Monitoring and Management of Visitor Flows in Recreational and Protected Areas
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# Serial Experiences : Monitoring, Modelling and Visualising the Free Independent Traveller in New Zealand at Multiple Scales with GIS

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Abstract: This paper outlines a number of approaches and methodologies, based on utilising itinerary analysis and Geographic Information Systems, which have sought to explore tourism flows and their impacts at a range of temporal and spatial resolutions. As such its basic records are the sequential movement patterns of individual tourists, either from night to night or from stop to stop. It draws from a data base of some 50,000 journeys nationally, and three major regional surveys in Northland, the West Coast and Rotorua conducted between 1997 and 2001. The paper initially deals with analysis and integration issues relating to existing national data sets on international and domestic visitors and their overnight stays. It then describes and critiques the development of map-based sample surveys applied to detailed information on intra-regional flows, with reference to work in both Tai Tokerau (Northland) and the South Island's West Coast. These surveys record the 'informal' stopping behaviour of visitors in greater detail, and allow initial analysis of movement and positioning of tourists at various times of the day. Insights gained from these data are explored, and their relationship to other data sets such as attraction visitation and accommodation usage surveys are reviewed. Finally, the significance of the data for tourism (in areas such as development strategies and impact assessment) and for wider geo-demographic applications are discussed, as are new data collection opportunities for recording itineraries and flows.

## NEW ZEALAND'S CONTEXT FOR FLOW RESEARCH

As a cluster of sizeable but isolated islands, blessed with sufficient attractions to attract substantial international visitor interest, New Zealand represents an almost ideal context for defining and researching tourist flows. With the nearest land mass three and a half hours flying time away, and with closely-monitored entry and exit points, few visits are incidental or casual trans-border excursions, and assessing gross patterns of visitation is straightforward. All visitors are recorded by entry and exit cards, and the great majority (well over 95%) arrive by plane at one of three sites: Auckland, Christchurch and Wellington. Auckland, with direct flights to Asia, the Americas and Pacific Islands, dominates traffic, while Wellington, with links only to a few Australian cities, plays a small but important role. Setting aside Australia, which is a significant but not dominant generator of visitors, most tourists either visit New Zealand as a solo destination (for 3 to 6 weeks typically) or combine New Zealand with a comprehensive tour including one or more of South East Asia, Australia or the Pacific Islands.


*Figure 1: New Zealand Context Map*

### *The International Visitor Survey*

In terms of identifying the total number of international visitors, and thus having a robust sampling frame for surveying the composition of visitor flows, New Zealand is thus in a highly favoured position. Since the late 1980s knowledge of gross flows has been used to collect additional information from international visitors through the *International Visitor Survey* (IVS). This has run annualy, initially with some 4,500 respondents each year and latterly with close to 5,500. This survey

has evolved over the years, but the methodology has constantly used an exit survey drawn from known departure patterns, and which has featured the collection of detailed marketing information, trip purpose and respondent (and companion) profiles. It has also collected information on internal activities while in New Zealand, including a sequential record of places where overnight stops were made, and their duration. These data were largely used to record total nights spent at specific locations, but in 1993 the first re-casting of the data was undertaken to illustrate regional flows, which resulted in the publication of a national map of international tourist flows (NZTB 1994). Broken down by categories of visitor and by country of origin, it revealed quite clearly the different travel patterns of visitors originating from different countries in the 1992-1993 survey (Figure 2).

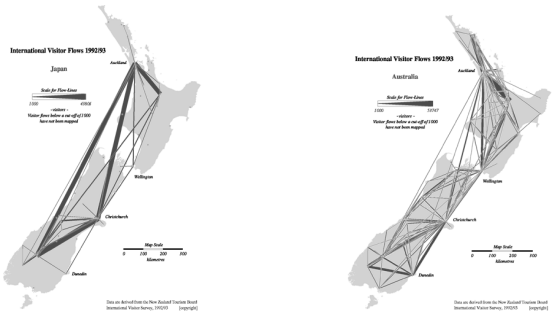


*Figure 2: Comparative Flow Patterns, Japanese (left) and Australian (right) visitors. Source NZTB 1994*

