Intercept Surveys of Cycle Usage

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Summary

The development of on-road and off-road cycle networks has seen cycling become more of a mainstream mode of transport for a variety of trip purposes. To support this new position, and to ensure that policies for cycling are based on the best available data, surveys of cycle travel patterns need to be conducted using state-of-the-art professional survey techniques. This paper describes surveys conducted on the Swiss Veloland Cycle Network in 1998 and 1999, which used intercept surveys of cyclists at various sites on the network. Three survey techniques were employed; a full count of cyclists at each site, a short trackside interview with a random sample of passing cyclists at each site, and a more comprehensive self-completion questionnaire which sampled cyclists were given to complete and return by post after their trip had finished. The paper outlines the techniques used in the conduct of the Veloland survey, and in the estimation of system-wide usage of the network from the data obtained at the survey sites. One conclusion of the paper is that the most sensitive parameter in the estimation of total network usage is the seasonal variability of cycle flows and the effect of weather and climate on these flows. Greater attention needs to be paid to the continuous monitoring of cycle flows and the development of models relating cycle flows to climate and weather variations, if a better understanding of the factors affecting cycle flows is to be developed.

1. Introduction

The Veloland Schweiz National Cycling Route system was introduced in May 1998 to encourage and promote cycling in Switzerland. The system consists of nine routes covering all the major cycling areas, as shown in Figure 1.

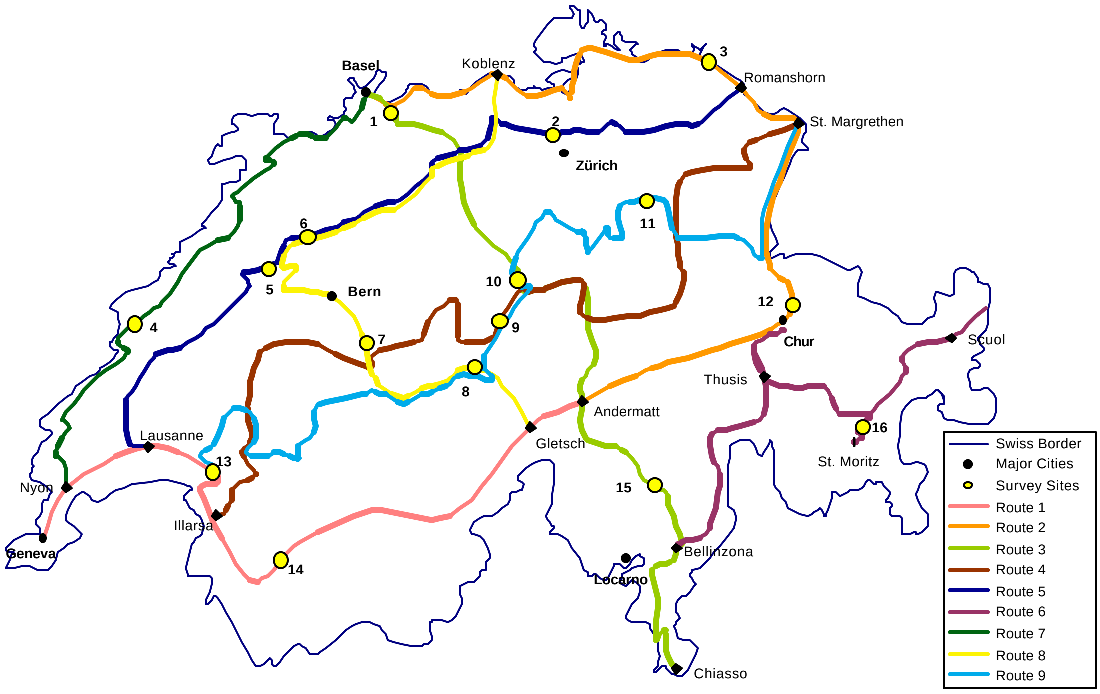

Figure 1 The Veloland Schweiz National Cycling Network

Following the introduction of these routes, Veloland Schweiz wanted to undertake user surveys to ascertain the level of usage of these routes by various types of cyclists. They also wanted to obtain demographic and geographic descriptions of the users and an indication of the amount of money spent on bicycle-related activities while using these routes.

To argue the case for supportive cycling policies, Veloland Schweiz required statistically reliable and politically credible estimates of the usage of the National Cycling Route System.

