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IN THIS ISSUE

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ABOUT THE COVER: *Detail from Tsukiji Market, hand-illustrated by Molly O'Halloran. To see the whole piece, as well as the author's other work, visit mollyohalloran.com.*

LETTER FROM THE PRESIDENT

Happy New Year, NACIS:

My first NACIS conference was in 1998 in Milwaukee, WI, where I gave a presentation on my dissertation. A few years later I was asked to run for the NACIS Board of Directors. Next, I took over organizing the student poster competition, served on the Board a few more times, became Editor of *Cartographic Perspectives*, and am now writing to you as the President of NACIS. Serving the organization in these different capacities has allowed me to give back to the Society that has been an enjoyable home to me for the past 20 years. NACIS remains a vibrant community of like-minded individuals who share a passion for all things map related. I am honored to serve as your President and hope to propel NACIS forward into 2018 and beyond.

At the close of every year, people tend to reflect and acknowledge significant achievements. The popularity of the NACIS Annual Meeting continues to grow, and Montréal 2017 was no exception, with over 350 attending. Considering that the conference was outside the United States, making international travel difficult for some, conference participation was incredibly strong. Practical Cartography Day continues to be a well-attended event with nearly 200 participants, even requiring several last-minute adjustments to the rooms in order to accommodate everyone. The paper presentations included a diverse cross-section of topics, which is a driving force in making the main conference rewarding and memorable. Geoffrey Mandel gave a fascinating keynote on his cartographic work with Star Trek and other science fiction productions.

In 2016, in Colorado Springs, CO, NACIS experimented with video recording and live streaming Practical Cartography Day. Given the success of this venture, NACIS wanted to expand on this initiative, so in Montréal 2017,

VIDEO: GEOFFREY MANDEL'S KEYNOTE

Click to watch, or visit youtu.be/Ex0Rc0Qz0wo.

recording and live streaming were available for all session tracks. As a member benefit, the NACIS community throughout the world was able to virtually participate. For conference attendees, live streaming offered a unique option to participate while sitting in the hotel commons, another parallel session, a hotel room, or a coffee shop down the street. Based on the post-conference survey, there was unanimous support for video recording and streaming. However, despite this success, video recording and live streaming incurs a significant expense and will not be sustainable for future conferences without our securing sponsored funding. The NACIS Board is looking into possible funding solutions and we encourage anyone from the NACIS community to suggest creative ways to keep video recording and live streaming ongoing as we look forward to Norfolk, VA and beyond. Check out the video recordings of the conference: **http://bit.ly/2yOpxTb**.

There have been a few personnel changes at NACIS to report. Tanya Buckingham stepped down from her role as Executive Director at the end of 2017. Tanya has diligently and selflessly served NACIS in many roles including those of President and Secretary. The NACIS community is sad to see her depart and thanks Tanya for her dedicated service to the Society not only in her current role but also in the diverse duties she has taken on during her many years as a leader in the organization. It is, however, with great excitement that I report that Tom Patterson, another long-time and involved NACIS member, has stepped forward to fill this position! Tom brings with him a strong record of contributions to the Society and a tremendous level of institutional knowledge. We welcome Tom to the Executive Director's position and we look forward to working with him to help lead NACIS into the future.

There are three NACIS initiatives on which I would like to report. First, it is hard to imagine but preparations for Volume #4 of the *Atlas of Design* are now underway. The success of the *Atlas of Design* has been tremendous and I extend my thanks to the current editors Alethea Steingisser, Lauren Tierney, and Caroline Rose for the excellent work they have done with this project. The *Atlas of Design* continues to be a popular outlet for the exhibition of stunning cartography. For more information on how you can contribute to this effort please visit **atlasofdesign.org**.

Second, Editor Amy Griffin continues to advance *Cartographic Perspectives* (*CP*) as the only freely available, peer-reviewed open access cartography journal in the world. *CP* offers a diverse set of content, including *Practical Cartographer's Corner*, presenting tips of the cartographic trade, *Cartographic Collections*, offering insights into map collections, *Visual Fields*, displaying beautiful cartographic works, and the ever popular *Book Reviews*, providing perspectives on recent cartographic literature. For authors interested in publishing their research in *CP*, reviews are quick, content is published in full color at no cost to the authors, and accepted and copyedited submissions are posted as open access. So, please consider *CP* as an outlet for your cartographic publications and take some time to look through the many diverse contributions in this issue of *CP*.

Third, during our 2017 Spring Board Meeting, the NACIS Board of Directors made the decision to wind down our support of CartoTalk, our online cartography discussion forum. Activity has been declining over the years, and, given our limited pool of volunteer time, it no longer makes sense for us to continue to maintain it. The Board is willing to turn over control of CartoTalk to another party that is interested in investing the energy needed to revitalize it, and willing to maintain it as a broad community that is not focused on one particular technology or variety of mapmaking. We will keep the membership updated on CartoTalk.

Looking forward to 2018, Vice President Ginny Mason, VP-Elect Leo Dillon, and Business Manager Susan Peschel are diligently organizing the next Annual Meeting, in Norfolk, VA. Please check out **nacis.org/2018** for updated information; we would really like to see you there! If you have ideas on how to contribute to the conference please let one of the organizers know as we strive to make the conference as beneficial as possible to the NACIS community.

I will close with a nod to the fact that NACIS is a community of volunteers who freely donate their time and efforts for the betterment of the Society. Volunteers serve on the NACIS Board, work on initiatives like the *Atlas of Design*, and help in countless other ways to make the annual conference a success. Thank you to all of the volunteers who donated their time and efforts in 2017 to making NACIS the Society it is. If you are interested in lending your time and talents to help the Society continue into 2018 and beyond please reach out to me or anyone on the NACIS Board. We would be much obliged for new perspectives, new voices, and new talents.

I hope that everyone had a successful 2017 and that 2018 will be equally gainful.

Fritz Kessler
President, NACIS

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Accessible Web Maps for Visually Impaired Users: Recommendations and Example Solutions

Sabine Hennig
Paris Lodron University of Salzburg
sabine.hennig@sbg.ac.at

Fritz Zobl
Paris Lodron University of Salzburg
fritz.zobl@sbg.ac.at

Wolfgang W. Wasserburger
AccessibleMap Association/TU Wien
wolfgang@wasserburger.at

Due to advances in information and communication technology, web maps are an increasingly important means of communication. While paper maps provide solutions that are accessible to the visually impaired, the use of web maps is still difficult for these users. This is true even though technology opens up new possibilities for developing accessible web maps. But, what must be considered when creating web maps suitable for the visually impaired? This paper presents recommendations, including example solutions based on the results obtained in two projects: AccessibleMap and senTour. In both projects mixed methods were used: literature and internet review, questionnaires, and analysis of similar systems. All work was done in close cooperation with organizations that represent the interests of the target group.

The findings underline that web maps accessible to visually impaired users must support different interaction modes and assistive technology. A carefully designed user interface, an easy-to-read map picture, and the provision of a verbal description of the map content are important. Further, additional aspects should be considered to enable these users to fully benefit from web maps. This refers to the need to widen the concept of accessibility, encompassing among others usability, the importance of building up these users' digital and spatial competencies, and to leverage the advantages that result from the application of the participatory design approach.

KEYWORDS: accessible maps; accessibility; usability; web maps; visually impaired users; disabled users; special needs users; digital and spatial literacy; participation

INTRODUCTION AND RESEARCH QUESTIONS

Foote and Crum (1995) suggest that maps are perhaps as fundamental to society as language and the written word. They help people to orient themselves in physical space, to navigate from place to place, to plan routes, to acquire spatial knowledge, and to build up cognitive or mental maps (Helal et al. 2001; Montello and Freundschuh 2005). For persons who are blind, or who are severely visually impaired, maps are even more important. Without a visual sense, they can easily lose their orientation, particularly when traveling in unknown environments (Clark-Carter et al. 1986; Helal et al. 2001). Maps enable them to construct a cognitive map of as yet unknown areas, which they can later recall from memory while on-site, supporting them in independently finding their way (Brock et al. 2013; Golledge et al. 1996).

Web maps, like many other technologies, have the potential to enhance the quality of life and independence of disabled people (Harris 2010; WHO 2007). Nevertheless, technology does not automatically bring them benefits merely by existing (Macdonald and Clayton 2013): solutions must be implemented with an understanding of a user group's requirements. However, while web maps have the potential to benefit those who are visually impaired, current examples rarely meet the requirements of this user group. Depending on the type and degree of a user's visual impairment, web maps can be quite challenging; in the case of people who are severely visually impaired or blind, their use is often hardly possible at all (Call-Jimenz and Lujan-Mora 2016; Höckner et al. 2012; Zeng and Weber 2011). Barriers that generally hinder these users from using web maps have been discussed by other authors (see, for example, Calle-Jimenez and Lujan-Mora 2016; Höckner et al. 2012): they may be too complex to use, feature inappropriate graphical design of the user interface and/or the map, suffer from a lack of appropriate interaction modes, or lack a verbal description of the map content.

To support the creation of web maps that are accessible to visually impaired users, several open questions need to be answered: What guidelines exist to support their development? Which applications already exist that can serve as examples to guide the design and implementation of accessible web maps? What recommendations can be offered to support the development of web maps accessible to visually impaired users? Which additional approaches, beyond a consideration of accessibility, can support the creation and use of such web maps? The findings we discuss in this paper are based on knowledge gained from two projects: AccessibleMap and senTour.

BACKGROUND

TARGET GROUP

The term "visual impairment" covers a wide range of different types of eye disorders and degrees of vision loss. As described by the International Council of Ophthalmology (2002), this encompasses minimal impairments; mild, moderate, severe, and profound vision loss; near-blindness and blindness; as well as color vision loss (Table 1). According to the World Health Organization (2013), in 2011 the number of people with reduced vision and blindness amounted to approximately 285 million worldwide, with 246 million suffering from low vision and 39 million affected by blindness. The reasons for visual impairment are manifold: examples include uncorrected refractive errors, cataracts, glaucoma, diabetic retinopathy, trachoma, corneal opacities, and age-related macular degeneration (Pascolini and Mariotti 2012).

Due to increasing life expectancies, the number of older persons is on the rise in many parts of the world. The over-65 population proportion is expected to more than double globally over the next forty years, climbing from 7% to 16% (to nearly 1.5 billion people). As the older population increases, so will the number of people affected by visual

Ranges of vision loss		Ability, ranges	Reading ability
(Near-) Normal Vision	Range of normal vision	Normal	Normal reading speed Normal reading distance Reserve capacity for small print
	Minimal impairment	Almost normal	Normal reading speed Reduced reading distance No reserve for small print
	Mild vision loss		
Low vision (partially sighted)	Moderate vision loss	Normal with aids	Near-normal Appropriate reading aids: strong reading glasses, large print books, readers, audio taped texts, and raised-line drawings
	Severe vision loss	Restricted with aids	Slower than normal Require reading aids High-power magnifiers
	Profound vision loss	Marginal with aids	Visual reading is limited Magnifiers for spot reading, talking books
(Near-) blindness	Near-blindness (legal blindness)	(Near-) impossible	No visual reading: talking books, Braille or other non-visual sources
	Total blindness		

Table 1. *Types and degrees of visual impairment (CUDE 2015; ICO 2002; WHO 2013).*

impairment—age is a significant factor in the decline of visual capacity. This is emphasized by the following numbers: while approximately 20% of the world's population is age 50 and older, about 65% of all visually impaired people worldwide belong to this age group (Pascolini and Mariotti 2012; WHO 2013).

Another significant population that must be considered is persons with color vision impairments. This term refers to an inability to distinguish certain color shades, or, in more severe cases, to see colors at all (AOA 2014). While many different forms of color vision impairment exist, the most common are: (1) protanopia (reduced sensitivity to red light), (2) deuteranopia (reduced sensitivity to green light), and (3) tritanoptia (blue-yellow color blindness). This trait is mainly carried by a sex-linked genetic disorder (though it can also be caused by injury, disease, or medication side effects); approximately 8% of the total male population and 1% of the total female population suffer from color vision deficiency (AOA 2014; Culp 2012; Olson and Brewer 1997). Since mapmakers often use colors to represent different categories of map features and to facilitate visual grouping, users suffering color visual impairment can find reading maps challenging—especially if maps are produced with little or no consideration for them (Olson and Brewer 1997).

RELATED WORK

Accessibility-oriented products aim to improve the extent to which everyone in a society is able to live independently and self-determinedly, and to participate fully in all aspects of life (ITU/G3ict 2014b). This is done through a focus on ensuring an equivalent user experience for people with disabilities (W3C 2010). As the internet becomes more and more a part of daily life for many people, numerous initiatives on web accessibility have emerged in recent years. Their focus is on the removal of technical barriers that hamper access to information, with the aim that all people can perceive, understand, and operate every control, instruction, or output related to a website (ITU/G3ict 2014b; W3C 2005; W3C 2012).