A knowledge of internal international visitor flows is important for understanding New Zealand tourism, partly because compared to many countries the free independent traveler, and the philosophy of touring holidays rather than single destination ones, are dominant aspects of tourist behaviour and impact. Touring by coach was once a major aspect of these flows (Forer and Pearce 1984), but increasingly car hire and independent and flexible travel behaviour have come to dominate in all but a few markets. The different behaviour of visitors from different markets, revealed by maps such as Figure 2, also gathers significance in terms of relating national marketing effort and focus to issues of regional development and involvement in tourism. For areas such as the West Coast of the South Island, growth in visitors from Australia or Germany, for instance, is worth considerably more than growth from Japan or Korea. These regional patterns also have significance in terms of influencing negative impact on New Zealand's natural assets, particularly the National Parks which have grown in number to fourteen and to constitute over 10% of the national land area. As international tourism numbers have grown consistently to over 1.5 mn in 2000, so concern with the potential impacts of tourism on national parks and other environmental attractions has increased, and answers are sought at the regional and local level rather than the national.

*The Domestic Tourism Monitor*

However, any significant understanding of impacts will also depend on domestic activity, which had been monitored infrequently from 1970 to 1998. In that year a pilot survey of the domestic sector was undertaken through Lincoln University, and in 1999 a full-fledged *Domestic Tourism Monitor* (DTM) was commenced surveying close to 17,000 people a year by telephone. This retrospectively recorded a single household member's travel patterns in the month prior, including day trips over 40 kms distant and overnight trips. The survey revealed that, in sum, the tourist activity from New Zealand's almost 4 mn residents generated slightly more economic turnover than the international sector, with a very different pattern of demand and trip duration. The DTM has been funded for further years, and it may become a more integrated exercise with the IVS through the design of questionnaires which use a compatible coding framework.

The initial mapping of IVS flows within New Zealand represented not simply a mapping exercise but also the substantial re-modelling of data into a compatible form for deployment within a Geographic Information System. Work by Forer and Oberdries ( NZTB 1994) recast the sequential tabulation of destinations into the sectors of the intinerary followed by a particular respondent, largely to allow quick tabulation of flow levels between centres, and to automate flow representation. Researchers at the University of Auckland and Lincoln University extended this process by utilizing innovations in dynamic segmentation and routing that became available in the late 1990s to transform the itineraries into forms which could provide a much wider range of queries about flows and their constituent parts. This development also offered means to allocate tourist flows along specific highway routes (Figure 3), or simply link the itineraries by desire lines, as used in Figure 2.

These developments offered two new areas of enquiry. One was a better and more flexible approach to estimating regional demand as evidenced by tourist visitor numbers within local areas. The other was a greatly enhanced means of querying flows not just by composition but also by time elements, such as who was where on what day of their holiday or where people had been to prior to any specific place. While the limitations of sample size compromised drilling down too far, these data now provided a better means to identify local demand through parameters such as the origin or nature of the visitors. Combined with parallel data sets, such as the New Zealand Accommodation Survey (which records data on visitors in formal accommodation establishments) these data sets now

provide a good initial estimate of regional patterns of visitation. They have formed significant inputs into ongoing work on environmental impacts and energy and material flows (Becken et al 2000), and provide a very useful national planning tool.

## TOURISM FLOW DATA FOR EVALUATING IMPACT

The insights to be gained from the IVS and DTM have yet to be fully revealed, since there have historically been some technical issues in combining the two, and to date the surveys have been analysed only on an annual tabular basis. However, the two data sets provide a substantial framework for identifying gross patterns of demand and recreational activity. A real issue is whether spatially finer patterns of demand can be revealed either by analyzing these data sets in new ways or by combining them with other data sets.

This question is of relevance to work under way through the TRECC group at Lincoln University and Landcare Crown Research Institute, which is targeted at finding a framework to monitor and assess environmental impacts at various kinds of natural attractions. For specific sites, this work is seeking to develop key indicators of acceptable change for different kinds of attractions. Consequent from this, the research needs to identify the likelihood of unacceptable change in specific areas, which involves identifying specific critical usage levels for specific sites. It particularly requires the prediction of future use regimes so that, hopefully, negative impacts can be pre-empted.

One approach to modeling future impact on attractions is to use a three level model of probable activity levels. National patterns of tourism are now quite well documented, and a number of studies exist that offer predictions of the most volatile element in New Zealand tourism, namely future international demand. These predictions, usually aimed at market analysis, typically offer likely changes of visitor number over the medium term disaggregated by country of origin or some other significant categorization. If sufficient is known about the specific nature of regional activity, then these disaggregated predictions can be propagated through to the regions using the national data sets described above. Such a development gets us some way to forecasting use and impact levels of facilities in an area, but to link the management of local impact to the likely level of demand requires three extra steps. One is a finer level of robust demand measurement, so that smaller (sub)regions can be modeled, and the likely pool of visitors to a local system of attractions can be estimated. A second is a better understanding of the activity that occurs between accommodation stops, since this is typically the active periods in which impact occurs. The last, and most problematic, issue is to link local levels of visitor demand to specific behaviour within local systems of attractions (and thus specific impacts on specific attractions). This paper is concerned only with the first two issues, that centre on how to get a better local understanding of flow-generated local demand within a model that is operating at three spatial scales.