2. The Survey Technique

After consideration of a variety of survey methods, the 1998 survey was designed on the basis of an intercept survey technique at 16 sites on the network, consisting of four basic steps for the interviewers:

- Counting passing cyclists
- Sampling cyclists
- Conducting a track-side interview
- Handing out the questionnaire

More comprehensive details of the survey technique are available elsewhere (Richardson, 1999a, 1999b) and are summarised below.

2.1 Counting Cyclists

At each survey site, all cyclists travelling in each direction were counted and recorded on an Interviewer Control Sheet. This count information was essential at later stages, since the sampled data was eventually expanded up to represent the population of cyclists recorded in this count.

2.2 Sampling Cyclists

It was important that riders were selected randomly for the survey. To ensure this, surveyors were instructed that they MUST select every n^{th} cyclist passing in their direction (where n was specified for each site in the interviewer instructions). This rider may have been by themselves, at the head of a group, in the middle of a group or at the rear of a group. When the n^{th} rider arrived and the surveyor had recorded this in the cyclist count column, they were then to record the time at which they arrived (to the nearest minute) on the Interviewer Control Sheet, together with their estimate of the cyclist's age, their sex and the size of the group in which they were riding. The surveyor then requested this rider to stop to receive a survey. If the selected rider refused to stop, this was to be recorded on the Interviewer Control Sheet.

If the selected rider was in a group, the surveyor was instructed to keep counting those following in the group on the next line of the Interviewer Control Sheet. It was stressed that it was important that the surveyor maintain a count of ALL riders passing the survey site. If a group contained more than n riders, then more than one rider may have been selected for interview. The cyclists were selected according to the order in which they reached the survey location. The surveyor was instructed to continue to count passing cyclists while conducting the interview with their selected rider (see below). It was stressed that this count information was extremely important for later analysis of the results.

When the track-side interview was finished, the surveyor was instructed to continue counting until the n^{th} rider after the previously selected rider arrived. If more than n riders passed while an interview was being conducted, the next multiple of n should be used to select the next rider for interview (for example, if six riders passed while an interview was being conducted at a survey site where n=4, then the surveyor kept counting up to eight before selecting the next rider).

2.3 The Track-side Interview

In addition to the information about the selected rider that surveyors had already recorded on the Interviewer Control Sheet, an initial Track-side Interview was conducted with every n^{th} rider to record the following information on the Interviewer Control Sheet:

1. "Where do you currently live?"
   (Town and Postcode, or Country for non-Swiss-residents)
2. "Do you know which National Route you are now travelling on?"
   (if the rider said YES, then they were asked the number of the Route)
3. "Has this bicycle journey included an overnight stay?"

The information from the Track-side Interview was used to provide an overall picture of cyclists' characteristics which were later used to investigate whether those who returned the questionnaire were similar to all riders who were selected in the sample.

2.4 The Questionnaire

Once the Track-side Interview was completed, the selected rider was given a questionnaire asking more detailed questions about their current trip (copies of the questionnaire were printed in German and French, depending on the preferred language of the selected rider).

Questionnaires were to be taken away and returned by post after the end of the bicycle journey. This ensured that respondents were not guessing about the remainder of their journey. If a selected rider refused to accept a questionnaire, this was to be recorded on the Interviewer Control Sheet.

3. Conduct of the Surveys

Surveys have been conducted at 16 sites on the network on three separate occasions; September 1998, July 1999 and September 1999. The survey method has been essentially the same on each occasion, and hence only the results from the September 1998 survey will be summarised below. The September 1998 surveys were conducted at the 16 sites between 1000 and 1700 hours on Sunday 20th September and Wednesday 23rd September, 1998. A total of 2,076 interviews were attempted on the two days of the survey.

4. Methodological Results from the Survey

The survey process as described above had four stages by which cyclists could be included in the final database of returned questionnaires. Firstly, they had to be selected from all the passing cyclists; secondly, they had to stop for an interview; thirdly, they had to accept a questionnaire; and fourthly, they had to return a completed questionnaire.

4.1 Selection Rates

The selection of cyclists was based on a pre-specified sampling interval for each of the sites. The sampling interval was chosen such that interviewers were kept busy, but not too busy, at each of the sites. Because of different flows at each site, the sampling interval varied across sites and across the survey days. On Sunday, about 1 in 4 cyclists were actually selected, whereas on Wednesday about 1 in 3 cyclists were selected.

