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Managing Tourist Time-Space Movements in Recreational Areas. A comparative study of a protected natural park in the French Alps and the « De Hoge Veluwe ». Dutch National Park using the same methodology / *Gérer les mouvements spatio-temporels des touristes dans les espaces récréatifs ; étude comparée à partir d'une méthodologie commune, dans les espaces protégés de montagnes françaises et un parc national néerlandais*

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Abstract

Abstract: Activities that concern tourism are a source of economic development for regions having attractive areas, either due to natural or cultural resources, but it may also endanger fragile environments. Evaluating and preventing over a long period of time the environment from the consequences of tourist activities is a major task. A better knowledge of spatial distribution and frequent usage over time of such areas can give evidence to pheno- mena like saturation, and give clues to understand what controls individual choices and/or typical collective itineraries. We present two studies based on an survey that combines information on: - the perception and the motivation of tourist practices, - a graphical representation of a trajectory in the tourist area that includes time period information. The first study concerns natural protected areas in the French Ardèche mountains and Northern Alpine Mountains (France). The second study concerns the Dutch National Park "De Hoge Veluwe" and the Kroller-Muller Museum (and its famous Van-Gogh paintings). By comparison, we show that a statistical analysis combined with a time-space oriented GIS (CDV-TS system) prove to be in both cases a powerful tool for recreational areas managers. The resulting information produced is related to symbolic systems based on practices and observed use of time-space. A principle of the CDV-TS system (Cartographic Data Visualizer for Time- Space data) is to give the user an access to data on tourist itineraries in a fully dynamic computing environment. The user selects items (e.g., type of hikers, type of day, type of motivation: such categories are defined from a previous statistical treatment) and visualises the selected list of existing itineraries. A temporal selection is also possible among the itineraries, either at a given time, or on periods of time during the day. The main results or concerns are: • from a fundamental point of view, the interest of developing new tools for both temporal and spatial data that will lead to new hypotheses; • from an operational point of view, the necessity of long term decisions on the development of such areas: insufficiently exploited resources, inappropriated uses, and simulation of consequences of controlling individual behaviour on areas.

Managing Tourist Time-Space Movements in Recreational Areas

A comparative study of a protected natural park in the French Alps and the "De Hoge Veluwe" Dutch National Park using the same methodology

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1. Introduction: tourist time-space movements and their influence on the environment

During their stay, tourists move around a region, visit different attractions and undertake several different activities, behaviour which provides them with a specific tourist experience. To develop and sustain a sound tourist opportunity structure in a tourist region, it is important to examine tourist behaviour. Not only is it important to know the types of tourist that visit a region, but also the places visited, and for how long, the routes followed, the kind of activities undertaken, the reason(s) for the visit, motivations and experiences, and so on. On the basis of such information, the manager of a park or region can introduce different measures to facilitate either the tourist or the environment in reaching a sound tourist opportunity structure. Time-space behaviour is an important but underestimated aspect of tourism research. Analyses of visitor numbers and demographic characteristics are often only static and do not take into account the dynamic nature of tourist movements, either in space or in time, nor the influence they have on behaviour and choices (the motivation and experiences).

By moving around an area and linking various tourist activities, the tourist constructs his or her own tourist experience. It is possible to abstract these time-space movements in an area to network patterns, which can then be analysed accordingly (van der Knaap,

All figures referred to in the text are grouped together in the colour section at the end of the article.
Toutes les figures appelées dans le texte sont regroupées dans le cahier couleurs en fin d'article (après p. 48).

1997). Within the created tourist experience three domains are considered to be important: time, space and context (van der Knaap, 1997). Currently available techniques and methods applied in time-budget studies for tourism do not deal with the three domains as they relate to one another. Instead they mainly focus on one or two of the domains (See, for instance, Aronsson (1997), Fennel (1996), Pearce (1988), Crompton (1997), Chardonnel (1999), Itami and Gimblett (2000)). The use of statistical software is one of the most common techniques in tourism analyses, especially to obtain frequency overviews of locations visited or to make a typology of tourists through data reduction techniques. But to deal with time, space and context concomitantly requires too many combinations of variables to derive a statistically sound answer concerning possible relationships. A different analysis methodology is therefore needed to support an approach where time, space and context are integrated.

Because of its spatial aspects, a Geographic Information System (GIS) seems to be an appropriate instrument. GIS is a tool which is particularly suited for the analysis of clearly delimited physical elements; such elements are easy to describe using geographical measurements and can be clearly characterised. The fuzzy boundaries of time-space behaviour, where context is important, make it difficult, but not impossible, to process time-space data using a GIS. Current GIS software can be applied to obtain a static overview and to perform spatial analyses of the use of a region at a certain moment, in a specific context. The presentation module within a GIS for 'static' data display is helpful in such an analysis. Displays are made quickly and parameters can be easily changed.

A new analytical tool has been found in data visualization techniques, which are used to make patterns in scientific data visible (Dykes 1996). The combination of dynamic visualization techniques with the cartographic approach of a GIS adds a new dimension to the visualization process: cartographic related data can be interactively browsed and explored for errors and patterns. New insights can emerge from the combination of thematic and cartographic data, and different hypotheses can be derived (Hearnshaw and Unwin 1994, MacEachren and Taylor 1994, Dykes 1999). A dynamic visualization method that combines the thematic, temporal and spatial aspects of tourist movements, and that is also easy to handle, provides an interesting way to communicate with the managers of tourism and recreational areas who have the dual task of dealing with tourist flows at the same time as trying to preserve the environment.

In 1996, an application was developed in cooperation with Jason Dykes at the University of Leicester (UK) to determine the possibilities for combining visualization techniques and dynamic cartography. The application, known as the Cartographic Data Visualizer for Time-Space data (CDV-TS), is used to perform a coherent analysis that combines the use of space over time and the context of such time-space behaviour, to explore linear, area or point related time-space data. The user can choose to examine either combined or separate variables. The interactive possibilities and visualization techniques within the CDV-TS software can be used to explore the data in numerous ways. The application was developed for a specific data set and for a specific area, the Schwalm-Nette area near the Netherlands.

To determine if this application is more generally applicable, and in different ways, a comparative study was made using data from two very similar surveys. The surveys provided two kinds of information:

- perceptions and motivations of tourists,
- graphical representations of trajectories in the tourist area that include time information.