The research described here is experimenting with ways to extend our ability to describe, and to some degree forecast, local sub-regional tourism demand, and then identify its significance for specific categories of sites, and for this it is using small sub-regions on the West Coast of the South Island as a case study area. The West Coast contains large areas that are of high environmental value and sensitivity (including parts of five National Parks and one World Heritage Area). The strategy is to identify likely fluctuations in visitor numbers in sub regions by visitor type, using a recreational opportunity spectrum (ROS) classification, and then as a separate exercise to model within sub-regions how demand growth reflects in use of specific attractions. This structure will be elaborated on later on in this paper, but clearly the IVS and DTM are starting points in trying to identify sub-regional demand. They are also problematic for this purpose for several reasons.

## LIMITATIONS WITH THE IVS AND DTM NATIONAL DATA SETS

While the national data sets form a powerful contribution to monitoring, and to some degree predicting, changes in tourist demand (both aggregated and to some degree disaggregated) they have several limitations in respect of being able to make links to actual impact on the ground, and especially to impacts in remote areas such as National Parks. These specifically relate to five aspects of the data sets: spatial resolution, sample size, absence of intervening corridors, absence of specific visitation data and limited local detail of movements.

### *Spatial Resolution*

During its history the IVS has evolved a relatively coarse spatial coding, featuring some 130 points initially and closer to 180 in the 2000 survey. Furthermore the actual places coded have changed over time, so that some have disappeared while others have been amalgamated or added. The coding has generally been undertaken in the light of the respondent's recollection of stops visited, with major destinations such as Rotorua being recorded as a clear node, while unusual or infrequently visited locations have sometimes been amalgamated into somewhat ambiguous areas. By contrast the DTM uses free-response coding of named features at present involving a gazetteer of some 1800 places, all of which are punctiform.

*Sample size*

Although the surveys involve quite large numbers of respondents, the sample size for any year places limits upon many of the disaggregations that are actually desirable for reporting, whether by attribute classes or by regions. This is usually restricted to defining areas of substantial visitation or population, such as New Zealand's Regional Council areas.

*Limited Knowledge of Corridors of Impact*

Both the IVS and DTM surveys deal primarily with destinations, rather than routes. In the case of the IVS a destination is an overnight destination, while for the DTM it is that or the main activity centre of a day trip from home. Although the IVS has increasingly sought to capture some additional information on 'significant stops' or side trips from major centres (for instance day trips to Te Anau while based at Queenstown) , there is little explicitly recorded on where people are when they are not in their accommodation centre. Yet with Free Independent Tourists (FITs) the majority of their awake time, and a substantial component of their expenditure or impact, may occur between such stops. Furthermore, the impacts are likely to be close to the road route(s) between the two night stops.

*Limited Knowledge of Stopping Patterns*

Some of the great attractions of New Zealand, whether in National Parks or not, can be found well away from any accommodation centre. Examples include Cape Reinga, the Northernmost point of New Zealand, and Tane Mahuta, the largest surviving kauri tree, both of which attract large numbers of visitors but are some distance from significant accommodation. Many other more minor attractions influence visitors to stop and walk. Some major attractions, such as the Glaciers in the West Coast of the South Island, are visited by transient visitors while also attracting overnighters. Neither the IVS nor DTM reveals a great deal about such patterns.

*Imperfect knowledge of specific route taken.*

While knowing the overnight stops for any day may enable one to identify the likely corridor of impacts for a touring visitor, there are many cases where major or minor options may exist for route choice. A significant example is the option for tourists traversing the North Island of passing East or West of Lake Taupo, or similarly passing East or West of the Tongariro National Park. Without some intervening information it is problematic to get a more accurate idea of the likely zones of impact or of activity. This concern is likely to be addressed by better knowledge of where visitors stop, since this will provide key reference points on possible routes

## EXTENDED SAMPLING BY SPECIALIST SURVEYS

This section briefly describes two aspects of work that seeks to address some of the shortcomings identified above, using examples from Tai Tokerau, and the West Coast study areas (Figure 1). The intention in both examples is to provide a better description of both where visitors actually travel, and where they can be found at transient stops during the day. The first, on its own, simply provides a better grasp of where potential visitors to natural attractions might be found, rather than any definite indication that they are actually present. The second indicates definite stopping points, and with refinement can even yield details of behaviour at that point (including the nature of any activity and its timing).