Like other accessible products, maps tailored to the needs of visually impaired people are not new. High contrast maps, large font maps, tactile maps, and Braille maps are well-established *analog* products. Technological advances—especially since the mid-1990s—have also facilitated the development of a variety of *digital* maps supporting visually impaired users. Examples include

- **virtual acoustic maps** representing information about features such as lakes, parks, and streets as verbal and non-verbal audio output (Heuten et al. 2007; Zhao et al. 2005);
- **virtual tactile maps**, in which tactile displays and other haptic devices (such as a joystick or haptic mouse) are used to explore maps (Moustakas et al. 2007; Parente and Bishop 2003);
- **tactile-audio maps**, in which users explore maps with their fingers using touch-sensitive pads and obtain more detailed information from auditory representations (Wang et al. 2009); and
- **Braille tactile maps**, which use tactile and touch-enabled Braille displays to present map information (e.g., points of interest) as well as interaction functions (pan, zoom, search, etc.) through raised pins (Zeng and Weber 2010).

As they have become more popular in recent years (and featured greater capabilities), a number of researchers have also worked to develop interactive web maps tailored to visually impaired users (see, for example, Brock and Jouffrais 2015; Helal et al. 2001; Poppinga et al. 2011; Rener 2017; Sánchez and Torre 2010; Siekierska and McCurdy 2008).

PROJECTS AND METHODS

The recommendations we present in this paper rely on work conducted in two projects: AccessibleMap and senTour. Both projects aimed at implementing a web map suitable for the disabled, and especially for people who are visually impaired (Table 2).

A good understanding of the user groups and their needs played a key role in both projects, and thus was a focus of much of our effort. The workflow and methods used to gain this knowledge about visually impaired users were quite similar for each project (Figure 1), and included literature reviews, questionnaires, internet research, and analysis of similar systems (AoSS). Throughout the entire development process we also cooperated closely with stakeholders (i.e., organizations that represent the interests of the target group). The results of these efforts were

	AccessibleMap project	senTour project
Duration	2011–2013	2014–2016
Funding	Austrian Federal Ministry of Transport, Innovation and Technology (BMVIT) under the FFG Benefit Program	
Goal	Development of a web map pilot that allows users to explore and memorize a city area and/or a route before going there	Development of a web portal, including an accessible web map that informs users of (accessible) recreational infrastructure (parking, trails, points of interest, etc.)
(Main) target group	The visually impaired, including the blind and color vision impaired	The disabled and elderly with focus on visually impaired users (due to the relevance of age-related vision changes)
Study area	An urban environment: the 2nd and 20th districts of Vienna	A natural site: Austria's Gesäuse National Park

Table 2. *Overview of the AccessibleMap and senTour projects.*

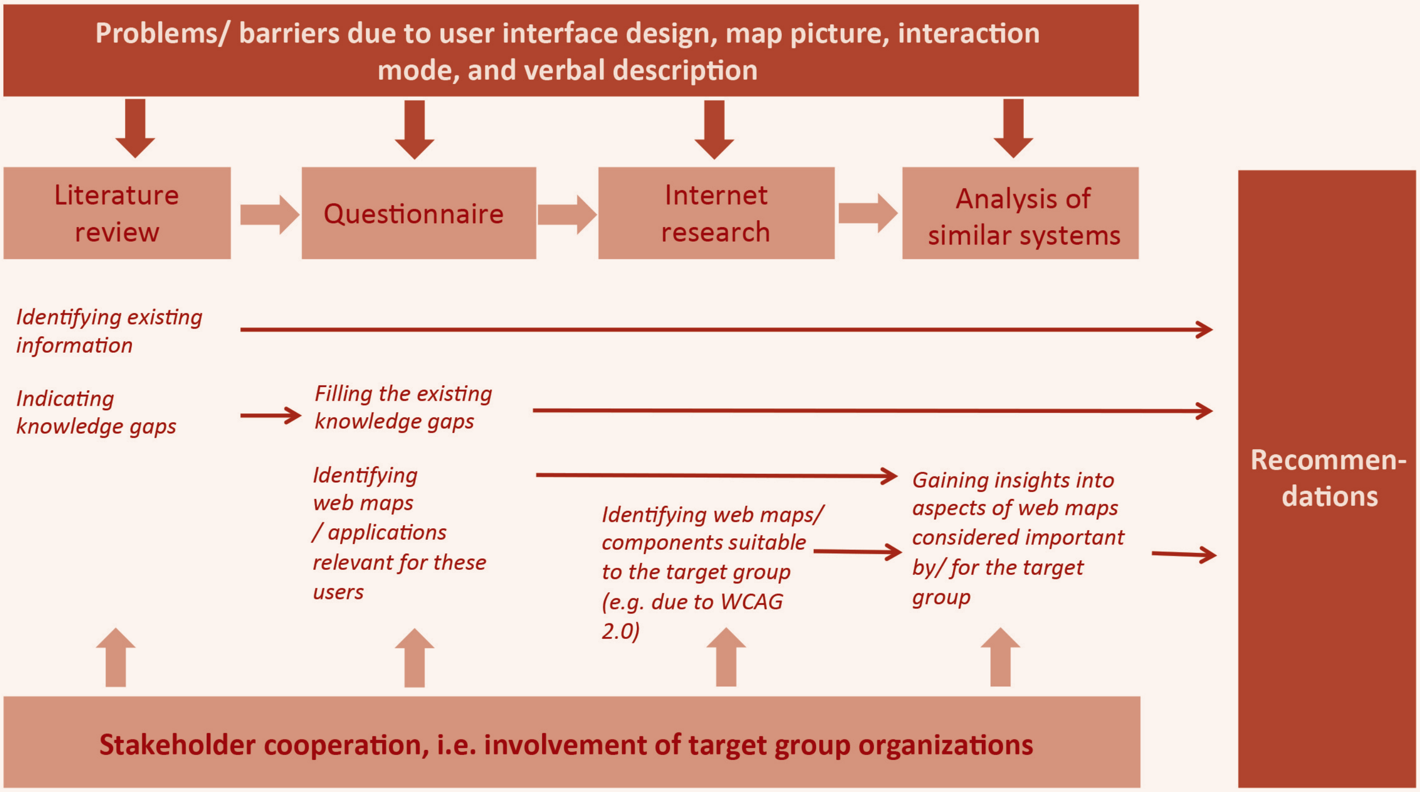


Figure 1. *Workflow and methods used in the AccessibleMap and senTour projects to gain understanding of users and their needs and to develop design recommendations.*

then combined and allowed us to develop design recommendations. Additionally, the findings obtained in the AccessibleMap project provided background for the subsequent senTour project.

Literature Review

In the first step, existing information on what to consider when creating web maps for visually impaired users was collected through a literature review. Our focus was on literature regarding (web) accessibility, geoinformatics and cartography, software and web engineering, and behavioral geography.

Questionnaires

In both projects questionnaires, prepared using the internet survey tool SurveyMonkey, were used to close knowledge gaps identified through the literature review. The AccessibleMap project questionnaire—addressing visually impaired and blind users—consisted of 55 open and closed questions (Table 3): 20 questions were directed towards all users, 16 towards profoundly visually impaired and blind users, and 19 towards users with low vision including color vision impairments. Several questions were asked in order to collect information about which existing city web maps the target group used and which aspects and features they liked and disliked about these applications. The questionnaire was distributed through face-to-face interviews and via email in the autumn and winter of 2011–12, in Austria, Germany, and Switzerland.

The senTour project used two questionnaires. The first was addressed to managers of large protected areas in Germany, Austria, and Switzerland in the autumn and winter of 2014–15. It encompassed 17 mostly open questions focusing on their experience with (digital/web-based) accessible products and which solutions they considered to be examples of best practices. The second questionnaire was directed towards the target user group. It contained 23 open and closed questions on socio-demographic data (e.g., place of residence, age, gender, educational level), the infrastructure used and desired by the target group, sources of information available for them to plan and conduct recreational visits to natural sites, and their preferences regarding the provision of information (amount, type, etc.). In the spring of 2015, the questionnaire was distributed through email; face-to-face interviews were also conducted.

	Focus of questions
Socio-demographic and personal data	Age, gender, education level, place of residence, type and degree of visual impairment, etc.
Internet use behavior	Extent of internet use, use of digital devices, use of assistive technology, etc.
Use of web maps	Extent of use, problems faced, web maps used, assessment of web maps used, etc.
User preferences & needs related to web map design	Design and structure of the user interface; design of (map) point, line, and area features; and design of map labels
Verbal description of the map content	Preferred wording to describe certain situations (e.g., crossings, course of a road), content to be delivered, etc.

Table 3. *Focus of the AccessibleMap questionnaire.*

Internet Research and AoSS

We then conducted an analysis of similar systems (Nemeth 2004) based on the applications and elements mentioned by the questionnaire respondents as well as those identified through internet research. Attention was given to aspects such as user interface and map design, the content and functionalities implemented, and web accessibility principles such as those outlined in WCAG 2.0 (W3C 2008).

Stakeholder Involvement

Target group organizations (for AccessibleMap, the Austrian Association in Support of the Blind and Visually Impaired; for senTour, the Austrian National Council of Disabled Persons) were involved throughout the development process for both web maps. They supported tasks related to gaining a deeper understanding of the intended user groups, such as advising on suitable questionnaire design, getting in contact with the target groups, and specifying user requirements.

OVERVIEW OF SELECTED RESULTS

RELEVANT AND USEFUL LITERATURE

Even though there are presently only a few specific recommendations for creating web maps that meet the needs of the disabled (and in particular the visually impaired), there is abundant literature that can still be useful when developing such web maps.

Numerous standards and guidelines exist to enhance the *accessibility* of digital and web-based products. They provide information on interface design, human-computer interaction, and the use of input/output devices that is helpful for the development of accessible web maps. Examples include:

- WCAG 2.0 "Web Content Accessibility Guidelines"
- ISO/IEC TR 29138-1 "Information technology — Accessibility considerations for people with disabilities — Part 1: User needs summary
- ISO TS 16071 "Ergonomics of human-system interaction — Guidance on accessibility for human-computer interfaces"
- ISO 9241-171:2008 "Guidance on software accessibility"
- ISO/IEC 9241—20:2008 "Accessibility guidelines for information/ communication technology (ICT) equipment and services"
- IBM Developer Accessibility Guidelines

Useful information can also be found in *usability* guidelines and recommendations. In particular, the Nielsen Norman Group (**nngroup.com**) has developed documents focusing on the usability of digital and web solutions for the visually impaired and the blind (see, for example, Nielsen 1994; Nielsen 1996; Pernice and Nielson 2001).

Literature specific to special needs cartography, such as Höckner et al. (2012) and Ienaga et al. (2006), delivers recommendations on how to design maps that are suitable for the intended user audience, as well as discussing the map content they require (e.g., information in support of orientation and wayfinding). There is also a body of research related to maps for the color vision impaired (see, for example, Culp 2012; Harrower and Brewer 2003; Jenny and Kelso 2007; Olson and Brewer 1997).

Verbal descriptions of map content are necessary to support the blind in constructing cognitive/ mental maps. For this, literature on behavioral geography is particularly useful: how the blind navigate and orient themselves in indoor and outdoor environments, on navigation systems, on spatial cognition and mental mapping (Ferguson and Hegarty 1994; Millonig and Schechtner 2005; Tversky 1993; Giudice et al. 2007; Sánchez and Torre 2010).

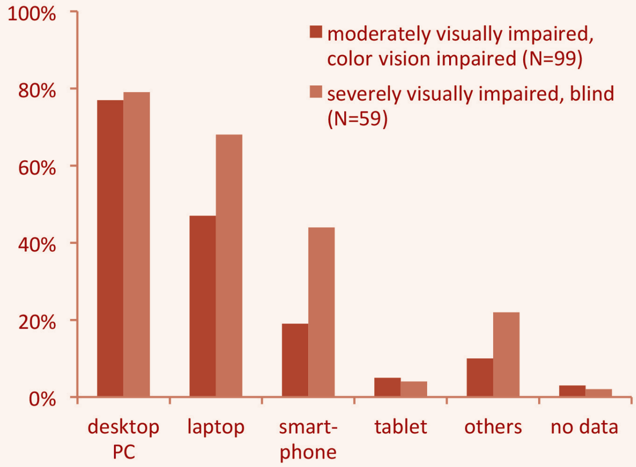
QUESTIONNAIRE RESULTS

After removing invalid responses (such as those from users who were not visually impaired), 158 of 199 AccessibleMap project user questionnaires remained. Of those, 63% of the respondents were people with low vision, while 37% were severely visually impaired or blind. Table 4 provides an overview of the respondents' socio-demographic characteristics, and Figure 2 presents selected questionnaire results. Further, the respondents named and commented on several city web maps they used, including specific maps of Berlin, Hagen, Mainz, Bern, and Vienna, as well as Google Maps and OpenStreetMap.