The first survey concerns natural protected areas in the French Northern Alps, while the second concerns the "De Hoge Veluwe" Dutch National Park and the Kroller-Muller Museum (and its famous Van-Gogh paintings). The comparison of these two surveys focuses more on the evaluation of the methodological approaches used rather than on the results themselves. A second aim of the present study is to determine whether managers can handle the software and interpret the resulting maps.

2. The CDV-TS system in general

The CDV-TS application makes use of five main windows to communicate with the user (figure 1). In the first window, context-related individual tourist attribute data are presented (figure 1a). A second window displays the time aspects of the data (figure 1b), while a third window contains a map of the region in which the time-space movements can be presented. A fourth window deals with the cartographic aspects (figure 1d). A fifth window provides a general description of the software and the study region (figure 1e). In figure 1, a sixth window is also shown, this being displayed after a choice is made from the attributes window.

Different individual characteristics can be chosen from the window showing the available, mostly context-related, attributes (figure 1a). Separate sections of the population can be distinguished, and their time-space behaviour visualized and assessed. By moving a scale bar or clicking the related attribute buttons, corresponding maps are instantly displayed, and time and attribute series can be produced and the data set analysed. In CDV-TS, a scale bar determines the time (figure 1b). Users can choose the time period which interests them — time slices or instant time, the actual "moment". The spatial domain is represented by the line, point or area-related items in a map of the region. These spatial elements are configured with size and colour combinations, depending on the number of individuals located on a route or in an area at the selected time (figure 1c). In addition, the application offers the possibility of examining each separate spatial element for use frequencies during the day (the smaller histogram windows in figure 1c), regardless of the way the time scale bar is set up. Because of the nature of this data exploration process, there is no explicit legend for this sort of map. However, certain visual aspects can be considered useful, such as the brightness of the colour of a line connected to a specific characteristic, or the width of lines or size of circles that give an impression of the number of people at given locations (see figure 1d). Researchers can also vary the display and selection characteristics through the use of widgets created to vary the cartographic variables and to restrict inclusion to individuals with specific characteristics.

The combined use of the different buttons and scale bars produces an interactive "movie", a series of time slices, of spatial behaviour during a selected period, based on context-related choices of attributes. Individuals (or group types) can be mapped as items with shape, colour, texture, and outline width conveying any of the personal attributes. It is also possible to link graphics such as histograms or scatter diagrams to the spatial data and to explore the spatial patterns through these graphics. A further option develops dynamically linked map views of different scales which allow location within the area and individual characteristics to be compared with the distribution of tourist points of origin on a national map. The software has advantages over time-series animation investigations in that the user has total control over the speed and order of the sequence of displays.

3. Time-space behaviour in a regional park of the French Alps

3.1. Background and survey protocol

The first example studied concerns protected natural areas of the Ardèche region and the Northern Alps in France. Both areas are the subject of intensive research programs to analyse the problems encountered by management staff. Overcrowding that causes ecological imbalances and landscape deterioration is a major concern for all actors involved. Methods and observation tools for analysing phenomena will be developed and eventually adapted to management needs (Chardonnel, Mignotte, 2001).

The networks of paths in these protected areas has been a focus of study to determine frequentation patterns and the underlying logic of such patterns. Part of the research program thus sought to identify typical use patterns for these paths, and a survey was undertaken during the summer of 2000 involving 750 tourists at three locations in the Alps and in the Ardèche. This paper presents the results obtained from one of these sites, the natural reserve of the Aiguilles Rouges in the Mont-Blanc massif.

The aim of the survey is twofold. First, we hope to obtain a better understanding of the symbolic systems underlying the decision-making and representations of individuals using these natural mountain areas. Second, the survey should be representative of real uses of these paths, that is their use in space and over time. The experimental procedure therefore combines both dimensions: an interview about the motivations and representations of users associated with their practices of protected areas consisted of a diary together with a map of the different paths to help them to visualize their hike trajectories (where both space and time are specified). One difficulty arising from the large amount of data collected is how to validate a method that can treat information obtained at a given time (the interview) together with more dynamic information (trajectories). The CDV-TS system helps deal with this problem by combining data on trajectories and visitor attributes.

3.2. Preliminary results

Two objectives are achieved by using the CDV system: the trajectory classification through data mining (1), and the description and explanation of the trajectories chosen (2).

1) Trajectory classification through data mining

The CDV-TS system offers the possibility of classifying trajectory data and of displaying them in an interactive way in order to identify structures. The use of space and time can be examined individually.

Use of space

Analysis of the use data for the Aiguilles Rouges area (sector "Lac Blanc", see figure 2) enabled three types of trajectories to be identified (figures 3a, 3b, 3c):

- Loop trajectories (a)
- Back and forth trajectories (b)
- Crossing over trajectories (c)

Trajectories that correspond to loops (as is the case for 49.7% of the survey) are divided between two main paths, with a stop at "Lac Blanc" as a goal. The first path starts at the "Index" and ends up at the "la Flégère", while the second starts at "Tréléchamps" and finishes at the "Col des Montets". Information about the exact sequence of trajectories is obtained directly thanks to temporal graphs associated with maps. Frequently used entrance points and exit paths are shown, with a preference indicated for "Index" and "la Flégère" (corresponding to the peak values on the histograms in figure 3).

Back and forth trajectories (36.4 % of the survey) are also organised in function of reaching "Lac Blanc", but share the same itinerary for the walk out and for the walk back. "La Flégère", "Index", and "Col des Montets" (in order of frequency of use) are the starting points of these itineraries. Finally, cross-trajectories (7.6% of the study) start from "la Flégère" (only entrance point) and go up to the Col des Montets, with a possible stop at "Lac Blanc".

Use of time

A visual simulation of the development of individual trajectories reveals the rhythms and time periods which are significant in describing behaviour in the path lattice. Portions of the network that link entrance points to "Lac Blanc" (Index-Lac Blanc, La Flégère-Lac Blanc, Tréléchamps-Lac Blanc, Col des Montets-Lac Blanc) are mostly used in the morning. The Index-Lac Blanc route represents a special situation as it is still frequented between 12am and 2pm (this section allows late access to the path network - thanks to the lift – for people that want to go for a short ramble). Another point concerns the overall analysis of time-budgets related to the walk: most of the hikers start between 9am and 11am and end between 3pm and 5pm.

