VII: Ontwikkelingen van het recreatiebezoek en het recreatieverkeer in de periode maart 1992 – februari 1997*. Nota 73. Wageningen University, Wageningen, NL. (In Dutch.)

Jaarsma, C.F., Webster, M.J., Beunen, R. & Bakker, J.G. 2003. *Monitoringsonderzoek recreatie duingebied Meijendel. Deel XIII: Ontwikkelingen van het recreatiebezoek en het recreatieverkeer in de periode maart 1992 - februari 2002 in de vallei Meijendel*. Nota 94. Wageningen University, Wageningen, NL. (In Dutch.)

Loomis, J.B. 2000. Counting on recreation use data: A call for long-term monitoring. *J. Leisure Res*. 32: 93-96.

MacGregor, C. 1998. *A guide to collecting visitor information for AONBs*. Centre for Leisure Research, Edinburgh, UK.

Micallef, A. & Williams, A.T. 2002. Theoretical strategy considerations for beach management. *Ocean Coastal Manage*. 45: 261-275.

Muhar A., Arnberger, A. & Brandenburg, C. 2002. Methods for visitor monitoring in recreational and protected areas: An overview. In: Arnberger, A., Brandenburg, C. & Muhar, A. (eds.) 2002. *Monitoring and management of visitor flows in recreational and protected areas*, pp. 1-6. Conference proceedings, Universität für Bodenkultur, Wien, AT.

Ploner, A. & Brandenburg, C. 2002. Modelling the dependency between visitor numbers and meteorological variables via regression trees. In: Arnberger, A., Brandenburg, C. & Muhar, A. (eds.) 2002. *Monitoring and management of visitor flows in recreational and protected areas*, pp. 225-232. Conference proceedings, Universität für Bodenkultur, Wien, AT.

Rauhala, J., Erkkonen, J. & Iisalo, H. 2002. Standardisation of visitor counting – Experiences from Finland. In: Arnberger, A., Brandenburg, C. & Muhar, A. (eds.) 2002. *Monitoring* *and management of visitor flows in recreational and protected areas*, pp. 258-263. Conference proceedings, Universität für Bodenkultur, Wien, AT.

Reynolds, G. & Elson, M.J. 1996. The sustainable use of sensitive countryside sites for sport and active recreation. *J. Environ. Planning Manage.* 39: 563-576.

Street, B. 2000. Pers. comm. on Manager and specialist, visitor counting, US National Park Service. In: Cessford, G., Cockburn, S. & Douglas, M. 2002. Developing new visitor counters and their applications for management. In: Arnberger, A., Brandenburg, C. & Muhar, A. (eds.) *Monitoring and management of visitor flows in recreational and protected areas,* pp. 14-20. Conference Proceedings 2002.

Visschedijk, P.A.M. & Henkens, R.J.H.G. 2002. Recreation Monitoring at the Dutch Forest Service. In: Arnberger, A., Brandenburg, C. & Muhar, A. (eds.). *Monitoring and management of visitor flows in recreational and protected areas*, pp. 65-67. Conference proceedings, Bodenkultur University Vienna, AT.

Received 13 October 2003;
Revision received 18 May 2004;
Accepted 20 August 2004.
Coordinating Editor: R. Paskoff.