*Tai Tokerau and the West Coast Surveys*

Tai Tokerau (Figure 3) provides the first example, based on project work active in 1998 (SJHMRC 1998,), which was intended to provide better detail of movements in the Northland Peninsula. This area possesses several significant accommodation stops recognized by the IVS, notably Pahia, Russel and the Bay of Islands, but also Whangarei and Kaiataia. Typical IVS records for the area record dominant links from Auckland to the Bay of Island/Pahia/Russell centre, with a few trips to the smaller centres. Although the coding varies by year, it is generally true that few or no movements are recorded on the West side of Northland, if accommodation is used as a measure of movement. Yet the West, with its outstanding kauri forests, and to a lesser degree Cape Reinga in the North, are not only significant loci of tourist activities but are both fragile areas in terms of tourist experience and impact.

To broaden the picture, additional data were gathered to provide better indicators for actual patterns on the ground. These data comprised the outcome from a survey conducted over two 3 week periods of 780 car drivers on holiday. The respondents were approached at a number of parking sites between Whangarei and Pahia and asked about their trip or planned movement, including any night stops and 'significant day stops'. This was not a complete route specification, but the points for each survey could nevertheless be fed into a route building algorithm in ArcInfo to generate multiple itineraries that could then be questioned and aggregated. The points could also be analysed to show a surface of stopping points.


*Figure 3a: Flows mapped to road network in Tai Tokerau.*

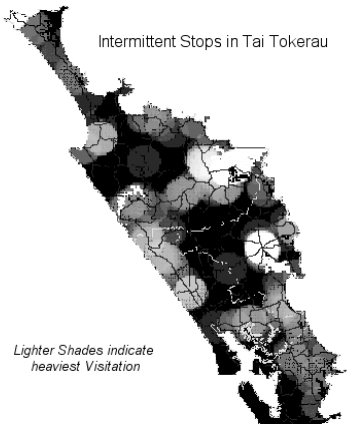


*Figure 3b: Patterns of non-overnight stopping*

Figure 3a) shows a sample of the route analysis, indicating the level of flows on the West and East Coast, and the nature of the tourists involved.
Figure 3b) shows an example visitation surface. Two useful additional insights to come from this analysis are the documentation of the balance of East versus West Coast flows, including some information on domestic and international visitor ratios, and the significance of totally different areas than overnight accommodation would reveal.

The Tai Tokerau study provided some enhanced information, and a better and more integrated description of spatial demand than the various alternative partial data sets available at the time. It also more than tripled the sample size of visitors available for analysis via the IVS (but closely mirrored its parameters when validated against country of origin from that survey). However, data were missing on the actual activities undertaken at significant stops (and any mention of short stops was also missing). Profile and attitudinal data on respondents was only partial, and timing and duration was not recorded.

The later West Coast study was developed to provide a richer augmentation of the IVS flow data, as well as to specifically address questions of the kind of visitors present and how they might behave, especially in a region where much of the attraction and experience lies in the travel and intermediate stops more than in the major accommodation sites. As figure 4 shows, the West Coast study area is long and thin. It fails to show two things important to understanding travel in the area, however. One is that the Southern Alps form a massive and rugged barrier between the West Coast and the rest of the island, which is breached for vehicular traffic in only three locations. The other is that while there are close to a million visits to the Coast each year, there are barely 30,000 residents, most of whom live in the mid-Northern quarter. Fuller details of this study can be found in Forer, Fairweather and Simmons (2000), but essentially it recorded the travel experience of some 2,700 visitors who holidayed on the West Coast between December 1999 and January 2001. Unlike the Northland exercise full itineraries were requested through either reflective or diary oriented survey instruments, and respondents were asked to record all stops of over 5 minutes including details of timing and the activity undertaken. The intention was to provide enhanced modeling options to augment the more generalized data from the IVS and DTM, and to provide sub-regional demand estimates by tourist category.