Simultaneous observation of spatial and temporal use shows that the choice of the entrance has a direct incidence on the trajectory followed and on the average duration of the hike. The entrance points at "Index" and "La Flégère" witness massive departures between 10am and 11am and returns between 2pm and 3pm, for a mean hike duration of 4.5 hours. Departures from "Index" almost prohibit going any further than Lac Blanc along the path to the Col des Montets. On the other hand, departures from the "La Flégère" leave the possibility open for some hikers to finish at the other extremity of the network. Departures from the "Col des Montets" or from "Tréléchamps" involve hikes of a longer duration (7 hours on average) that start between 8am and 9am and finish between 4pm and 5pm. None of these trajectories use the paths near "Index" or "La Flégère". It seems therefore that there is a unique point of convergence of all trajectories, both in space and time, at Lac Blanc: this is the predominant goal of all spatial and temporal circuit logics.

2) Describing and explaining the trajectories

The CDV-TS system includes tests of hypotheses about paths taken, influenced by forms of practices (and of frequentation in particular). Requests can be made to the database concerning attributes for visualizing itineraries. These attributes include characteristics such as sex, age, and geographic origin that are obtained directly from the survey.

Simple hypotheses concern the restriction among the full set of itineraries to some shared by a given set of individuals, characterised by simple socio-demographic variables. Analysis reveals that variables such as place of residence and profession have no visible influence on space and time uses. However, variables like age or group composition (type of people accompanying the respondent) show some kind of correlation. From figure 4 it can be seen that adults accompanying children (as opposed to adults without children) are mostly concentrated on portions of the network accessible by lift, resulting in walks generally shorter in duration. These simple tests also make it possible to check and eventually validate certain empirical knowledge, and to determine more systematically which criteria (variables) are significant. Such information is crucial if we wish to better understand the many types of visitor behaviour encountered in a particular recreational area. An observation grid could also be used by recreational area managers to obtain information in a more systematical and regular way.

A statistical analysis was carried out at the same time on survey answers concerning the level of interest in and motivation for hiking holidays in a protected area. This resulted in a typology of the visitor population comprising three categories:

- People concerned with high quality services and equipment;
- People attaching importance to the authentic and intrinsic beauty of the landscape (fauna, flora, panorama) during their hike;
- People stressing the importance of physical comfort during their hike (shade, not too steep slope, etc.).

When we compare these three groups with their corresponding itineraries in space and time, no obvious correlation is revealed (figures 5a, 5b, 5c). One category of hikers, defined on the basis of personal motivation criteria, does NOT correspond to a single type of spatial or temporal pattern observed. Finally, analysis also reveals the gap that exists between what people claim, wish or say (survey) and what people actually do (diary).

4. Time-space behaviour in "De Hoge Veluwe" National Park

The survey in the "De Hoge Veluwe" National Park took place in 1995. The following section is partly based on the report published in 1996 by Jansen et al., in which the main statistical analyses were presented. The data were collected to obtain insights into the actual use of the infrastructure and amenities visited. Based on the analysis, the management of the park can take measures, for instance, to level highs and lows in visitor numbers or to improve the quality of the amenities and services provided.

The survey was conducted using the diary method in which tourists were asked to give details of their visit, such as places visited, time spent, and modes of transport, and to sketch on a map the routes taken. In addition, visual counts were made, including the number of accompanying persons per transport mode, which combined with the diary data gave a more accurate estimate of the absolute number of visitors. Interviews were held in pre-season (April/May), high season (July/August) and late season (September/October). About 1100 persons returned their diary, out of a total of 1500. To complement the diary information, individual questions were asked, relating to demographic data, appreciation of the visit, statements about specific tourist motives, and behaviour. The last group of statements can be used to identify specific tourist groups based on how the tourist perceives his or her behaviour. In addition to the analysis of infrastructure used, it is possible to determine specific time-space behaviour from the routes followed and the places visited. This information can be combined with the tourist typology based on the statements about tourist motivations.

First, the main aspects of the time-space analysis in relation to infrastructure are described. Almost 80% of visitors come by car, about 20% use a bike (their own or rented), and a very small group use public transport or come on foot. Inside the park, visitors mainly use bikes (20%) and cars (40%), or walk (20%). These figures vary according to the season, however, so that in the summer the car is not used as often, and bikes are a preferred mode of transport inside the park. The combination of different modes of transport, for instance car and white bike (free bike available inside the park), or car and some walking, is also very common. However, about 40% of the visitors only use a bike, either their own or the white bike, for transport to or within the park. With regard to the areas of the park used, the northern part is the most frequented, with the heaviest use observed on the routes in the central northern area. The hiking paths are not used so often, which means there are still places in the park which are quiet. The main walking route is between the Kroller Muller Museum and the Visitors Centre and restaurant.

The CDV-TS program also shows how the roads are used during the day. Major peaks of traffic are usually observed around noon. A significant difference in park use is also revealed between visitors who come by car and those who arrive by bike (figure 6). Most of the visitors go to the central area of the park first, where the main amenities are located close together. Differences in park use are also apparent between visitors who are goal-oriented and those who just wander around, visiting the first thing of interest they encounter. Most visitors go to the Kroller Muller Museum, the Visitors Centre/Museonder, the "De Koperen Kop" restaurant, or the (hunting) lodge, Sint Hubertus. The most popular time for such visits is the afternoon. The mean length of stay in the park is about three hours, with generally no more than one hour being spent per amenity.

The way visitors connect different locations and amenities is also very different. The paths that are followed are not identical. While most of them visit the same locations and amenities, it is not necessarily in the same order. This fact can help management in controlling visitor use within the park, by influencing visitor behaviour, for instance, through the use of information signs.