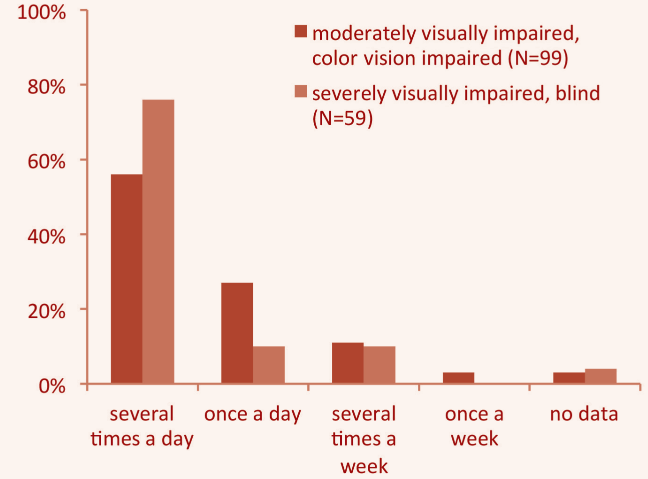
Of the 197 managers of large protected areas to which the first senTour project questionnaire was sent, 68 responded. Collectively, respondents named more than 30 websites or web applications that in one or another way were directed to the target user group of the disabled and elderly. Examples included the websites of Lüneburger Heide Nature Park (Germany), Gesäuse National Park (Austria), Dümmer Nature Park (Germany), Harz National Park

	Low vision & color vision impaired users (n=99)	Blind users (n=59)
Number of Respondents	low vision: 59%; color vision impaired: 4%	37%
Age	< 30 years: 11% < 40 years: 9% < 50 years: 13% < 60 years: 10% < 70 years: 14% ≥ 70 years: 2% No data: 41%	< 30 years: 4% < 40 years: 12% < 50 years: 10% < 60 years: 10% < 70 years: 5% ≥ 70 years: 0% No data: 59%
Gender	Female: 31%; Male: 37% No data: 32%	Female: 24%; Male: 47% No data: 29%
Education level	High school degree: 11% University degree: 23% Vocational training: 19% Others: 14% No data: 33%	High school degree: 17% University degree: 27% Vocational training: 17% Others: 10% No data: 29%

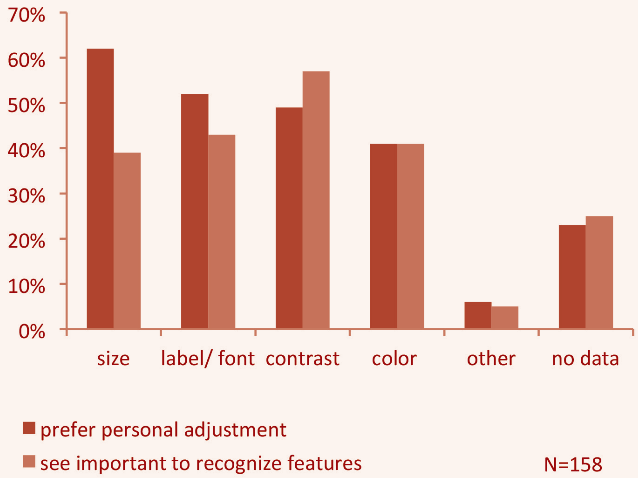
Table 4. *Summary of respondents' socio-demographic characteristics in the AccessibleMap project questionnaire.*



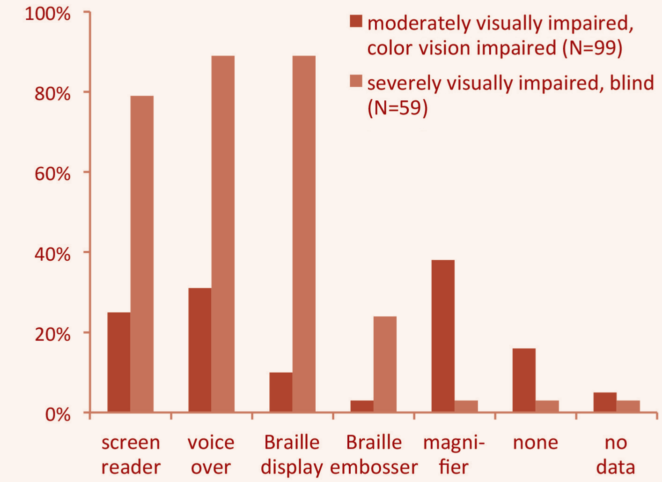
Use of devices by the visually impaired (multiple responses)



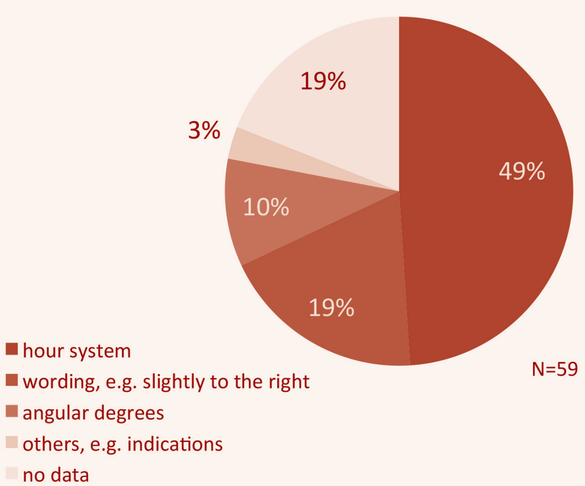
Use of the internet by the visually impaired



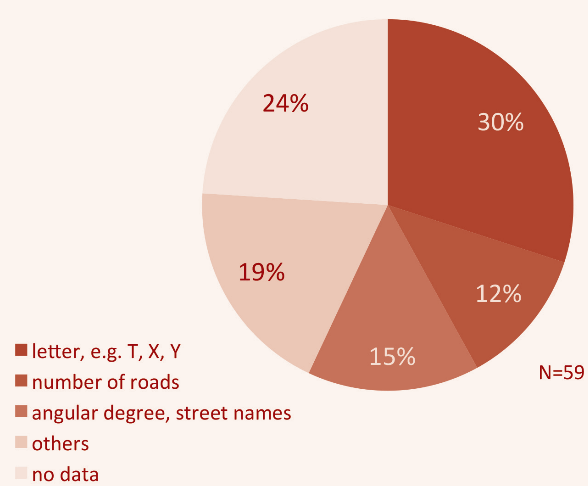
Relevance of visual variables in the map for the visually impaired (multiple responses)



Use of assistive technology by the visually impaired (multiple responses)



Preference regarding the description of directions (severely visually impaired and blind users)



Preference regarding the description of crossings (severely visually impaired and blind users)

Figure 2. *Selected results from the AccessibleMap project questionnaire.*

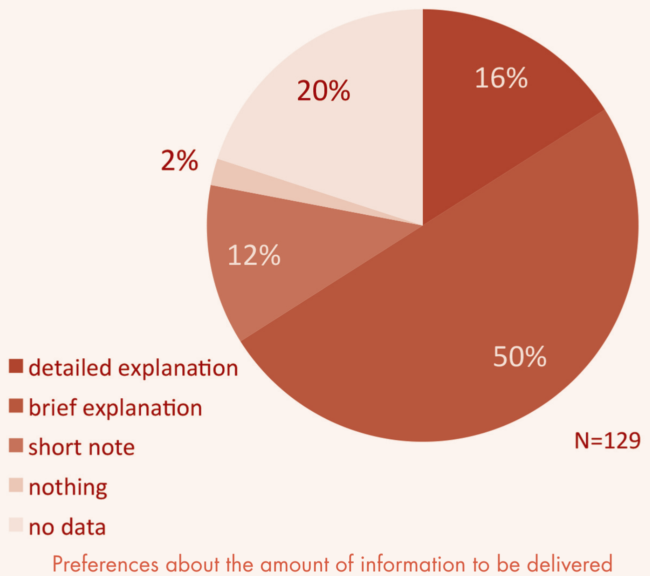
(Germany), Südschwarzwald Nature Park (Germany), and Eifel National Park (Germany). The second senTour project questionnaire, which was directed to web map users, received 129 valid responses. Table 5 gives a summary of respondents' characteristics and Figure 3 presents selected results.

BEST-PRACTICE EXAMPLES

The questionnaires and our internet research provided us information about web (map) applications that in one way or another met the needs of the target groups. Table 6 lists and describes those applications with components that can serve as a pattern or template for the development of web maps accessible to the visually impaired.

	Questionnaire Respondents (n=129)
Age	< 55 years: 24% 55–60 years: 16% 61–65 years: 24% > 65 years: 34% No data: 2%
Gender	Female: 54%; Male: 44%; No data: 2%
Education level	High school degree: 19% University degree: 29% Vocational training: 36% Others: 12% No data: 5%
Degree of visual impairment	Moderately visually impaired: 57% Severely visually impaired or blind: 9% Others: 34% No data: 0%

***Table 5.** Summary of respondents' characteristics for the senTour project target group questionnaire.*



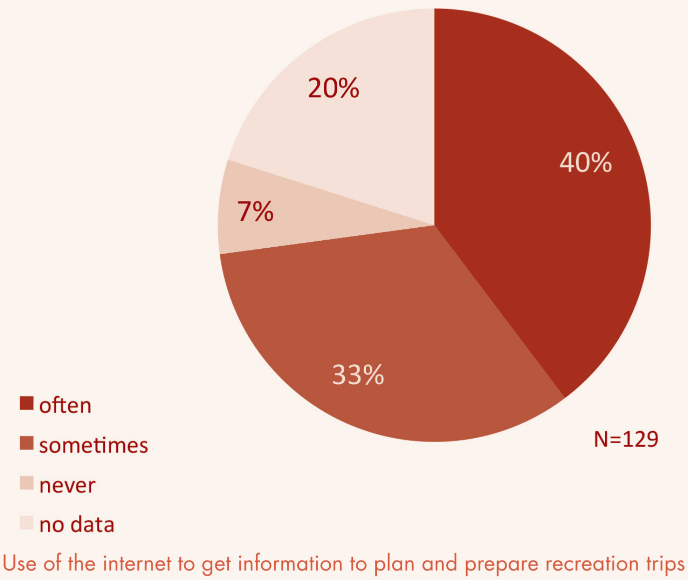


***Figure 3.** Selected results from the senTour project target group questionnaire.*

RECOMMENDATIONS FOR THE DEVELOPMENT OF WEB MAPS SUITABLE FOR VISUALLY IMPAIRED MAP USERS

As we discussed in our Introduction, visually impaired users face different problems when using web maps. These problems vary depending on the type and degree of their visual impairment. Accordingly, we offer different recommendations for the color vision impaired, the moderately visually impaired, and the severely visually impaired or blind (Table 7). These recommendations relate to user interface design, map design, interaction modes, and the verbal description of map content, each relevant in creating web maps accessible to these user groups.

	Best-practice components
Google Maps *www.google.de/maps*	Use of the keyboard to navigate the map Optimal map design aspects: • representation of different categories of roads with different colors (main/important roads: yellow; smaller roads: white) • representation of different categories of buildings with different colors • presentation of different point of interest (POI) categories using different icons and colors • labels do not overlap any POI symbols
Vienna city map (Austria) *www.wien.gv.at/stadtplan/en*	User can select between different basemaps, including ones with high/optimized contrast (e.g., a black & white basemap) Use of arrow keys to pan around the map Layer-switching control is located outside the map component Presentation of different POIs with different icons and colors High contrast between buildings (red) and roads (white) Provision of emergency numbers
Bern city map (Switzerland) *map.bern.ch/stadtplan*	User can select between different basemaps, such as a black & white one Buttons with high contrast between text and background
German Railway *reiseauskunft.bahn.de* (after selection of start and end station, press map view button)	Placement of zoom buttons outside the map component Design of zoom buttons: large buttons with labels Pan the map by arrow buttons located around the map component
Immoscout *www.immobilienscout24.de* (select object, scroll down to map)	Placement of layer selector outside the map component Design of layer selector: large buttons with well-known symbols
Harz National Park (Germany) *www.nationalpark-harz.de*	Website developed according to WCAG 2.0 principles: e.g., use of text-to-speech technology, allowing users to choose higher contrast text and background colors, zoomable web page
Eifel National Park (Germany) *www.nationalpark-eifel.de*	Website developed according to WCAG 2.0 principles: e.g., users can change font size, choose higher contrast between the text and background colors, switch to a text-based version (with verbal description of the content), or access verbal description of images
Lüneburger Heide Nature Park (Germany) *www.naturpark-lueneburger-heide.de/aktiv-in-der-heide/naturpark-barrierefrei/barrierefreies-natur-erleben/amelinghausen*	Features a verbal description of the trail shown in a static map, including a general description of the trail, and how to visit it Verbally describes specific accessibility aspects of the trail, such as its length, conditions, material, and the availability of barrier-free infrastructure

Table 6. *Selection of web applications addressing the needs of the visually impaired in one way or another.*

	Color vision impaired	Moderately visually impaired	Severely visually impaired, blind
User interface design	General user interface design guidelines	Depending on the type and degree of visual impairment: general user interface design guidelines application of web accessibility principles	General user interface design guidelines Application of web accessibility principles
Map	Optimized visual design	Optimized visual design	
Interaction mode	Visual	Visual and auditory	Auditory
Verbal description of map content	Nice to have	Depending on the degree of visual impairment	Mandatory

Table 7. *Requirements for users with different types and degrees of visual impairment.*

USER INTERFACE DESIGN AND STRUCTURE

As outlined by Tsou and Curran (2008), the user interface is the prime factor that decides the fate of any software application—in the worst case, even determining whether or not an application is used at all. For accessible applications and websites, an appropriately designed user interface is even more important (Hung 2001; Jacobson 1998; TTC 2013).

