Applications of GIS in Spatial Visitor Management of Protected Areas

Dr. Isabelle D. Wolf
contact: i.wolf@online.ms

Office of Environment and Heritage
The University of New South Wales
Australia

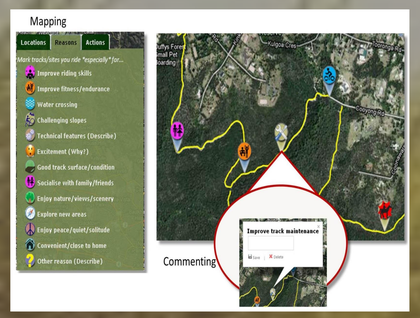
1 Introduction

Spatial land use planning is a critical component of visitor management in urban parks and other protected areas. It serves to manage visitor distributions in relation to park infrastructure and landscape features (Wolf, Hagenloh, & Croft, 2012; Wolf, Stricker, & Hagenloh, 2012; Wolf, Stricker, & Hagenloh, 2013).

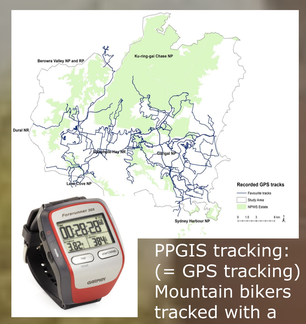
2 Methods

Participatory spatial planning of public lands is a relatively new development in visitor management. In this research we used public participation geographic information system (PPGIS) mapping and tracking combined with questionnaire-based surveying to monitor distributions, land use behavior, and certain impacts of visitors to selected national parks and surrounding land tenures in Northern Sydney, Australia (Wolf, Wohlfart, & Brown, 2014; Wolf, Wohlfart, Brown, & Bartolomé Lasa, 2015).

Fundamental spatially implicit management questions were asked on (1) distributions of visitors; (2) spatial overlap of different visitor activities; (3) use of visitor infrastructure; (4) location-specific actions required to improve existing visitor experiences. (5) Another aim was to evaluate the various PPGIS methods.



PPGIS mapping: Internet-based public participation geographic information system (PPGIS) to map and comment on locations, reasons and required actions for mountain biking and horse riding experiences in Northern Sydney.



PPGIS tracking: (= GPS tracking) Mountain bikers tracked with a GPS tracking device.

4 Conclusion

This research showcases how effective spatial GIS planning tools are in visitor land use management to determine locations that people visit, manage visitor conflicts, identify demand for visitor infrastructure, and facilitate visitor experience development.

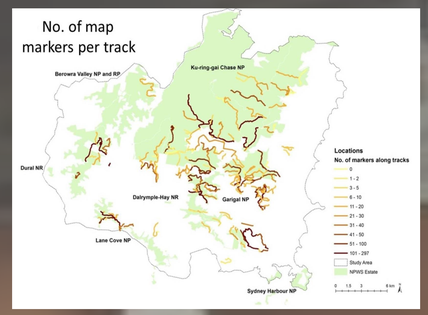
We presented a methodological evaluation of using spatial visitor planning tools with a focus on sampling efficiency, time commitment, hardware requirements, technical knowledge of participants, representativeness of data, spatio-temporal data coverage, and data processing.

5 Acknowledgements

The research was funded by the Australian NSW National Parks and Wildlife Service, Office of Environment and Heritage. The authors thank NSW National Parks and Wildlife Service staff for enabling data collection and providing other support.

3.1 Results: How do visitors distribute in parks?

- PPGIS mapping allowed for detailed mapping of visitor distributions. Generally visitors tend to aggregate in parks using preferred infrastructure for their activities or movements between sights/sites.

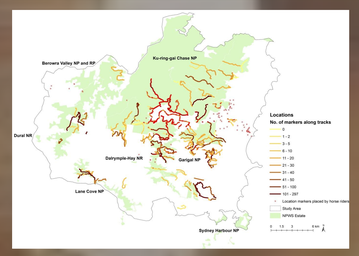


This map illustrates how distributions of mountain bikers along tracks can be visualised in ArcGIS.

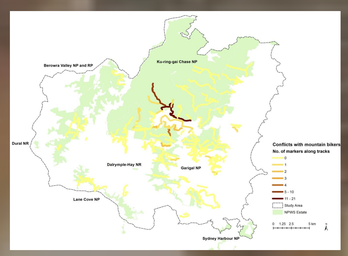
Dark tracks symbolise the most popular tracks used frequently by many mountain bikers based on a spatial join between tracks and PPGIS markers placed on a map to indicate riding locations.

3.2 Results: How do different visitor activities spatially overlap?

- PPGIS mapping was used to identify areas of overlap of visitation by mountain bikers and horse riders. This generated evidence that conflicts may arise in specific locations.