The CDV-TS program offers a lot of quick insights into the time-space dataset of the De Hoge Veluwe park. Although information was collected on many attributes during the interview, only one third of the attributes could be used in any one CDV-TS session. This meant that different analyses had to be conducted first, from which a new set of relevant attributes was derived. The CDV system offers park management the possibility of analysing time-space behaviour in relation to numerous different variables such as the park entrance used, the mode of transport to the park, first location visited, order of locations visited, use of the white bikes, experiences during the visit, and use of the park as a whole. A major drawback of using this system, however, is the amount of data to be handled and the different conversions of the dataset needed to get it right for CDV-TS. People have a lot of information to fill in during their stay in the park and they are not always very careful or precise. Some of them also have problems reading maps and drawing routes on a map.

5. Comparisons and conclusions

5.1. Data collecting

For a successful analysis of time-space behaviour, a large amount of data on movements in time and space is needed. The kind of data needed requires a certain amount of effort from interviewees: *e.g.* map reading skills, sketching skills to draw the routes followed on a map, and diary keeping. Also, the processes of data input, data correction and fine tuning are very laborious. As already stated, a major drawback of the system is the amount of data and the different conversions required for use in CDV-TS. Therefore data collection and storage through links with a GPS (Global Positioning System) or even the use of mobile phones may offer solutions to these can remove the mentioned problems.

Although the two survey protocols are very similar, there are some differences. The two approaches vary, for example, in their classification of individual behaviour. In the first study (the Alps), the classification is based on the statistical analysis of survey data, whereas the second study (De Hoge Veluwe) uses a classification previously established in the literature and used as a reference to investigate tourist behaviour. Some differences also appear in the data acquisition procedure, but a certain amount of flexibility in the program nevertheless allows the data to be entered into the system, even though this can represent an onerous task.

We can conclude that the CDV-TS system provides a classification tool which is both flexible and rigid. It allows the processing of data that has been obtained in different ways and with different goals, but there is still no automatic process to convert the raw data into the CDV-format. A link to a GPS might solve this problem.

5.2. Methodological conclusions

The methodological objective of both studies is really to bring together two types of approaches, the first based on information of a *dynamic nature* about tourist *trajectories* in time and space, the second on information of a more *static* and *descriptive nature* relating to the circumstances under which activities are carried out.

In general, it concerns the conditions of staying in a resort (involving group composition, means of transportation, geographical aspects...), but also the intentions of visitors and the mental representations guiding their behaviour.

The CDV-TS system makes it possible to integrate both these categories of information through three major functions. The CDV-TS system:

- arranges information that is both constant over time and dynamic in a relatively basic database system;
- accesses the data in an interactive manner, enabling requests in a user-friendly environment (does not require database language request knowledge) to access either the full set of data or selected variables;
- visualizes changes (movements in space and time) in individual trajectories. The dynamic dimension is a key point in understanding the tourist frequentation of recreational areas.

The exploration phase suggests some different approaches that can be used. By way of an example, we would like to develop a model that describes the repetition phenomenon, through frequency analysis. The initial data mining consists of a visual selection of certain types of trajectory that can be used to relate nodes and segments in the network. We would like to represent this information later in the form of a mathematical graph[1]. CDV-TS would then become a test tool for a proper model at a higher level of abstraction. The analysis of a given problem could then be made more universal and provide the background for a forecast planning analysis.

1. See: Lebegue E. and Nedjaï R. (2001), and also van Langevelde, van der Knaap and Claassen (1998).

5.3. The recreational manager's point of view

When data input is complete, the manager has a powerful tool to examine time, space and context-related tourist data as a coherent whole for a particular region.

The software has already been partly tested with recreational and tourist area managers. In the French study, managers examined the initial results and concluded that it could certainly help them in their management tasks thanks to the real communicative capacity of the tool: it makes it possible to adopt a holistic approach in presenting tourist time-space movements to a wide community of actors involved in tourism. While testing the different kinds of requests, the managers underlined the fact that it might help them to be able to determine the most important variables involved in the tourist decision-making process. These variables could then be the subject of more detailed investigations (for example, by interviews). Interviews could also help identify alternative sites to improve both supply and demand conditions.

In the Hoge Veluwe study, certain managers were only offered a quick overview of the system, showing its main possibilities. The original data set of the Schwalm Nette area was used for this purpose. It was noted that managers were able to handle the software very easily. The way the data are organised in windows makes it easy to browse, explore, and search for basic relations and hypotheses. Following the brief overview, the managers saw new opportunities for using the tool in management tasks. For instance, they would like to evaluate the impact of alterations to paths or the introduction of new amenities. However, to deal with these types of questions requires a link to a behavioural model such as that offered by the RBSIM (recreational behaviour simulation) model of Itami and Gimblett (2000).

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Résumé : Gérer les mouvements spatio-temporels des touristes dans les espaces récréatifs. *Étude comparée à partir d'une méthodologie commune, dans les espaces protégés de montagnes françaises et un parc national néerlandais.* Les activités touristiques, sources de développement économique pour les régions dotées d'espaces attractifs par leurs qualités naturelles ou bien culturelles, peuvent aussi fragiliser l'environnement. Afin d'évaluer et éventuellement prévenir leurs conséquences sur la durabilité de l'environnement, l'analyse de l'utilisation des espaces au cours du temps par les touristes peut être d'une grande utilité. En effet, mieux connaître les comportements spatio-temporels des touristes permet de mettre en évidence la répartition les flux dans les réseaux des espaces fréquentés, et savoir où et quand apparaissent des phénomènes de saturation, quelles motivations sous-tendent les choix individuels et/ou collectifs d'itinéraires-types.

Les deux études présentées se basent sur un type d'enquête combinant des informations sur :

- la perception et la motivation des pratiques des touristes
- le récit graphique d'un parcours réalisé dans l'espace touristique agrémenté des horaires l'ayant rythmé.