4.2 Acceptance Rates

Once the cyclist had been selected, they were then expected to stop to be interviewed and then accept a questionnaire. Not all cyclists stopped when requested, not all cyclists who stopped then answered the interview questions, and not all cyclists who answered the interview questions then accepted a questionnaire (although it seems that it was an exception for someone who stopped not to then accept a questionnaire). Since it was often not clear from the Control Sheet information at what stage a refusal precisely occurred, these three behaviours have been grouped into one measurement. The Acceptance Rate is defined as the proportion of cyclists selected who eventually accepted a questionnaire.

The acceptance rate at each of the survey sites on each of the survey days varied substantially, from over 90% on both days at sites 8 and 11, down to about 40% on both days at site 13. Overall, acceptance rates were higher on Sunday (72%) than on Wednesday (66%).

When the cyclist was selected at the survey site, three variables were recorded; age, gender, and size of the group in which the cyclist was riding. It is therefore possible to check for any differences in acceptance rate within each of these variables. The acceptance rate for cyclists who were riding by themselves was much lower (about 60% acceptance rate) than for cyclists riding in groups (about 80% acceptance rate). It appears that the peer pressure of being in a group had the effect of encouraging the cyclist to stop and accept the questionnaire, while lone riders were more likely to just continue riding without stopping. The acceptance rates show little variation by age, but the acceptance rates for females (an average of 78% acceptance) was consistently higher than for males (an average of 68% acceptance). Cyclists on overnight trips are more likely (96%) to accept the questionnaire than cyclists on day trips (87%).

4.3 Response Rates

Not all cyclists who accepted a questionnaire actually completed and returned it to the Veloland office. Overall, the response rate on Sunday was 45% while on Wednesday it was 42%. However, there was substantial variation in response rates between the sites, ranging from 11% at site 10 on Wednesday up to 75% at site 15 on Wednesday.

In the same way that acceptance rate could be investigated by cyclist characteristic, so too could response rate. While 49% of cyclists in groups returned their questionnaire, only 35% of lone riders returned them. Of those accepting a questionnaire females are slightly more likely to return it (46%) compared to males (44%). The only difference by age is that teenagers (i.e. those between 11 and 20 years of age) are much less likely to return the questionnaire than any other age. Of those accepting a questionnaire, cyclists on overnight trips are more likely to return it (60%) compared to those on day trips (43%).

4.4 Weighting of Data

The intercept surveys conducted at the 16 sites collected information about the population of cyclists passing each site. As noted in the previous section, however, biases exist in which cyclists accepted and returned the self-completion questionnaire. Therefore, if the data from the returned questionnaires are to be used to represent the population of cyclists passing each site, adjustments need to be made to the sampled questionnaire data to account for the differential acceptance and return rates of the questionnaires by different groups of cyclists.

This weighting of the data is performed by comparing the user composition of the returned questionnaires (in terms of sex, group size and type of trip by survey site and day of survey) with the user composition observed by the surveyors in the field. Weights are then applied to the questionnaire data to bring it into line with the proportions of each group in the field survey data. At the same time, the sample questionnaire data is expanded to estimate the population totals of usage by comparing the number of returned questionnaires with the number of observed cyclists at each site on each survey day.

5. Estimation of System-Wide Network Usage

While the analysis has taken account of differential acceptance and response rates, it has not, so far, taken due account of the differing degrees of exposure of different cyclist groups to being included in the initial survey. Firstly, since the survey sites were spread geographically around the network, cyclists who made longer trips were more likely to have passed one of the survey sites and hence have a chance of being in the survey population. Therefore, the results observed at the 16 sites have to be inversely weighted by the length of the trips observed, with longer trips having a lower weighting factor. Secondly, the results obtained will depend on the specific location of the survey sites. A survey site which is located closer to a major urban area will generally have a higher proportion of day trips than a survey site in a rural area, where the proportion of overnight trips will be higher. To the extent that the 16 survey sites are not necessarily representative of the entire network, the results obtained from the selected survey sites need to be re-weighted to account for their specific locations.

These two weighting processes are related, because they are both a function of the length of cycling trips made on the network. They were therefore handled in the one process by a technique which estimates the total annual usage of the entire network. This was done by first developing a model of usage at any point on the network, and then applying this model to the entire network.

5.1 Developing the Model of Network Usage

The basic idea underlying the model is that usage at any point of the network is a function of the distance of that point from centres of population. Points close to cities will have larger flows of cyclists than points further away from those cities, while being close to a large city will generate more cyclists than being close to a small city. This concept is that of the familiar Gravity Model, as used in many models of transportation and locational behaviour.