Web maps are a special kind of web application. Apart from elements common to other web applications, such as orientation and navigation tools, messaging systems, help components, and settings tools, web maps have a map component that is embedded in their graphical user interface (GUI). This map component itself also comes with several of its own elements: navigation tools for panning and zooming the map, feature pop-up windows, layer and basemap selectors, etc. Like the GUI, the map component (including its related elements) must be accessible and developed in line with user needs.

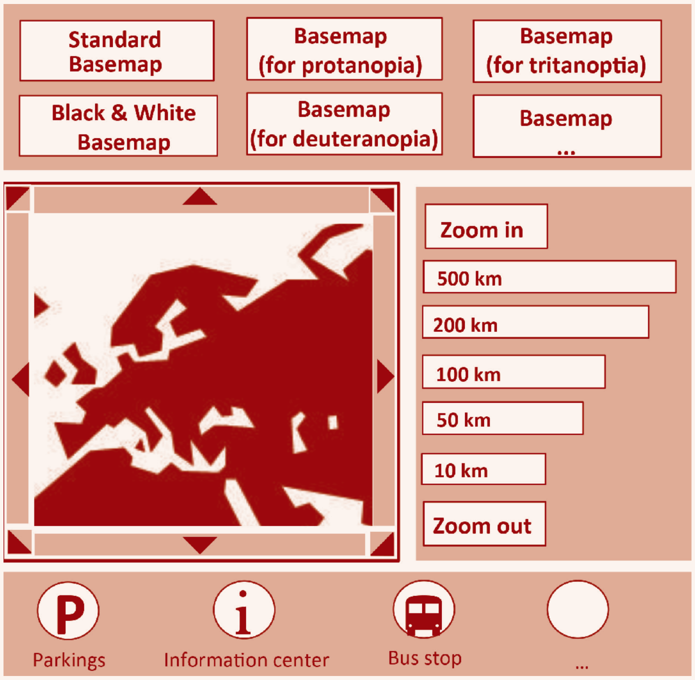


Figure 4. Sketch of a web map layout that is designed for easier access by the visually impaired.

Arrangement of Components

To ensure an application is easy to use, its user interface should be kept simple and consistent, and follow a clear, predictable layout (Nielson 1994; W3C 2008). Achieving this involves the careful selection and arrangement of individual interface components. Since these components are usually linked to specific functions, user interface design depends on the range of functions implemented. In order to benefit the target group, user interface complexity can be decreased by considering the following guidelines (which mostly refer to the development of desktop GUIs):

- implement only as many control elements as necessary and as few as possible—check for unnecessary elements and remove them (Guenga et al. 2006);
- control elements with similar focus should be grouped with each other—but at the same time, avoid grouping too many elements at once (Pernice and Nielsen 2001; W3C 2008);
- locate control elements of the same type in the same place across similar programs (as is done, for example, by Microsoft Office applications) (W3C 2008);
- provide a flat and horizontally organized interface structure, with no dropdown or nested elements (Pernice and Nielsen 2001);
- avoid or reduce scrolling, so that all (critical) elements are visible and accessible without scrolling the screen (Pernice and Nielsen 2001); and
- avoid overlapping of elements (WAWG 2014).

The last point is particularly relevant for web maps. In these applications, basemap selectors and navigation tools are often placed within the map component, which makes it difficult for visually impaired users to read the map as well as to recognize and use control elements. Interaction tools (e.g., for zooming and panning, or selectors for basemaps and overlays) should be located outside the map component. They should not cover parts of the map. Taking into account the AoSS results (Table 6), Figure 4 illustrates an arrangement of the map component and related elements within the GUI that is optimized to support the visually impaired.

Visual Design of Components

An appropriate visual design for the user interface makes it easier for users to perceive, understand, and operate an application (ITU/G3ict 2014b). To assist users, interfaces and their components must be implemented at a suitable size. Likewise, colors should be chosen to provide high contrast between elements such as text, buttons, and checkboxes. Complex backgrounds, such as pattern fills, should be avoided. Symbols should be well known to users and intuitive to understand (ITU/G3ict 2014b; W3C 2008; Figure 4).

Language Used

To make information accessible (i.e., understandable), the careful use of language plays an important role (W3C 2008). This is relevant not only to visually impaired users, but to all non-expert users of spatial data products. Hennig and Vogler (2016) state that laypersons often refuse to click buttons labeled with (technical) terms unknown to them; they instead close the application. Hence, all terms used throughout an application must be familiar to the users. Simple and user-focused language as well as consistent semantics should be used (W3C 2008).

MAP

A map that is as easy as possible to read increases success in communicating the content to the users (Kraak and Ormeling 2010). This is especially relevant for people with reduced vision or those affected by color vision impairments. A thoughtful choice of visual variables (size, shape, position, pattern, arrangement, and color) to create point, line, and area symbols can make the difference between a map being easy or difficult to read (Christophe and Hoarau 2012; Muehlenhaus 2014). The AccessibleMap project questionnaire results confirm the importance of visual variables in creating a visual design suitable for visually impaired users (Figure 2).

Hung (2001), as well as Jeffrey and Fendley (2011), suggest that size and color (e.g., no garish colors, but saturated and bright colors), and increased contrast settings between features such as buildings, streets, parks, places, points of interest, annotations, etc. are important aspects to consider in the appropriate presentation of map features to the target group. Since patterned areas and lines are easier to recognize and to distinguish than areas or lines with coloring only, Jenny and Kelso (2007) recommend combining coloring with simple patterns to enhance map readability. They also suggest that feature labeling (e.g., buildings, streets, parks, and rivers) is helpful for the user group to understand the map content. A selection of recommendations on the usage of visual variables for map features and text elements (labels, annotations, pop-ups, etc.) is listed in Table 8. These recommendations are not only important for building basemaps, but also for displaying overlays (such as points of interest) on maps.

One way to meet the (different) map needs of moderately visually impaired and colorblind users is to provide a set of basemaps from which the user can choose. Thus, for instance, the Vienna and Bern city web maps permit the user to switch between a standard basemap and a black and white version. The high contrast between black and white makes these basemaps particularly useful for visually impaired users. To optimize color contrasts, color contrast ratio and related recommendations are useful (for instance, those presented in detail in W3C [2008]). Finally, tools such as ColorBrewer (**colorbrewer2.org**), Color Oracle (**colororacle.org**), or Color Contrast Checker (**webaim.org/resources/contrastchecker**) can be used to create and test color vision impaired-friendly designs.

Due to the different types and degrees of visual impairment, the literature suggests permitting user adjustment of contrast, symbol size, line width, color combinations, and color brightness (Andrews 2007; Jeffrey and Fendley 2011). This is confirmed by the AccessibleMap questionnaire results (Figure 2): 77 % of the respondents would prefer to be able to adjust one or more visual variables in the map themselves.

INTERACTION MODES

Currently, user interfaces are usually implemented as GUIs. The users interact with the system through menu bars, icons, and windows; these interactions are handled by input devices such as mice, keyboards, or touchscreens. Information is returned as a graphical display on the device's screen. Since GUIs rely heavily on the visual sense, people who are severely visually impaired or blind are at a disadvantage. However, supporting keyboard accessibility, as well as using assistive technology, can be pivotal to a solution.

Keyboard Accessibility

Keyboard accessibility is important for improving the operability of web maps for visually impaired users (Langen and Ballantyne 2014; Victorian Government 2011; W3C 2008). Many severely visually impaired and blind users typically use a keyboard to navigate applications. Even for users who are partially sighted, the use of a keyboard provides easier access to web content (WebAIM 2016).

	Recommendations
Points	• Simple symbols and glyphs (Gill 2009; Harley 2014) • Widely-/well-known icons (Jeffrey and Fendley 2011) • Appropriate color design: use of bright colors (Liu 2010); optimized color contrast between symbol and background, symbol and surrounding items (Fowler 2011; Jenny and Kelso 2007) according to the color contrast ratio as discussed in WCAG 2.0 (W3C 2008) • Different colors and icons for different features (Jenny and Kelso 2007) • Adequate size of symbols and glyphs—this depends on a number of parameters such as the user, complexity of the symbol, display qualities, and viewing conditions; thus, the minimum acceptable symbol size has to be tested by the intended user group (Gill 2009)
Lines	• Lines should not be too thin, however appropriate thickness depends on color use and color contrast with the background (see, for example, Gill 2009; W3C 2017) • Appropriate color design: use of bright colors (Liu 2010); optimized color contrast between lines and other elements (Jenny and Kelso 2007) according to the color contrast ratio as discussed in WCAG 2.0 (W3C 2008) • Different colors to represent different types of lines (Galvin 2014; Jenny and Kelso 2007) • In addition to color, use different line thickness and patterns to represent different types of lines (AccessiQ 2015; Galvin 2014; Jenny and Kelso 2007)
Areas	• Use dark outlines (see, e.g. Liu 2010) • Appropriate color design: use of bright colors (Liu 2010); optimized color contrast between lines and other elements (Jenny and Kelso 2007) according to the color contrast ratio as discussed in WCAG 2.0 (W3C 2008) • To distinguish different types of areas, use patterns in combination with colors (Jenny and Kelso 2007; W3C 2016)
Text	• Optimize color contrast between text and background, or between text and surrounding text; black letters on a white background are considered best practice (Fowler 2011; Jeffrey and Fendley 2011; W3C 2016) • Use of simple, well-established, and popular sans serif typefaces (Jeffrey and Fendley 2011) • No underlining or italicizing of characters (Jeffrey and Fendley 2011; W3C 2016) • Only the first character of a word should be capitalized (if any are at all), others are written in lower case letters (W3C 2016) • Suitably large font size: guidance on type size varies from recommending 12 to 18 point type (Jeffrey and Fendley 2011; W3C 2008) • Left-aligned (Jeffrey and Fendley 2011) • Not overlapping with other features or labels (WAWG 2014)

Table 8. *Recommendations on how to employ visual variables to design a map suitable for visually impaired users.*

In addition to addressing frequently relevant aspects of keyboard accessibility, such as the provision of focus indicators or the definition of a navigation order (WebAIM 2016), map control elements must be designed and implemented in a particular way. Map navigation tools should provide pre-defined, discrete zoom and pan steps that are tied to keyboard shortcuts, permitting the user to navigate around the map without using a mouse. In Google Maps, for example, to move the map north or south in small steps, the arrow-up or -down keys can be used; to move the map north or south in large steps, the page-up or -down keys can be used (Table 6).

Assistive Technology

Assistive technology refers to any object or system directed toward aiding people with disabilities in interacting with their environment, in communicating with others, and in accomplishing a variety of tasks. With regard to digital products, assistive technology refers to technology that supports users in accessing and using software applications and websites (W3C 2008).

Among existing assistive technology tools for the visually impared, voice output, screen readers, Braille displays, and magnification software are the most popular (Bártek and Kopeček 2006; Leporini and Paternò 2008). The importance of assistive technology for our target group is confirmed by the results of the AccessibleMap questionnaire (Figure 2): among moderately visually impaired users, magnifier software is used most frequently (38%), while the severely visually impaired and the blind primarily use Braille displays (89%), voice-over (89%), and screen reader software (79%).

Screen magnification is relatively easy to implement using existing software tools (such as Virtual Magnifying Glass) or custom-programmed solutions (using, for example, JavaScript libraries).

In contrast to this, Braille displays, screen readers, and voice-over software require specific applications to be installed by the user. If needed, external devices such as Braille displays must also be available. To support these options, text alternatives for every non-text element (including the map itself) must be available. Depending on the tool, text alternatives are read aloud (screen reader, voice-over) or are delivered as tactile output (Braille display). Very short verbal descriptions (~125 characters) of images, including embedded static web maps, are usually provided using the ALT-attribute/ALT-tag in HTML (Nielsen 1996; Penn State Accessibility 2015b). To deliver more detailed descriptions of non-text elements than the ALT-tag can offer, or to provide any kind of verbal information about dynamic/interactive web maps, text can be presented in separate components (such as additional browser tabs) related to the map (Table 6: Lüneburger Heide Nature Park; Eifel National Park).