Elles ont été menées d'une part dans des espaces naturels protégés de montagnes d'Ardèche et des Alpes du Nord (France) et d'autre part dans le parc national de "De Hoge Veluwe" dans lequel se situe le musée Kroller-Muller (présentant les œuvres de Van-Gogh). L'objectif de cet essai comparatif est de montrer comment une analyse statistique combinée à un SIG spatio-temporel (CDV-TS system) sont un outil opératoire, dans des contextes différents, pour des gestionnaires d'espaces touristiques. En effet, il permet de produire de l'information sur les relations entre systèmes

symboliques sous-jacents aux pratiques et usages observés des espaces au cours du temps. Le principe du CDV-TS system (Cartographic Data Visualizer for Time-Space analysis) est de permettre à l'utilisateur d'explorer les données sur les itinéraires des randonneurs dans un environnement informatique complètement dynamique. L'utilisateur peut faire varier la sélection des variables (types de randonneurs, types de journées, types de motivations : ces typologies étant issues du traitement statistique préalable) et visualiser l'ensemble (issu de la sélection) des circuits effectués dans l'espace considéré. Une sélection temporelle peut aussi être réalisée sur le corpus des itinéraires, permettant par exemple la visualisation de cartes à des instants successifs ou bien sur des périodes de la journée.
Les résultats de ces analyses s'attacheront à montrer :
• d'un point de vue méthodologique, l'intérêt de développer des outils de traitement exploratoire des données spatio-temporelles permettant de formuler de nouvelles hypothèses sur les comportements touristiques,
• d'un point de vue opérationnel, l'utilité des résultats dans le cadre d'une réflexion sur le développement durable de ces espaces : découverte de potentiels sous-exploités, détermination de dérives d'utilisation, simulation d'actions sur les espaces en « contrôlant » les comportements.

Mots-clés : Développement touristique régional, comportements spatio-temporels, visualisation cartographique dynamique, SIG.

Abstract: Activities that concern tourism are a source of economic development for regions having attractive areas, either due to natural or cultural resources, but it may also endanger fragile environments. Evaluating and preventing over a long period of time the environment from the consequences of tourist activities is a major task. A better knowledge of spatial distribution and frequent usage over time of such areas can give evidence to phenomena like saturation, and give clues to understand what controls individual choices and/or typical collective itineraries.
We present two studies based on an survey that combines information on:
- the perception and the motivation of tourist practices,
- a graphical representation of a trajectory in the tourist area that includes time period information.
The first study concerns natural protected areas in the French Ardèche mountains and Northern Alpine Mountains (France). The second study concerns the Dutch National Park "De Hoge Veluwe" and the Kroller-Muller Museum (and its famous Van-Gogh paintings). By comparison, we show that a statistical analysis combined with a time-space oriented GIS (CDV-TS system) prove to be in both cases a powerful tool for recreational areas managers. The resulting information produced is related to symbolic systems based on practices and observed use of time-space.
A principle of the CDV-TS system (Cartographic Data Visualizer for Time-Space data) is to give the user an access to data on tourist itineraries in a fully dynamic computing environment. The user selects items (e.g., type of hikers, type of day, type of motivation: such categories are defined from a previous statistical treatment) and visualises the selected list of existing itineraries. A temporal selection is also possible among the itineraries, either at a given time, or on periods of time during the day.
The main results or concerns are:
• from a fundamental point of view, the interest of developing new tools for both temporal and spatial data that will lead to new hypotheses;
• from an operational point of view, the necessity of long term decisions on the development of such areas: insufficiently exploited resources, inappropriated uses, and simulation of consequences of controlling individual behaviour on areas.

Keywords: Regional tourism management, Time-space behaviour, Dynamic visualisation, GIS

Figure 1: Windows in the exploratory data analysis software CDV-TS.
Fenêtres dans l'analyse exploratoire des données du logiciel CDV-TS.