For each survey site, the distribution of distances from that site to the residential location of the cyclist making each trip was first calculated. Using the a database of the population and x-y coordinates of all Swiss communities, the total number of residents living at various distances from each survey site was also calculated. By dividing the number of cyclists observed at a survey site by the total number of residents (for each distance from the survey site), it is possible to calculate the number of observed cyclists per 1000 resident population (the "trip rate") for each residential access distance interval.

To these data, a model of the following form was fitted:

$$\frac{T}{P} = c + Ae^{-nd}$$

where T = number of observed trips from a given distance to the survey site
P = residential population at a given distance to the survey site
c = a constant reflecting the balance between town size and access distance
A = a constant reflecting the overall attractiveness of that site for cycling trips
e = the base of logarithms
n = a constant reflecting the impedance effect of distance to the survey site
d = the distance from the residential location to the survey site

The parameters of the models of best fit, which were checked by calculating the expected number of trips at the survey site from each distance interval and comparing this against the observed number of trips, are shown in Table 4.

Table 1 Parameters for the Day and Overnight Trip Models

	Parameter		
Trip Type	C	A	N
Day Trip	0.0040	5.0	0.18
Overnight Trip	0.0057	0.5	0.08

5.2 Applying the Model of Network Usage

The models developed in the previous section allow the prediction of trip numbers at any point on the route based on the proximity of that point to areas of population. The model is applied by calculating such usage at many points along the route to obtain an overall profile of usage on the route, rather than just at the selected survey site, using the following process.

1. Calculate the Distances from Route Points to all Swiss Communities

2. Apply the Trip Rate Models, to obtain the total number of cyclists expected at each point along the route

3. Compare Predictions and Observations at the Survey Sites, to calculate route-specific attractiveness coefficients

4. Construct Route Profiles of flows at each point along a route

5. Calculate the "Locus" of each Point on a Route, given by half of the distance between neighbouring points on each side

6. Calculate Trip Kilometres for each Point and for Whole Routes, by assuming that each cyclist passing a point travels the distance indicated by the “locus” of each point

7. Calculate Trips on each Route, by dividing the total trip kilometres on each route by the average length of each trip. The average trip lengths for day trips and overnight trips are obtained from the survey results as 40 km and 195 km respectively

8. Expand Results to a Full Day, to account for the fact that the survey was conducted only between the hours of 10am and 5pm on the survey days. On both days, a full day is about 18% more than the surveyed day, in terms of number of trips observed.

9. Expand Results to a Full Week, assuming that a Saturday is like a Sunday and each weekday is the same as a Wednesday

10. Expand Results to a Full Month, by multiplying by the number of days in the month divided by seven

11. Expand Results to Annual Totals, by dividing by the proportion of annual trips occurring in the month in which the survey was performed.

Application of all these temporal expansion factors gives an estimate of the total number of trips per annum on each of the cycle routes. Multiplying by the average length of day trips and overnight trips gives an estimate of the annual trip kilometres on each route.

Each of the stages listed above is relatively robust, except for stages 9, 10 and especially 11 which expand the results of the survey to an annual total. This was highlighted by the September 1999 surveys, when the weather on one of the survey days was particularly bad, leading to very low cyclist flows. Research performed since the conduct of the 1999 surveys has highlighted the importance of weather variations, and has calculated expansion factors for each month, based on the average weather conditions at each site in each month. It has also demonstrated that the results obtained on any survey day (even when the weather is good) should be weighted so as to represent the weather conditions prevailing on an average day of the year.

5.3 Annual Estimates of Network Usage and Expenditures

The estimated annual results, based on the September 1998 survey, are summarised in Table 2. Several features of these results are important. Firstly, in terms of trips, day trips vastly outnumber overnight trips, with overnight trips comprising only 4% of all trips. However, because of their much longer average length, overnight trips make up 15% of the trip-kilometres on the network. The survey method is better at estimating trip kilometres rather than trips, because when standing by the side of the track counting cyclists, as was done in the Veloland surveys, it is really short sections of trips, measured in trip-kilometres, which are being observed, rather than trips themselves. For this reason, the results reported from simple analysis of the survey data match more closely with the trip-kilometre figures than they do with the trip results. The second major feature is the order of magnitude of the results. There are over 3 million day trips made on the network annually, and about 120,000 overnight trips (from a total Swiss population of about 7 million). These trips generate a total of about 150 million kilometres of travel (i.e. approximately the distance from the Earth to the Sun!).