The West Coast survey was undertaken over five sample periods between early December 1999 and late January 2001, but the nature of the survey instruments (diary and retrospective) mean that the journeys recorded start as early as October 1999 and end as late as March 2001. During the nine weeks that survey teams were in the field tourists were sampled within the three entry zones to the West Coast, both going in and coming out. Those entering were invited to undertake a diary survey, while those leaving were asked to fill out a questionnaire on the spot. In the end, approximately equal numbers of each instrument were completed, and when compared appear to have performed with equal capabilities, in that comparison of the data from each shows a strong concurrence.

Both instruments collected data on visitor profiles, their attitudes, their overnight stops on the Coast, and intermediate (between accommodation) stops. For intermediate stops information was requested on the arrival time, the duration, the purpose, and food eaten or expenditure made, and any extra transport used (for instance helicopter transport onto ski-fields). While compliance with the request for time data was not complete, a significant amount was provided and considerably more could be inferred. For all stops, of course, location was also requested, both as a name or description and as a point on the A3 map provided with the survey. This process allowed the utmost flexibility in identifying stopping points, which are by nature often serendipitous decisions at various points within natural features such as the 25 km

long Buller Gorge. In all some 27,000 stops were identified, over a total of approximately six hundred specific locations. Figure 4 shows the location of these stops with over 5 visits, the relative number of people stopping at each location, the extent of the study area and the location of the three main portals.

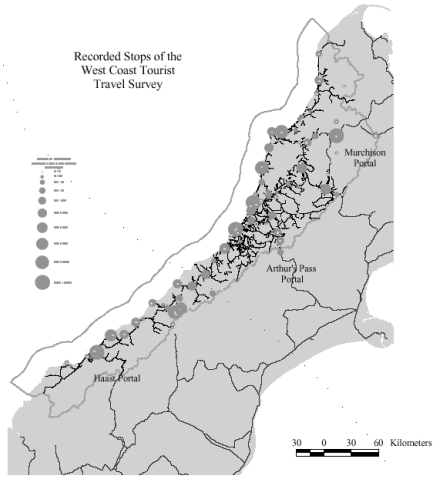


*Figure 4: The West Coast Study Area and distribution of respondent's reported stops*

What is striking, but hardly unexpected, is that the distribution of tourist stop events shows very limited relationship to the distribution of the population or available accommodation. The anomalous areas can be largely identified as those of outstanding beauty, particularly areas in, or close to, the National Parks. It is the development of better knowledge of the nature and degree of these visitations, in relationship to the trips in which they are embedded, which is a prime goal of the entire survey. It is hypothesized that, as visitors progress up or down the Coast, their stopping behaviour, and on-the-spot activities are very much conditioned by the duration of their total visit to the Coast and by the specific priorities they place on spending time at icon sites as opposed to meandering and diffuse visitations. To explore the influence of these possible factors the analysis of the data is focusing on identifying the way in which visitor patterns at specific locations reflect factors such as geographic position relative to entry point or previous night's accommodation, as well as the attractions at that site and the characteristics of the visitors. The significance of the direction of travel (North to South or vice versa) is also investigated.

The complexity and scope of this data base offers much room for analysis, and work is under way by Zhao to develop various flow-mapping techniques to visualize aspects of the flows and stopping behaviour at different scales of aggregation from the individual itinerary upwards. This is complemented by Chan and Chen's investigation of the influence of certain factors on revealed patterns of trips (Chan and Chen 2001). They have specifically reviewed ways in which length of trip, country of origin or entry point affect the pattern of stops, although as yet the interaction between these factors has not been investigated. One interesting finding however is the tendency for Northward travelers to stop less frequently and stay less long than South-bound ones. Whether this is due to the 'returning traveler' syndrome, i.e. most such trips represent the start of the journey to Auckland or Christchurch and then home, or due to timing issues is still to be clarified.

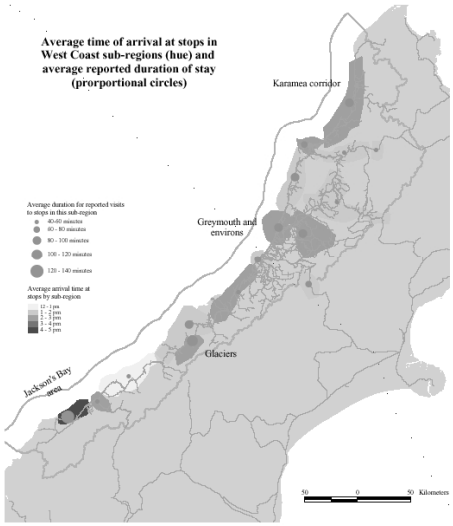


*Figure 5: Temporal Aspects of West Coast Flows, showing proposed sub-regional demand zones*