VERBAL DESCRIPTION OF THE MAP'S CONTENT

As outlined in the literature, maps (as well as other non-text elements such as images or diagrams) should be provided with both a brief, sentence-length description as well as a more detailed one (Penn State Accessibility 2015a; Victorian Government 2011; W3C 2008). The availability of a brief explanation was considered particularly important by the majority of senTour project user questionnaire respondents (Figure 4).

A short comment about the map's content can usually be created without any difficulty, since it is usually a simple and static text element that delivers a general overview of the map and its content via the use of the ALT-tag. In contrast to this, writing a more comprehensive verbal description of (interactive/dynamic) map content is a challenge (see, for example, Ferguson and Hegarty 1994; Jacobson 2002): apart from information about individual features ("bus stop," "street," "crossing," etc.), a holistic overview of an area of interest has to be given. This must include information about the relationships and distances between different elements (for example, "this shop is located on Main Street; it is twenty meters away from the intersection of Main Street and 3rd Avenue").

Amount of Information

Since people usually can only remember a limited number of things at a time (on average seven, according to Nielsen [2009]), the amount of information an application delivers must be in line with this. Users should not be overloaded with too much detail. Detailed descriptions should focus on certain locations (e.g., selected by the user or at the user's current position; Giudice et al. 2007).

Here, to understand an entire map, a user can start at a selected location and then move virtually along streets or trails, receiving information about each section along the way (Figure 5). As the user moves around the map, step by step, a comprehensive description of its content is given. This enables the user to explore the map gradually and to build up a cognitive map of an area without using the visual sense.

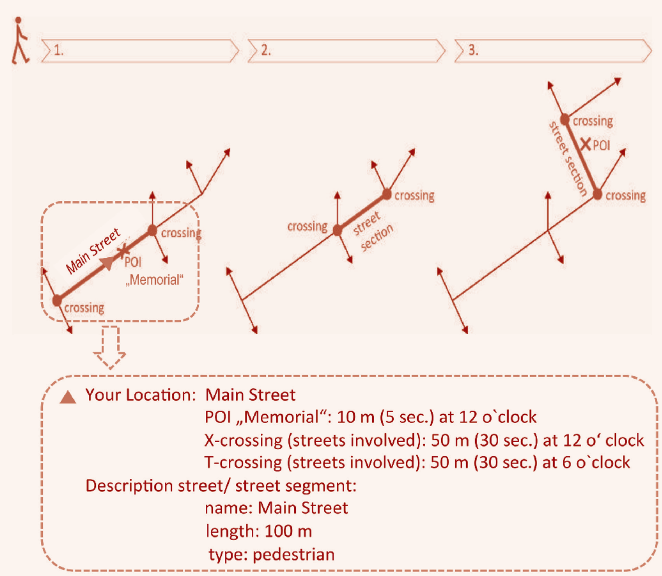


Figure 5. Example approach to deliver a verbal description of the map content (adapted from Wasserburger et al. 2011).

Order of Information

The order in which information is presented should be in accordance with its relevance to the user, prioritizing key elements for the construction of a cognitive map such as reference points or cues (landmarks) first, and second, paths, streets, or trails (Ferguson and Hegarty 1994; Millonig and Schechtner 2005; Tversky 1993). This approach is particularly important for people who are blind, since they usually walk linearly along a chain of orientation points. However, the landmarks, orientation points, and points of interest used by the blind are often different from those of the sighted. The blind consider elements such as acoustic traffic lights, tactile guiding systems, or type of pavement to be relevant (Ienaga et al. 2006; Jacobson 1998).

Information on Distance and Direction

Distance information should be provided using both metric and walking time measurements (Kalia et al. 2010). Information on direction should be provided based on using body-orientation indications (left, right, forward, backward, etc.), the cardinal points system (north, south, east, west), or the hour system. The hour system uses a metaphor to indicate directions: the user is imagined to be in the center of an analog clock, with 12:00 to their front, 3:00 to their right, 6:00 directly behind them, 9:00 to their left, and so on (Sánchez and Torre 2010). The AccessibleMap project questionnaire's results underline the hour system's relevance for describing directions: 49% of the respondents prefer it (Figure 2). The AccessibleMap questionnaire respondents also preferred pedestrian crossing layouts to be described using letters (e.g., T-, V- or X-crossing; Figure 2).

Today, verbal descriptions of map content can often be generated automatically using spatial databases and geographic information systems. This allows the description to be adapted whenever the user selects a new location on the map, or whenever the map content changes due to user interactions (zooming, panning, switching layers, etc.).

ADDITIONAL CONSIDERATIONS FOR INCREASING ACCESSIBILITY

The work conducted in the AccessibleMap and senTour projects allowed us to not only develop recommendations about what to consider when creating web maps that are accessible to the visually impaired, but also made it obvious that additional aspects should be considered to enable these users to benefit fully from web maps.

	Description
Accessibility	Extent to which the product is usable by people with the widest range of capabilities
Usability	Extent to which the product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction, in a specified context of use
Utility	Extent to which the product provides functionality that meets real user needs, such as those associated with independent living and participation in society
Compatibility	Extent to which the product works together with other devices, and conforms with current technical standards, guidelines, and laws

Table 9. *Criteria closely linked to accessibility (based on ITU/G3ict 2014a).*

ACCESSIBILITY AND RELATED CONCEPTS

As we discussed above, web accessibility focuses on the removal of technical barriers that might hamper people with disabilities from accessing information. However, it does not explicitly address other, equally important considerations. Accessibility alone is not enough: usability, utility, and compatibility must additionally be considered (Table 9). Together, these four concepts, which are closely intertwined with each other, provide a framework of characteristics for products that aim to be well suited for disabled users (ITU/G3ict 2014a; ITU/G3ict 2014b; Leporini and Paternò 2008). In consequence, the concept of accessibility must be considered broadly.

The terms usability and accessibility are closely related, but each has a different focus, though their objectives, approaches, and guidelines overlap significantly. Krug (2006) suggests that a website (or any product) is not usable unless it is accessible, and Brajnik (2000) stresses that accessibility is a subset of usability.

The same is true for utility and compatibility: websites and web applications must not only be accessible, but they must also provide content, functionality, and access to devices relevant to its users. Thus, for instance, our intended user group requires functionality that permits the use of assistive technology. Further, apart from the information commonly found in web maps (e.g., streets, places, buildings, parks, and rivers; Horstmann et al. 2006), visually impaired users require information on specific infrastructure (e.g., guidance systems, accessible parking, toilets, and public transportation) and feature characteristics (i.e., tactile, audible, and smellable). Such elements play a particularly important role in helping the blind to orient themselves in physical space and to engage in wayfinding (Ienaga et al. 2006; Karimi et al. 2014).

DIGITAL AND SPATIAL LITERACY

The questionnaire results obtained in the AccessibleMap and senTour projects highlight the widespread usage of information and communication technology (ICT) among the target group: the majority of the AccessibleMap project questionnaire respondents indicated they use desktop PCs, laptops, smartphones, and tablets, and that they use the internet several times a day (Figure 2). The senTour project target group questionnaire showed that 73% of the respondents use the internet to get information about recreation or tourism (Figure 3). These results are consistent with the findings of Harris (2010), who stated that disabled people engage enthusiastically with technology.

Selected skills and competencies		Users as
Digital skills	Register/login including self-representation, profile creation, identity management, etc.	Prosumer
	Use, create, remix, publish, share, embed content and objects (using different web 2.0 tools)	Producer
	Network (search, combine, disseminate information) and negotiate (travel across diverse communities, discerning and respecting multiple perspectives, etc.)	Prosumer
	Work in a cooperative way	Producer
	Judge/evaluate the reliability and credibility of information sources	Prosumer
	Internet safety issues: copyright, data privacy, etc.	Prosumer
	Understand the logistics of cloud-based interleaving of services and media	Producer
Abilities to handle spatial data products	Know and understand basemaps and layers	Prosumer
	Use basic functions of digital maps (find, open, zoom, pan, etc.)	Prosumer
	Create maps and features (add markers, lines, areas, labels)	Producer
	Add additional information (using information windows/feature pop-ups)	Producer
	Handle data files (import, export, convert, transfer)	Producer
	Output maps (print, save, export, embed, share)	Prosumer
	Re-use data (find data, assess data, process data, integrate data)	Prosumer
Capabilities to handle spatial data products	Know relevant vocabulary and technical terms (e.g. layer, basemap, POIs)	Prosumer
	Cartographic design guidelines: decide upon adequate symbols, map image, background map, combine multimedia and geo-media	Prosumer
	Multimedia use (add, post, comment)	Prosumer
	Critical reflection on the power of maps	Prosumer
	Use maps as a powerful mediator and communication means of interests	Prosumer

***Table 10.** Selected skills allowing users to use spatial data and spatial data products in a competent and capable manner (adapted from Hennig et al. 2013).*

Despite their high usage of ICT, the target group considered the use of the internet and of web maps to be a complex task (Höckner et al. 2012). In this context, Guenga et al. (2006, 287) suggest that "better skills using technologies and ICT, make a big difference." Here, "skills" refers to digital skills and competencies that enable users—who today are acting as prosumers (both consumers and producers) of spatial data (Rinner and Fast 2015)—to handle web maps in a competent and capable manner (Table 10). Measures to foster these skills, which are still often missing in society, are desired, including appropriate user support, help and tutorials, as well as

	Advantages
General	• Developers get to know users; they learn profoundly about user abilities, use purposes, and life circumstances • Prevent and reduce problems of communication and misunderstanding between developers and users • Users offer a source of new ideas
Development process	• Valuable user input • Address users' lack of awareness of their own requirements and their inability to outline these reliably • Support developers to identify, describe, and fully recognize user requirements • Avoid undesirable developments
Afterwards	• Guarantee that the application aligns with user needs/demands and that it delivers a good user experience (focusing, for example, on accessibility, usability, utility, compatibility, and desirability) • Increase user knowledge and acceptance of the application • Ensure that the implemented product really meets the needs of the user group

Table 11. *Selected advantages of participatory design (Hennig and Vogler 2016).*

education and training opportunities. It is widely accepted that such measures to strengthen spatial literacy are equally important as providing accessible applications (Hennig et al. 2013).

PARTICIPATORY DESIGN

The methods used in the AccessibleMap and senTOUR projects—literature and internet review, user survey, AoSS, and stakeholder involvement (Figure 1)—are well-recognized in software engineering and requirements engineering. But, applying them might not be enough to gain a profound understanding of users. Reasons include communication problems between users and developers (misunderstandings, use of different vocabulary, etc.), users' lack of awareness of their own needs, and users' lack of ability to reliably describe their requirements (Firesmith 2007; Hennig and Vogler 2016). Direct and active cooperation with future users in the application development process can be seen as a remedy to these shortcomings, using the approach of participatory design.

Participatory design is defined as a process that aims at involving representatives of future users in the design and development process of a system or product. This can occur in different ways and with varying intensity (Baek et al. 2007). A distinction is made between weak and strong participatory design: in weak participatory design, even though user input is solicited throughout the entire development process, decision making is largely undertaken by the developers. In strong participatory design, the users take part in decision making. Detailed information on participatory design can be found in the literature (see, for example, Enerson 2013; Mazzone and Read 2005; Steen et al. 2007).

Several advantages of participatory design are laid out in Table 11. Because users are experts in their own requirements, participatory design exposes user needs and skills (as tacit knowledge: aspects usually not known to developers) and brings them into the development process. This helps to generate applications that better adhere to users' aims (Muller and Druin 2012; Steen et al. 2007), which is particularly relevant for the development of web maps that address laypersons and/or special needs users such as disabled people, the elderly, and children. Tsou (2003) stresses that the developers of web maps are challenged with meeting the needs of non-experts, who are a lot more diverse and unfamiliar to the developers than are traditional GIS users. Hennig and Vogler (2016) further explain that special needs users, including visually impaired users, are even more unknown to web map developers. Thus, the participatory design approach can play a critical role in the development of accessible web maps.

CONCLUSION AND OUTLOOK

The use of web maps is as important for the visually impaired as it is for sighted people, and sometimes it is even more important. Having access to spatial information regarding unknown areas allows them to plan and prepare trips in advance; this can lead to a more independent life. Since accessible web maps enable everyone to benefit from

ICT, including the internet, these applications can be seen as a contribution towards e-inclusion, and strengthening the information society.

Even though visually impaired users may require special solutions depending on the type and degree of their visual impairment, the following recommendations are of general interest when developing web maps accessible to them: provide an easy-to-use and well-designed user interface with a well thought out range of implemented functions; create an easy-to-read map picture; support different interaction modes (including use of assistive technology); and give a verbal description of the map content.