Distribution of horse riders (red dots) superimposed on tracks frequented by mountain bikers.

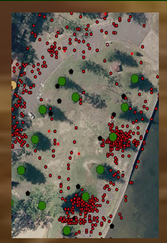


Locations of conflicts with mountain bikers mapped by horse riders.

3.3a Results: How do visitors use infrastructure: park assets?

- Similarly as shown for visitor movements along tracks in parks, PPGIS is effective at capturing visitor use of point assets such as picnic tables. In this case we used PPGIS tracking (GPS tracking).
- Notably, assets or landscape features in the proximity of other assets strongly influenced their use. For instance, proximity to barbecues, parking lots, playgrounds, toilets and garbage bins either attracted or repelled visitors from using picnic sites depending on their primary motivation to visit.

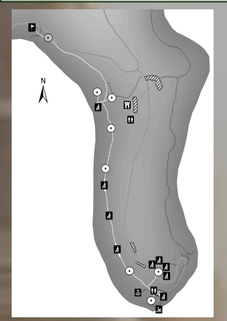
Example of GPS-tracked visitors travelling through a national park in Northern Sydney.



Use of picnic tables (green circles) by tracked visitors (red dots). Picnic tables closer to the shoreline were considerably more popular as shown by the greater density of visitor track dots near these assets.

3.3b Results: How do visitors use infrastructure: interpretive media?

- Varying demand for specific visitor assets or the effectiveness of interpretive media to attract visitors to various sights can be captured through several important variables:
  - Attracting power: percentage of visitors who stop at an asset/sight,
  - Distracting power: number of detours that visitors take to access assets/sights off the main path,
  - Holding power: time spent at an asset/sight.



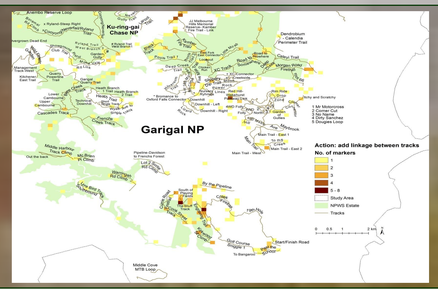
Both images visualise the attracting power of sights and other assets along a scenic walk in Northern Sydney.

Visitors in the left figure travelled without interpretive media and therefore rarely stopped anywhere.

The dark circles in the right figure demonstrate that many visitors stopped at sights if they used interpretive media.

3.4 Results: How can visitor experiences be improved?

- PPGIS mapping can be be used to visualise actions required to improve existing experiences.



New linkages requested by mountain bikers between existing tracks as captured via PPGIS mapping.

3.5 Results: How do the different PPGIS visitor monitoring methods compare?

	PPGIS (GPS) Tracking	PPGIS Mapping (online vs. field/paper-based)
Sampling efficiency	Intermediate	Great (online); Low (field)
Time commitment by participants	High	Intermediate (online); Low (field)
Hardware requirements	GPS tracking device	Internet (online); None (field)
Technical knowledge	Some (if participants have to supply the GPS tracking data)	Little (online); None (field)
Representativeness of data	Captures actual visitor movements	Captures stated visitor movements
Data coverage	In-depth spatio-temporal data, whole networks, but restricted to sampling period.	Collection of point locations, no networks, no time data, but not restricted to a sampling period.
Data processing time	(Very) high due to the continuous tracking and large datasets.	(Very) high, however data sets are smaller. Additional time needed to digitise data if collected in the field.

References: (1) Wolf, I. D., Hagenloh, G., & Croft, D. B. (2012). Visitor monitoring along roads and hiking trails: How to determine usage levels in tourist sites. Tourism Management, 33. (2) Wolf, I. D., Stricker, H., & Hagenloh, G. (2012). The implementation of GPS tracking and GIS technology for park visitor monitoring: a key to managing visitor assets and experiences. In Proceedings of the 6th international conference on monitoring and management of visitors in recreational and protected areas. (3) Wolf, I. D., Stricker, H. K., & Hagenloh, G. (2013). Interpretive media that attract park visitors and enhance their experiences: a comparison of modern and traditional tools using GPS tracking and GIS technology. Tourism Management Perspectives, 7, 59-72. (4) Wolf, I. D., Wohlfart, T., & Brown, G. (2014). The role of public participation GIS in protected areas management: a case study of mountain biking and horse riding. In Proceedings of the 20th international symposium on society and resource management. (5) Wolf, I. D., Wohlfart, T., Brown, G., & Bartolomé Lasa, A. (2015). The use of public participation GIS (PPGIS) for park visitor management: A case study of mountain biking. Tourism Management, 51, 112-130.