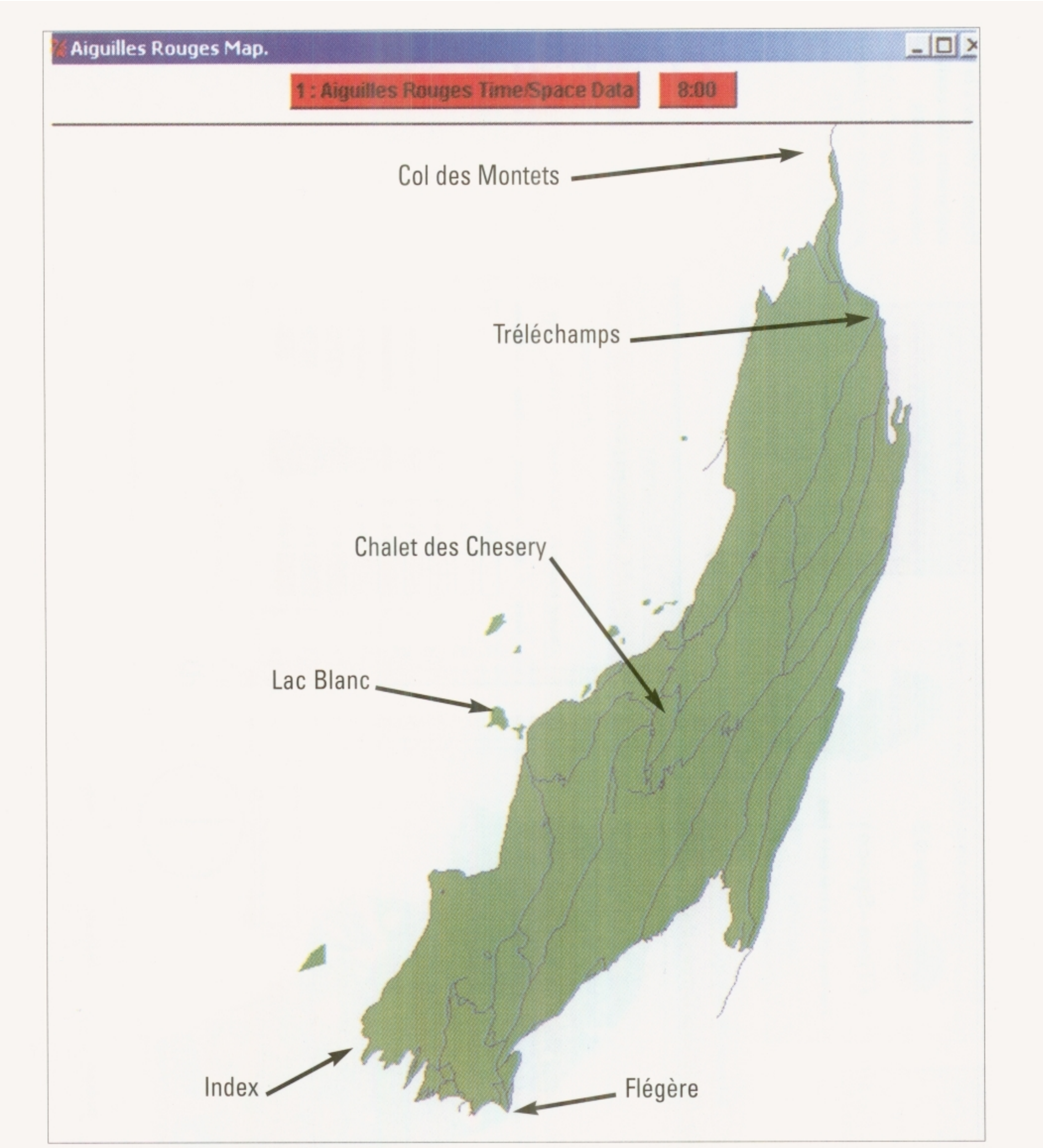

Figure 2: Overview of the Site Aiguilles Rouges-Lac Blanc.
Le site des Aiguilles Rouges-Lac Blanc