Due to these issues web maps accessible to visually impaired users are different from conventional web maps. They feature added flexibility, alternative modes, and more choices for their users. But making web maps accessible to disabled users does not mean that they become any less useful for others. To the contrary, increased accessibility often results in improved design for everyone, as it makes applications easier to use and more attractive.

In support of building applications tailored to the visually impaired, several standards and guidelines exist, but there are very few recommendations that provide guidance on creating accessible web maps specifically. This gap needs to be filled. We refer not only to the provision of these recommendations, but also to the elaboration of design patterns, and describing and presenting best-practice solutions, which should be evaluated by experts and target groups. Having such information at hand would be helpful to developers who are designing and implementing accessible web maps.

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Indexing the Jacaranda Atlas

Craig Molyneux
Spatial Vision
craig.molyneux@spatialvision.com.au

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Spatial Vision has produced the last three editions (7, 8, and 9) of the *Jacaranda Atlas* for John Wiley & Sons, and by far the biggest individual task is indexing the features that appear on the atlas maps. Generating such complex gazetteer indexes is a bane of cartographers, and it takes roughly four to five weeks of production time to generate, collate, format, and check the *Jacaranda Atlas* index. Before the advent of computers, this was an entirely manual process. With the development of geographic information systems and relational databases, the process has been automated somewhat, though in spite of this, errors can still creep in.

The purpose of a gazetteer index is to locate a feature on a map that places it in the most appropriate context, which can be challenging when the feature appears on more than one map. Additionally, the index should provide some extra information about the feature—its latitude and longitude, along with its type (park, mountain, bay, etc.; Irvine 2005).

Spatial Vision uses a multi-step approach to the production of the atlas maps. For the atlas plates we use Esri ArcGIS for the base map creation, with final clean up and styling in Adobe Illustrator. This approach has proved challenging when creating indexes, as any map edits need to be done in ArcGIS, then re-exported to Illustrator. The index is derived from the ArcGIS .mxd files created for each atlas plate. As deadlines loom, shortcuts are often taken with label adjustments, which are not reflected in the master ArcGIS files. This then requires a thorough manual check of the index text to ensure everything is correct—a timely and costly process.

Here, I propose an alternative approach (one that has been tried and tested) to map production and index generation for atlases that takes place entirely within one production environment: Adobe Illustrator and its MAPublisher plugin. The indexing process uses a little known (and undocumented) feature of MAPublisher to create additional data for the labels to make indexing easier.

All good maps are dependent upon good data, and in order to improve the speed of index creation, we need to improve the quality of the data. We can do this by adding additional feature classes to the core datasets that will assist later in the indexing process.

The basic workflow I propose is to store all spatial datasets in a master PostGIS database or Esri file geodatabase for import into master Adobe Illustrator (AI) working files (Figures 1 & 2). The master AI files contain all the text layers (no elements, but data structures have been defined), graphic styles, symbols, character styles, MAP Themes, MAP Selections, and MAP Views required to produce the atlas maps.

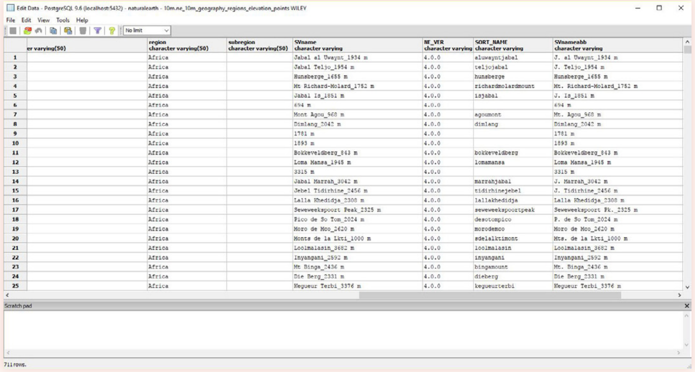

Figure 1. PostGIS database with custom feature classes.

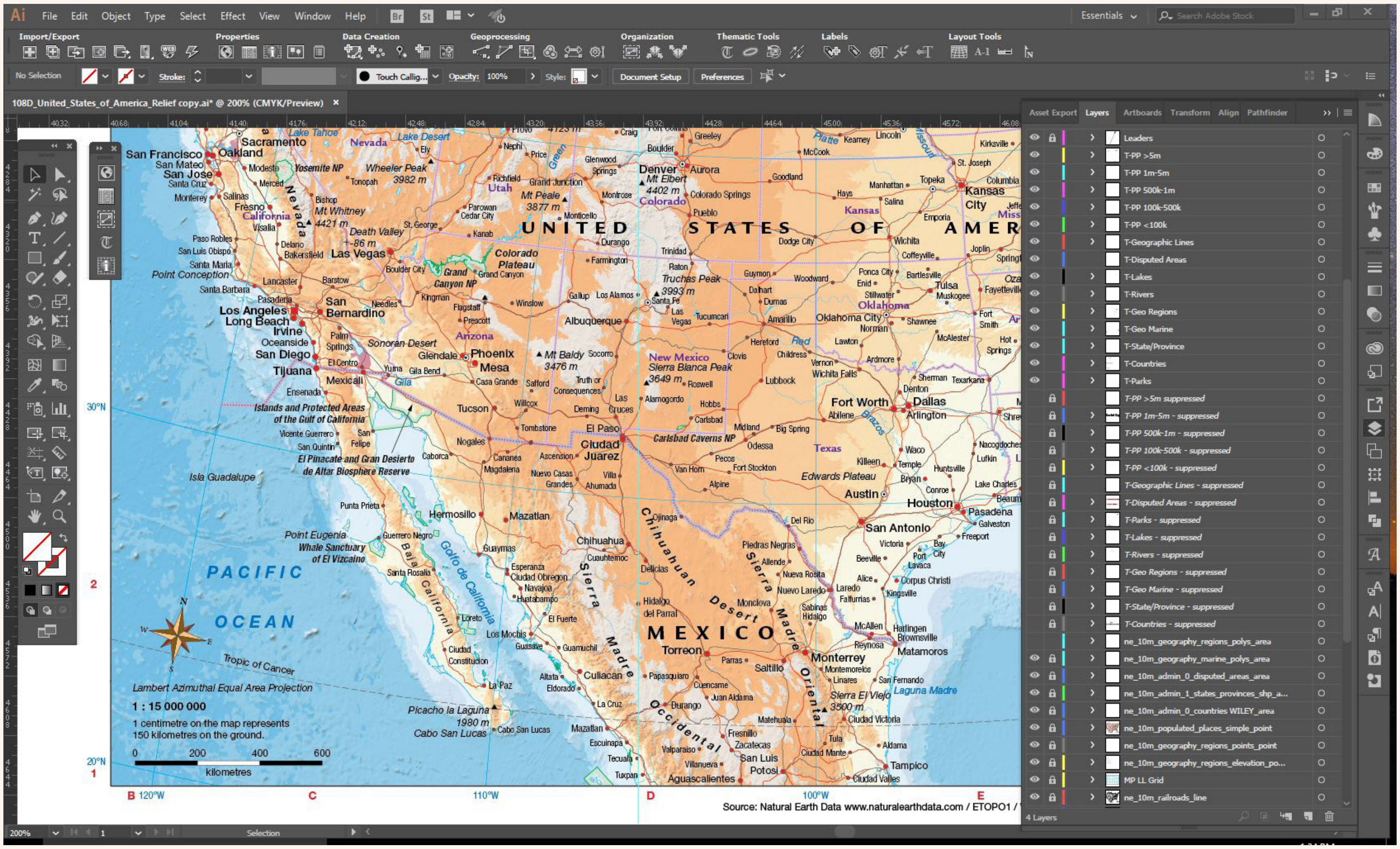

Figure 2. Adobe Illustrator master map file.

When datasets are imported into the master AI file (Figure 3), their geographic extents can be defined so that they can be clipped to the map frame. Map features are automatically styled, as the MAPublisher MAP Themes have pre-defined styles based on layer attributes (Figure 4). This ensures graphical consistency across all maps.

The label layers require the data structure of the labels to be pre-defined, which is then later used for indexing. This can be achieved in MAPublisher using the editor in the MAP Attributes palette, by placing an object on the text layer and creating the required data structure. For the *Jacaranda Atlas* maps we added a number of additional data columns that assist in indexing (Figure 5). The column names shown in lower case have been extracted from the data, whilst column names in upper case are user defined.

The **sortname** column is one that we have created that allows the label to be placed in the correct order in the gazetteer index. For example, a mountain labeled Mt. Kosciuszko on the map would be indexed as Kosciuszko, Mount in the gazetteer index. The **sortname** for Mount Kosciuszko would be kosciuszkomount.

Point features in the data have **latitude** and **longitude** attributes defined in decimal degrees. We use this data to create a degrees and minutes value for the feature in the index.

The **PAGE_NO** data is manually added in the AI artwork, once we know which page the map is placed on. Text features are selected and, using MAPublisher's Find and Replace function in the MAP Attributes palette, we can add the odd and even page numbers. A map may spread across two pages, in which case we add a guide defining the page gutter. Text is positioned so that it doesn't fall within the gutter. Text on the left of the guide will fall on an even-numbered page, whilst text on the right of the guide will be an odd-numbered page.

The **REP_COLOUR** attribute allows us to define the colour of the label in the gazetteer index. Land-based geographic features (mountains, capes, ranges, etc.) are shown in brown, water-based geographic features (lakes, rivers, bays, seas, and oceans) are shown in blue, World Heritage Areas are shown in green, and cities and towns are shown in black.

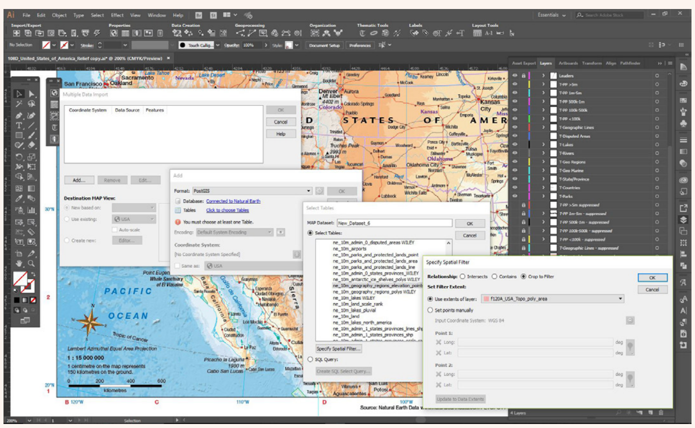

Figure 3. *MAPublisher importing data from the PostGIS database using a spatial filter.*

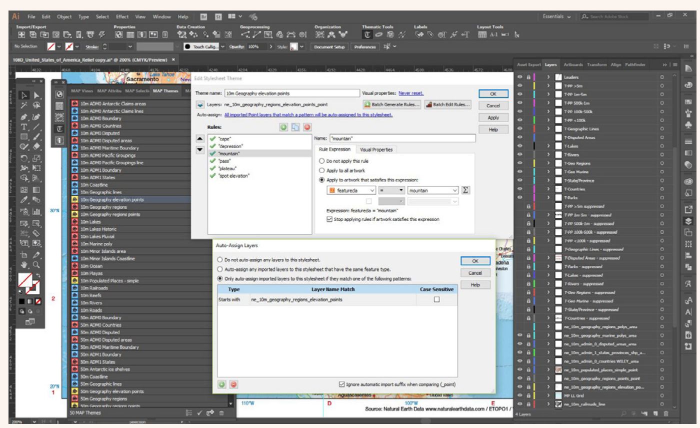

Figure 4. *MAP Themes allowing automated styling of data on import.*

	#Text	PAGE_NO	REP_COLOUR	MAP_SCALE	featurecla	type	latitude	longitude	adm0name	adm1name	pop_max	sortname
1	Chicago	109	Black	15,000,000	Populated place		41.829991	-87.750055	United States of America	Illinois	8,990,000	chicago
2	Miami	109	Black	15,000,000	Populated place		25.787611	-80.224106	United States of America	Florida	5,585,000	miami
3	New York	109	Black	15,000,000	Populated place		40.749979	-73.980017	United States of America	New York	19,040,000	new york
4	Philadelphia	109	Black	15,000,000	Populated place		39.999973	-75.169996	United States of America	Pennsylvania	5,492,000	philadelphia
5	Toronto	109	Black	15,000,000	Admin-1 capital		43.699980	-79.420021	Canada	Ontario	5,213,000	toronto

Figure 5. *Custom attributes added to text features. These fields are automatically populated when the text is generated using LabelPro.*