Table 2 Estimated Annual Trips and Trip-Kilometres on National Routes

Route	Day Trips	Overnight trips	% Overnight Trips	Day Trip-kms	Overnight Trip-kms	% Overnight Trip-kms
1	192,127	5,702	3%	7,685,075	1,111,813	13%
2	743,702	32,960	4%	29,748,073	6,427,113	18%
3	301,487	4,419	1%	12,059,472	861,706	7%
4	413,666	14,328	3%	16,546,659	2,793,986	14%
5	317,680	17,148	5%	12,707,200	3,343,896	21%
6	121,192	11,352	9%	4,847,671	2,213,718	31%
7	257,971	2,065	1%	10,318,853	402,722	4%
8	402,085	17,462	4%	16,083,413	3,405,142	17%
9	457,528	15,232	3%	18,301,131	2,970,310	14%
TOTAL	3,207,439	120,669	4%	128,297,546	23,530,406	15%

The annual expenditure by cyclists on these trips can be estimated by applying the average expenditure per trip by day-trippers and overnight tripmakers, as calculated from the Veloland questionnaire survey, to the annual number of trips. The average expenditures per trip are shown in Table 3, while the total annual expenditures are shown in Table 4.

Table 3 Average Expenditures per Trip

	Day Trips	Overnight trips
Eat & Drink	SFr. 12.69	SFr. 178.35
Transport	SFr. 4.01	SFr. 31.92
Accommodation	SFr. 0.00	SFr. 183.92
Other	SFr. 2.42	SFr. 35.09

Table 4 Total Annual Expenditures

	Day	Overnight	TOTAL
Eat &	SFr.	SFr.	SFr.
Transpo	SFr.	SFr.	SFr.
Accommodatio	SFr.	SFr.	SFr.
Othe	SFr.	SFr.	SFr.
TOTAL	SFr.	SFr.	SFr.

It can be seen that the total annual expenditure of cyclists using the Veloland network on trip-related items is approximately 110 Million Swiss Francs. This amount is split about evenly between day trips and overnight trips. Although overnight trips have far higher expenditures per trip, the sheer number of day trips means that the total expenditure on day trips is, if anything, slightly higher than on overnight trips. A useful index can be obtained by dividing the total expenditures by the total trip-kilometres for each type of trip. This shows that day trips have an expenditure rate of about SFr. 0.50 per kilometre, while overnight trips have an expenditure rate of about SFr. 2.00 per kilometre.

6. Policy Implications of the Survey Results

Veloland Schweiz needs reliable data about the cyclists using the national routes. It is important to know if the cyclist is content with the infrastructure and service quality. With the survey method used, we now know a lot about the cyclists using the national routes (social factors, trip behaviour etc.). We can adapt marketing measures to these target groups. We can also direct infrastructure investments (routes, signage etc.) and service improvements (information, accommodation, transport etc.) to the needs of these cyclists.

Most importantly, we now know if Veloland Schweiz plays a role in the tourism market or not. We now know, for example, that 1 in 200 tourists is a Veloland tourist in terms of used accommodation. At a first look it may not seem a lot, but Veloland only started in 1998, and as a result of the first year activities, it is considered very satisfactory. Cycle tourism is starting to play an important role in the tourism market. Furthermore, 3 million day-trip cyclists on the 3300 km network are a considerable number. Leisure cycling is widely used and we think, that the offer of Veloland Schweiz stimulates the potential cyclist to start another tour. In addition, the annual expenditure by the cyclists of 110 Million Swiss Francs is worth a comparison. The project cost for the realisation of the Veloland Schweiz network was about 10 Million Swiss Francs, while the annual tax revenue from the 110 Million Swiss Francs is about 10 Million Swiss Francs. In other words, the project costs are paid back by tax revenue on the cyclists' expenditures in one year.

To improve the quality of the infrastructure and services provided, money is needed, of course. The results of the survey help us to argue that the representative bodies (cantons, communities) should invest in further improvements. Because the foundation Veloland Schweiz is not itself in possession of money for such investments, the success is due to the willingness of the cantons and communities to invest in the improvement of the national routes.

References

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Further information about Veloland Schweiz for German and French speaking: www.veloland.ch and www.suisse-a-velo.ch (from 2001 also in english: www.cycling-in-switzerland.ch)