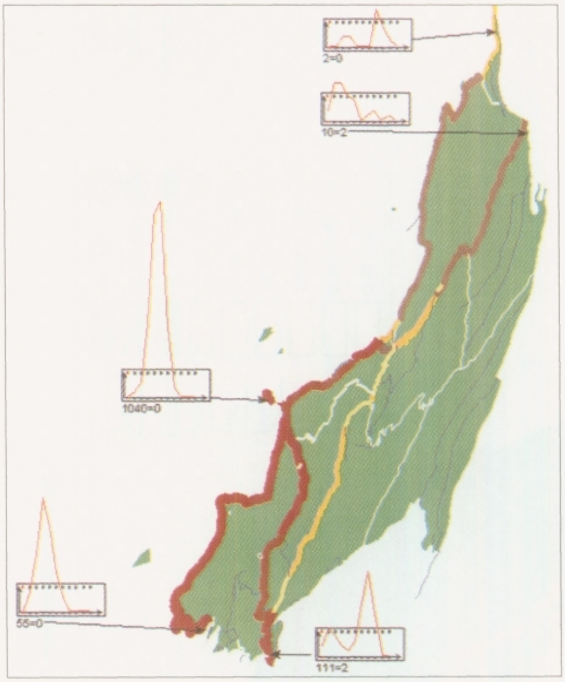

Figure 3a: Loop trajectories. *Trajectoires en circuit.*

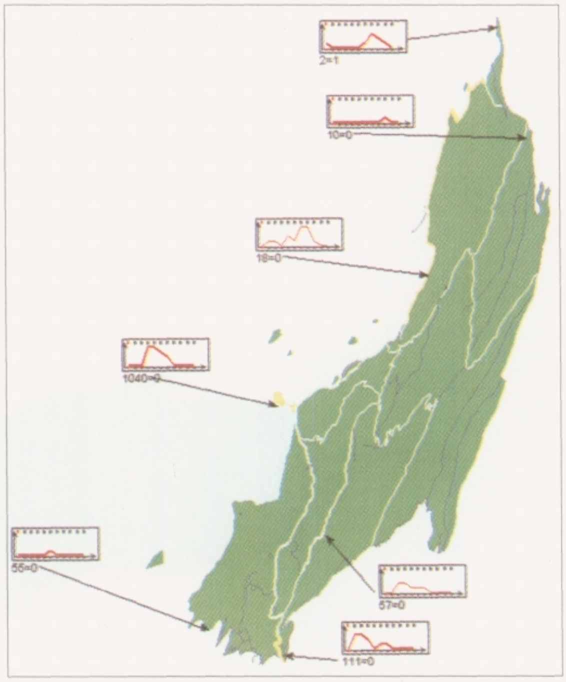

Figure 3c: Crossing over trajectories. *Trajectoires en traversée.*

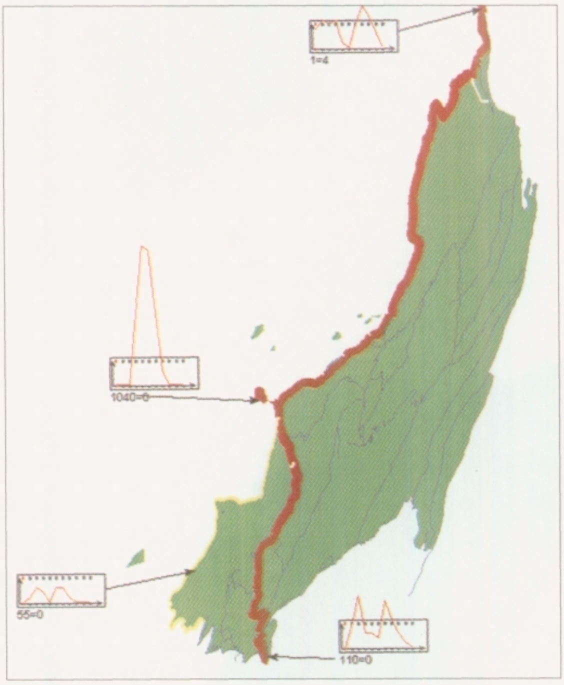

Figure 3b: Back and forth trajectories. *Trajectoires allers-retours.*

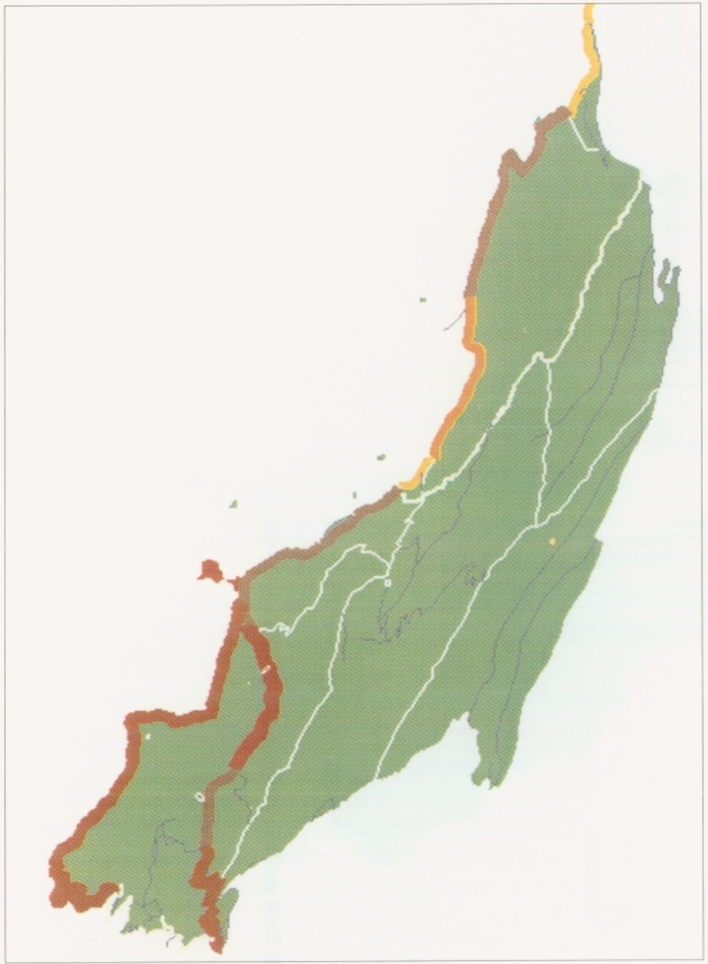

Figure 4a: Trajectories with children. *Trajectoires avec enfants.*

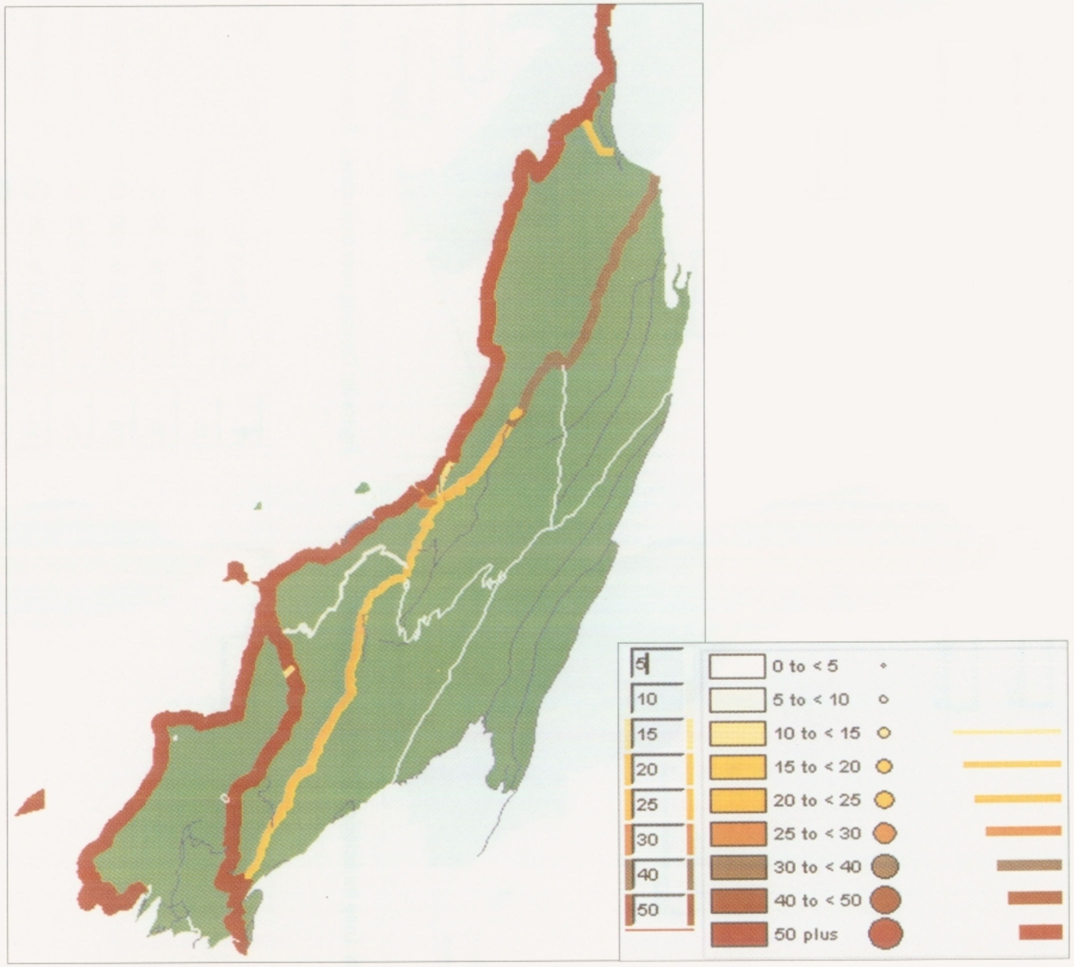

Figure 4b: Trajectories without children. *Trajectoires sans enfant.*

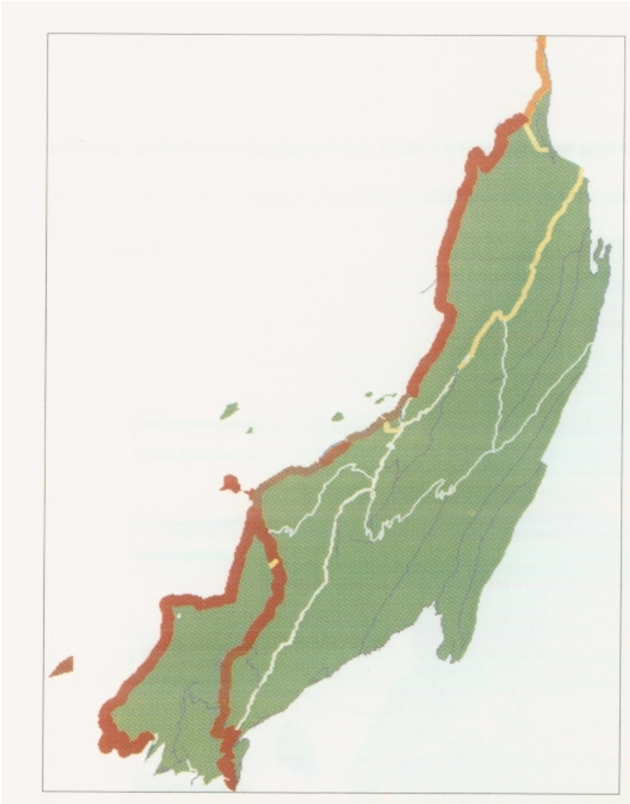

Figure 5a: Class 1 High quality services and equipment.
Classe 1 : Equipements et services de bon niveau.