Investigations of individual movements using the most fine spatial scale available, however, are not directly useful for sub-regional forecasts, where more aggregate information is needed, particularly on how long tourists typically spend in an area, and incidentally when they arrive. Figure 5 shows some initial analysis of the full data set in terms of a set of sub-regions that are being considered for ongoing modeling. These divide the West Coast into 19 regions (not all are shown here) which include the main settlements and their immediate environment (such as Westport and Greymouth), icon sites (such as Punakaiki and the Glaciers), back country zones, and corridors (such as South Westland and the Buller Gorge). The map illustrates the average time of arrival at stops in these areas, but also the average time spent at sites within the areas (not including overnight stays). The role of Haast/Jackson's Bay as a significant stop, but also as an 'anchor' to people's days, is clear, as is the influence of Karamea's isolated position in the North.

When compared with figure 4, the prevalence of multiple, short stops in many of the less inhabited areas is quite clear. The next stage of work is targeted at mapping in more detail the patterns of stops relative to visitor and trip characteristics, and to assessing at what scale regions exist with

adequate sample sizes to allow useful additional modeling.

The Tai Tokerau and West Coast surveys both represent relatively simple flow systems, largely linear and with limited access. It is hoped that they can yield more insights into basic flow behaviour governing intermittent stopping and route selection on a wider scale. Certain regularities, such as stopping frequency or propensity to stop after specific time lengths, may then be applicable to national movements and activities. More complex flow situations certainly exist, of which Rotorua is perhaps the best example. It is the major North Island tourist centre, with diverse markets amongst both domestic and international visitors, and it is position astride a wide web of flows that come to the area from all directions. A data set collected for Rotorua is to be the test bed for validating findings from the West Coast.

## LIMITATIONS AND OPPORTUNITIES FOR LOCAL SURVEYS AS ADJUNCTS TO NATIONAL DATA SETS

This paper has discussed the IVS and DTM as national data sets which can be given added value by integration with surveys of finer detail, and it should also acknowledge the value of the national sets in validating the sampling of local surveys. While the IVS and DTM enjoy stable sampling frames, most local surveys are faced by well known practical problems of maintaining a constant sampling fractions with interviews, as well as weighting problems with establishing just what the extent is of the universe of flows which they are sampling. In New Zealand several additional sources useful for data validation exist. The national monthly census of accommodation usage was referred to earlier, and it assists with establishing total raw numbers of visitors as well as a quarterly breakdown by origin of them. Other data include traffic flow counts, car registration owner details, and attraction visitation numbers from the Department of Conservation, all of which provide an guides to the validity of sampled patterns. These different data sets have different spatial and temporal granularity, and different properties and precision, but together they provide a reasonable confirmatory web of cross references.

The other major issues with local surveys are compliance and cost. Concern for both restrict the information collected, and an additional aspect of the survey work to date is an analysis of the specific benefits accruing from specific questions and techniques relative to their cost of capture.

## SIGNIFICANCE OF LOCAL FLOW SURVEYS AND FUTURE DIRECTIONS

The local flow surveys described here are part of a much wider research agenda in tourism flows, and in human movement and environmental interaction. They have been presented as a way to address the issues of calculating small area tourism demand, and the nature of places in regional tourist circuits. At a wider scale, they also offer a better insight into how active FITs allocate the substantial portion of their time, and significant portion of their expenditure, that is not spent in 'destination/ overnight' centres. There are substantial aspects of regional development, facility development and tourism demand management which are better understood when patterns of sequential flows are acknowledged. Related work has pointed out the potential value of a better understanding of issues in health and bio-security that can come from a knowledge of flows, and the work by Beken (2000) to link flows to energy and material impacts on the environment offers a topical perspective on how tourism affects the triple bottom line. Future work will address how flows can be interpreted into a classification of linear landscape experiences.

While the research agenda for flow analysis is attractive, at both micro, meso and national level, data capture remains a major barrier. Two trends offer hopes of cheaper and better ways to capture movement data. One is the growing interest in time geography, 'tracks' and the (x,y,t,a) trace (CSISS 2001), which might well offer new analytical tools and insights. The other is use of new technologies, specifically position aware devices (PADs), which are becoming far more commonplace, and intelligent map-server based Web questionnaires that ease the burden of personal data collection of space-time data (Glen, Huisman and Forer 2001).

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