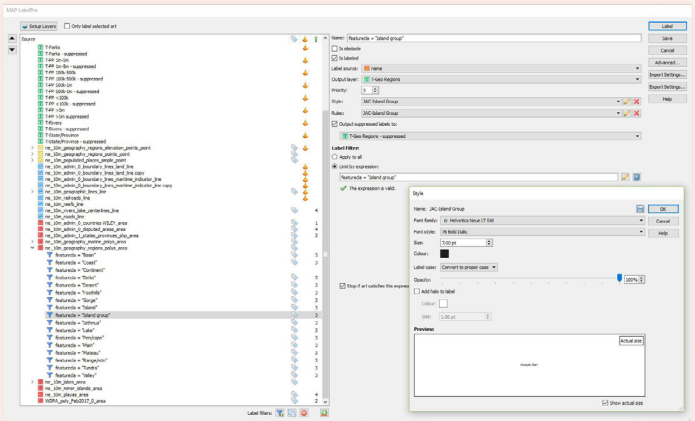

Figure 6. *LabelPro settings for the Natural Earth layers.*

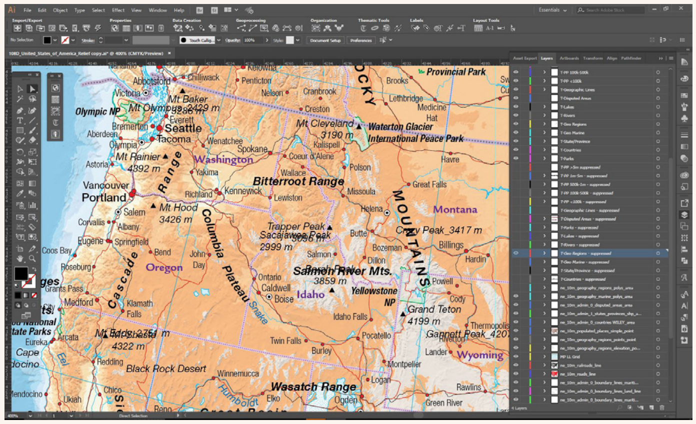

Figure 7. *Suppression layer displayed for geographic areas.*

The **MAP_SCALE** attribute contains the map scale, e.g., 15,000,000. When we have multiple instances of the same feature we use the MAP_SCALE to select the best scale the feature is represented on and remove the other duplicates.

Where multiple cities or towns have the same name, such as Richmond (Australia: Tasmania, Victoria, New South Wales, Queensland and South Australia; New Zealand; United States: Utah, Virginia), we need to differentiate these by specifying the country followed by the state or province. The **adm0name** (country) and **adm1name** (state) are pulled from the Natural Earth data to facilitate this.

With our text data structures in place and the data imported and styled in the AI document, we can now label the map using MAPublisher's LabelPro extension (Figure 6). LabelPro is a rule-based auto-labelling engine that can quickly and easily place labels on the map using the attribute information in the data. Setting up the rules for each layer can be time consuming; however it is still faster and more accurate than labelling the map by hand.

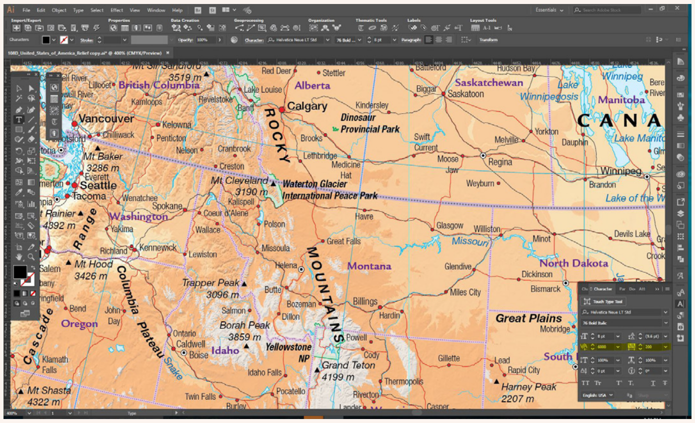

Figure 8. *Good tracking and kerning settings for labels (in this case ROCKY MOUNTAINS) ensures clean indexes.*

During the auto-labelling process any labels that can't be placed are placed on suppression layers (Figure 7). These suppression layers need to have the same data structure as your other text layers. During the map clean-up process, some labels may need to be repositioned, deleted, or added. Rather than delete a label we move this label to its corresponding suppression layer. Likewise, if a label needs to be added, we take the label from the suppression layer and place it on the visible label layer. In this way attribute information is retained for all labels.

During this labelling process, because we have our pre-defined attributes in the text layers, all the data from those matching fields will be added to our labels. From our list above, **the featurecla**, **type**, **latitude**, **longitude**, **adm0name**, **adm1name**, **pop_max**, and **sortname** columns will be populated with data (where the data exist).

An important consideration in map labelling is the tracking and kerning of labels. Large area features, such as deserts, ranges, and oceans will often have their tracking (space between characters) increased so that the label can spread across or along the feature. Kerning adjustments alter the space between two individual characters. To further spread out multi-word labels, we increase the kerning between the last letter of a word and the space before the next word, rather than add spaces (Figure 8). In this way the label string is fit for use in the gazetteer index.

Label positions are indexed using an alphanumeric reference. The alpha references run from left to right, whilst the numeric references run from bottom to top on the left

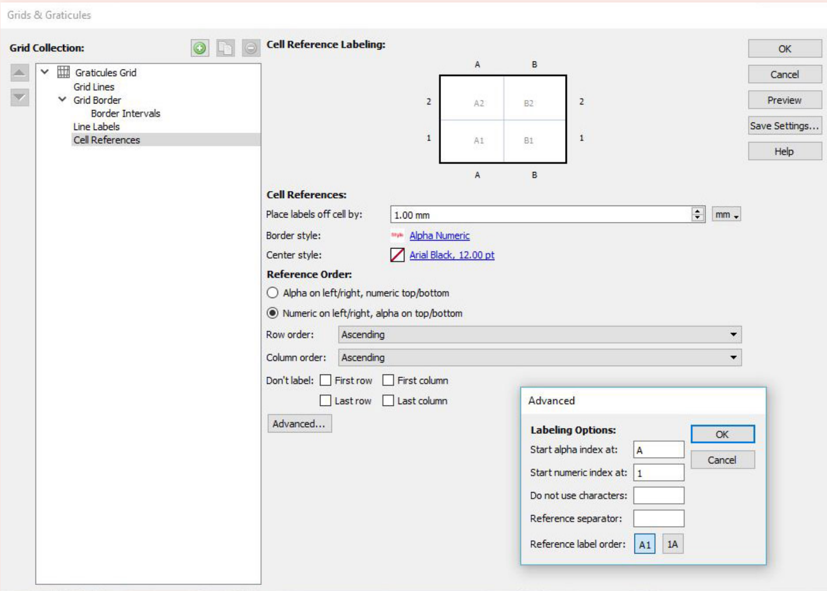

Figure 9. Creating an alphanumeric grid using MAPublisher's Grid tool.

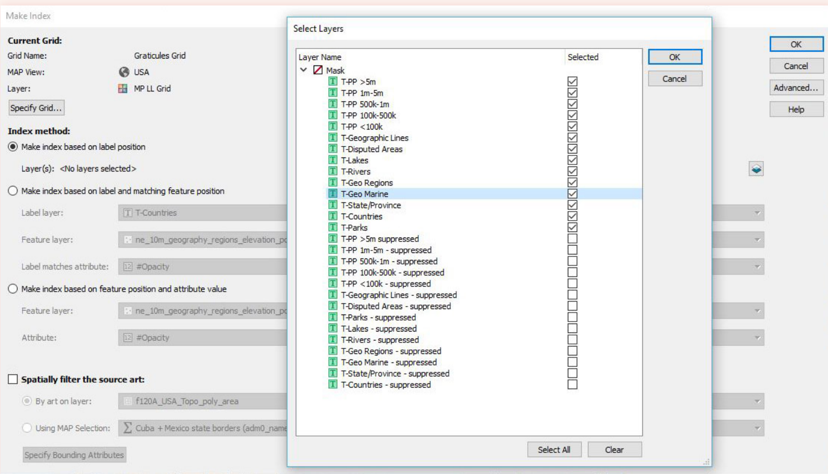

Figure 10. The Make Index panel settings define which text layers get indexed.

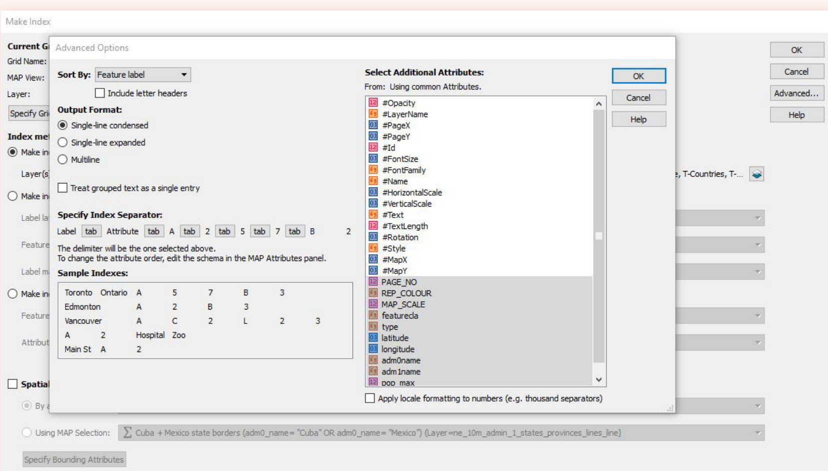

Figure 11. The Advanced Settings of the Make Index panel allow additional text attributes to be used when generating an index.

side of the map. The location of the first character of the label is referenced in this manner. Note also, that because this is a student atlas, the alpha references of 'I' and 'O' are included. In some atlases these letters are not used because of the potential confusion with the numerals '1' and '0,' however for students this can be misleading if they are left out.

Once we have our map labels finalised and the maps have been checked through the editorial process we can begin the indexing. MAPublisher has an indexing tool that can create an alphanumeric index based on a pre-defined grid in the artwork (Figure 9). In the *Jacaranda Atlas* we use the latitude and longitude graticule as the index grid. This can vary from a rectangular grid on a map using the Mercator projection to a curved grid on a map using a conical projection. In most cases, we can use the MAPublisher grid, however there are some instances where the auto-created grid does not conform to our requirements. You can also use a custom area layer to define a grid. Each grid cell needs to be defined with an alphanumeric value so that indexing can be done.

With a grid selected, the final step in the indexing process is to define which fields will be added to the index table (Figures 10 & 11). By selecting all our custom fields we can create a .csv file that contains all the data required for the final collation in Microsoft Excel (Figure 12).

This indexing step needs to be done for each .ai file. Each index .csv file is then converted to an Excel file, which is then aggregated with others into one master gazetteer index document (Figure 13). In the final master index, the latitude and longitude fields in decimal degrees are converted to degrees-minutes format using a simple formula. Fields are concatenated together and styled in Excel to create a final list that is exported as a Word document for placement into Adobe InDesign.

The benefits of the indexing approach described are:

- All labelled features on the final map artwork are indexed
- Any labels that are edited on the map are reflected in the index
- The additional data fields in the map labels reduce indexing processing time at the time-critical end of the project
- Complex grids can be indexed easily
- The whole map production and index generation process can be done in one software environment

The approach outlined above has been designed to make the indexing process more efficient and error free. For this approach to work successfully there is a need to set up files correctly that conform with the spatial data source that you're using.

Since the time of writing, Avenza has released an update to MAPublisher (10.1) which includes a feature to specify page numbers in your map artwork for indexing purposes. More details can be found here: www.avenza.com/resources/blog/2018/03/23/indexing-atlas-just-got-whole-lot-easier.

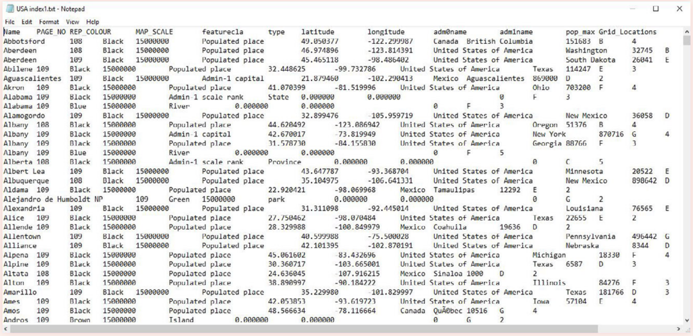

Figure 12. Raw .csv file of generated text.

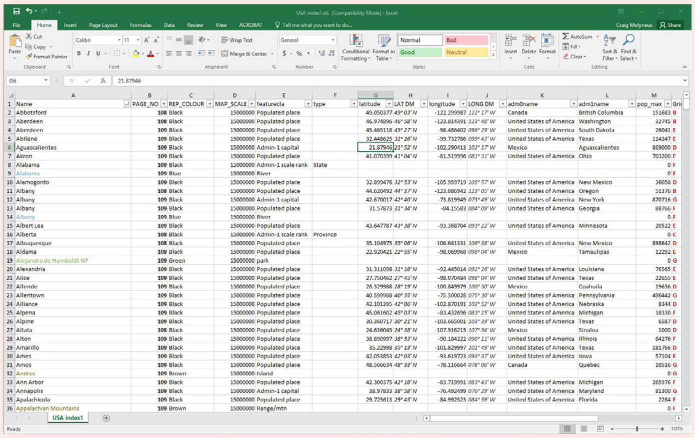

Figure 13. Excel file of the generated index with formatted fields.