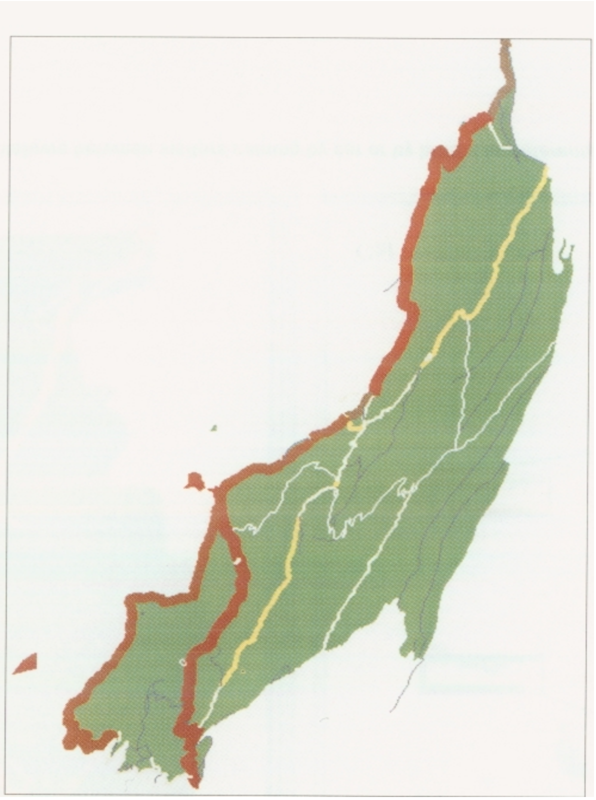

Figure 5b: Class 2 Beauty of landscape.
Classe 2 : Paysages pittoresques.

Figure 5c: Class 3 Physical comfort.
Classe 3 : Agréments physiques et personnels.

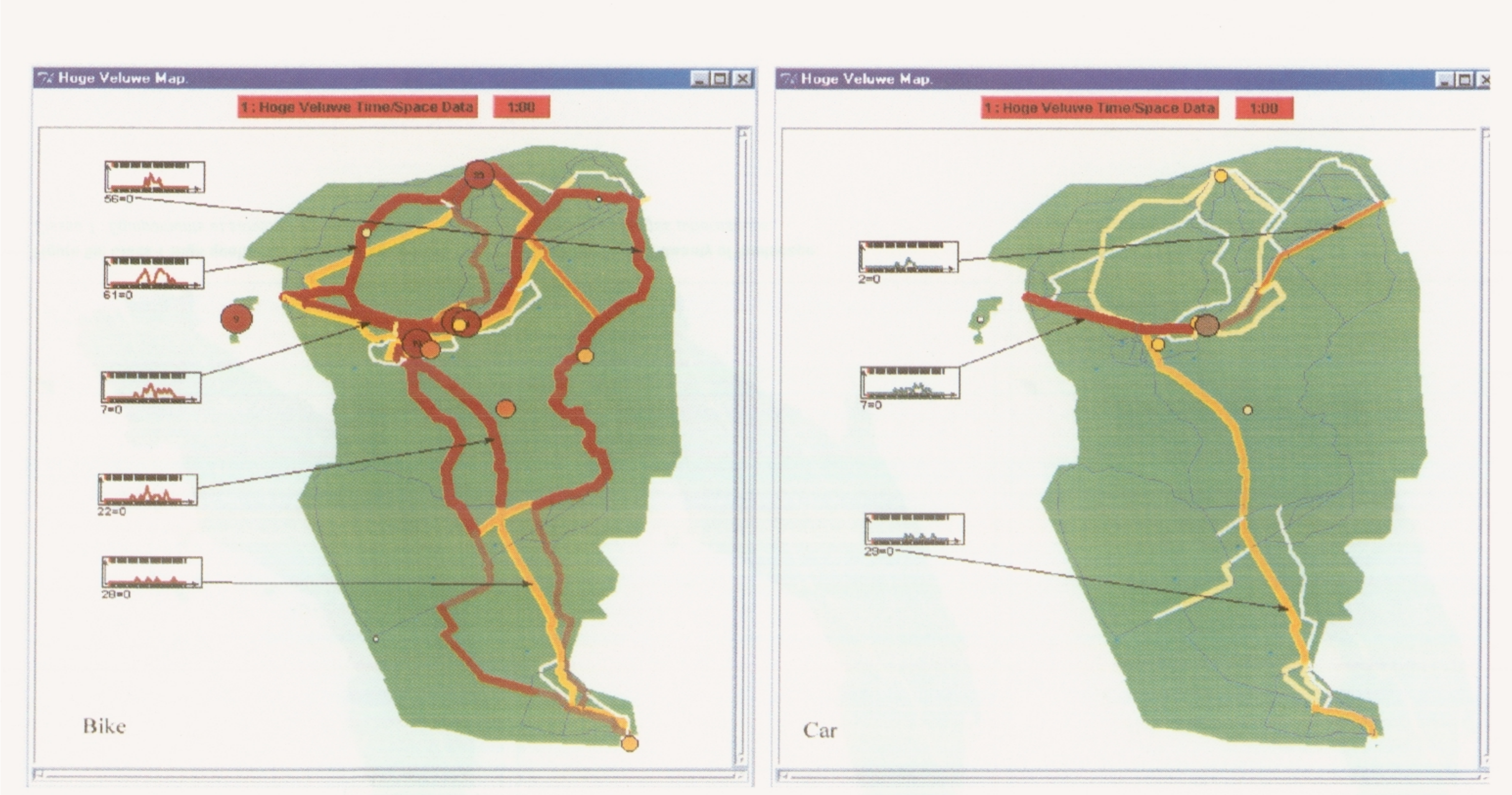

Figure 6 : Impression of differences in the use of the park Hoge Veluwe between visitors coming by car or by bike. *Les différentes utilisations du parc Hoge Veluwe selon le moyen de locomotion.*