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DOI: 10.14714/CP88.1438

A Walk in the Park: Perceptions of Place through Mapping

Joanna Gardener
joannagardener.com
jgardener@swin.edu.au

A Walk in the Park is the initial stage of an exploratory mapping project that investigates the aesthetics of cartography and its capacity to tell stories, communicate ideas, and evoke sensory impression and experience. This year-long exercise explores the Edinburgh Gardens, a 60-acre parkland situated in the heart of North Fitzroy, an inner suburb just north of the city of Melbourne, Australia. The focus of this project is the perception of place, the transitory nature of that perception, and the role maps might play in enhancing that perception. I wanted to draw upon my diverse experiences of the park to visually explore cartography's potential to arouse the senses, evoke emotion, and stimulate the imagination.

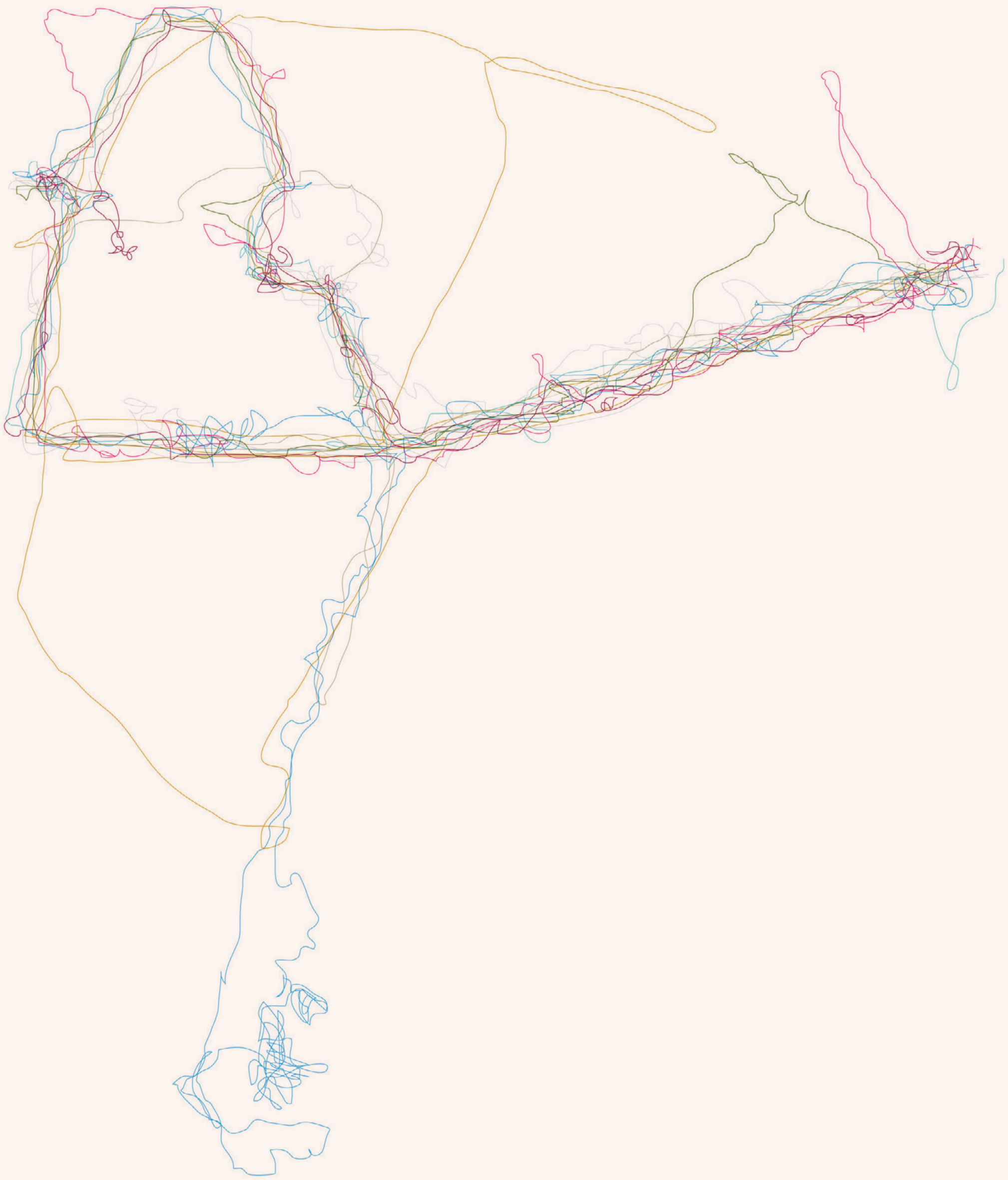


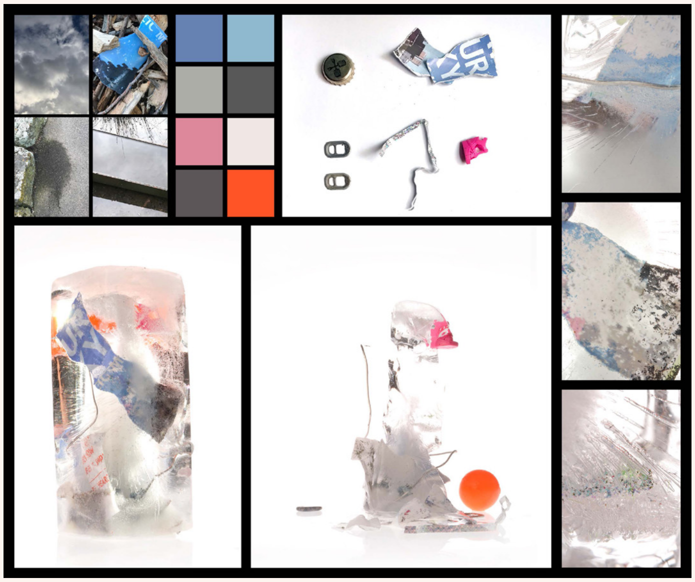
Figure 1. *MAPPED ROUTES, 2017. Paths undertaken during walks.*

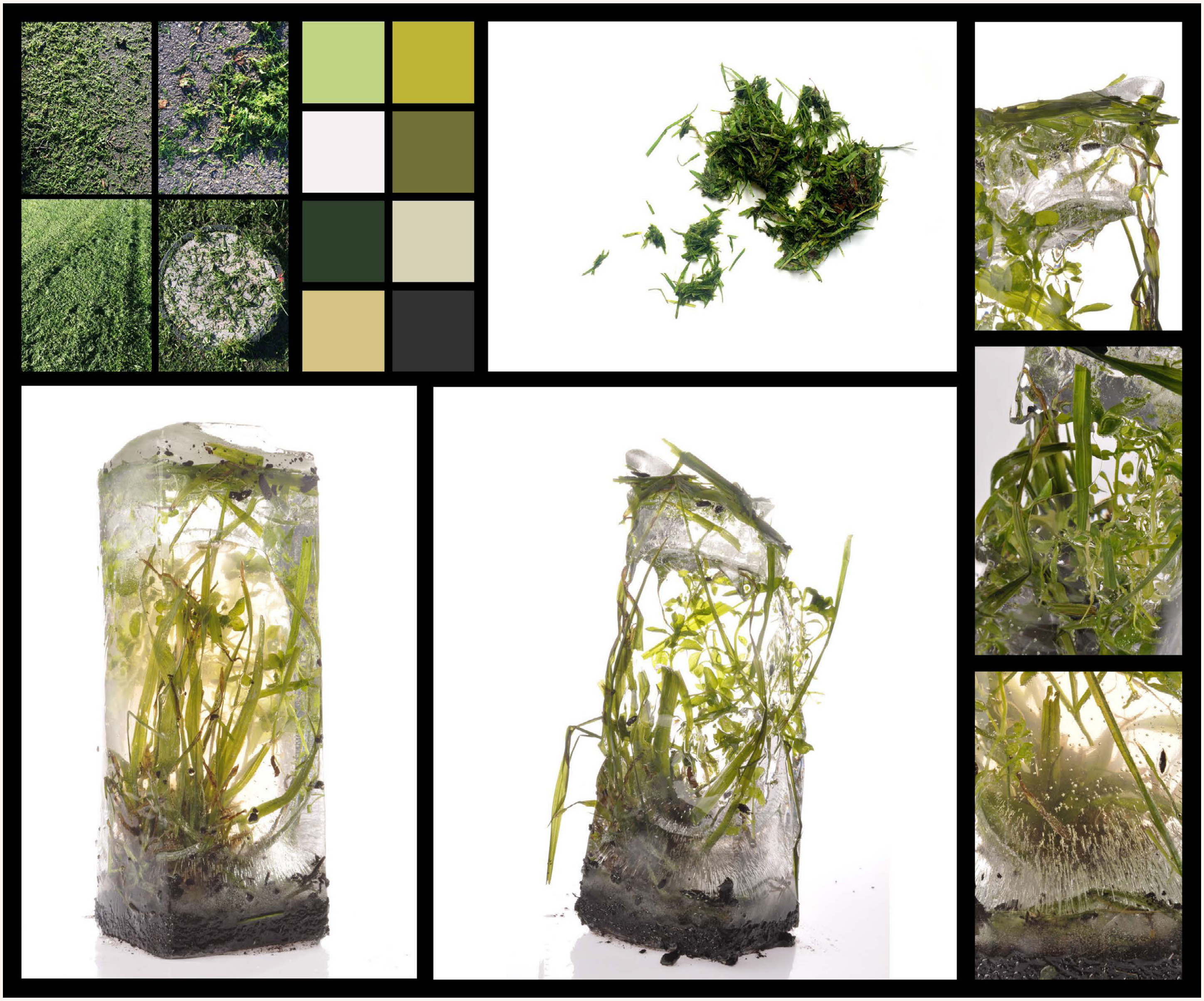
The role of time emerged with each park visit and I drew upon Torsten Hägerstrand's concept of a space-time cube as a method for investigation. A space-time cube is a graphic visualization combining time and space within a contained three-dimensional space, a "cube." During each walk, I collected data that informed my own interpretation of space-time cubes, each one representing a different walk (Figure 1). I compared the route and duration of the walks with the weather and with

Figure 2. *CABINET OF CURIOSITIES, 2017. Selections of found objects from each walk.*

photographs I had taken. From this information, I generated colour palettes through sampling dominant colours of the photographs and then began a "cabinet of curiosities" showcasing a collection of objects I found during each visit (Figures 2–5). To fully capture the experience and my perceptions of the walks, I wanted to use a combination of the collected data. I selectively filtered the information, choosing aspects that best embodied the experience of each walk. As I investigated how to put these disparate elements back together, I reassembled and reinterpreted fragments pulled from the already filtered information, which then collectively formed the basis of my individual space-time cubes (Figure 6).

A sculptural project appeared to be a suitable method for exploring the potential of the three-dimensional space-time cube. Ice became my medium of choice, as I wanted one that allowed for the suspension of the found artifacts





Figures 3–5. *December (top left), November (top right), and August (bottom) collections and colour palettes.*

from my walks. Ice also proved to be an excellent medium for exploring weight and light, by manipulating its constitution with texture and adding colour with pigments. Ice allowed me to work in layers and intervene in its freezing at different points to build my space-time cubes. The transitory nature of ice as a medium was also important in capturing the transitory nature of time. My walks, and the perception and experience of the walks, were temporary,

Figure 6. *Space-time cubes.*

Figure 7. *Space-time cubes melting over time.*

thus freezing a moment of time seemed fitting. So, it is through ice that I explored the concept of Hägerstrand's space-time cubes for each walk in the park.

The melting of the space-time cubes represents time passing, embodying the temporal aspect of each walk (Figure 7). As the ice melts, it reveals layers of the walk, exposing materials and found artifacts. This reveal is reflective of the walk itself that bares its milieu to you as you walk the path. With melting, the colour palettes and light continually shift, similar to clouds passing overhead on a sunny day, or an unexpected encounter, or sudden change in mood. The melting illuminates those personal moments, emotions, or secrets embedded within each walk (see video).

VIDEO: A WALK IN THE PARK

Click to watch, or visit vimeo.com/238308478.

When one visits the park, one just passes through. One's time in the park is transient, and the only clue that one was ever there are the traces left behind. When the space-time cube has melted, the walk is complete and only the found artifacts remain (Figure 8).

00:29:28 August, 2016 | 01:21:05 July, 2016 | 01:01:00 January, 2017

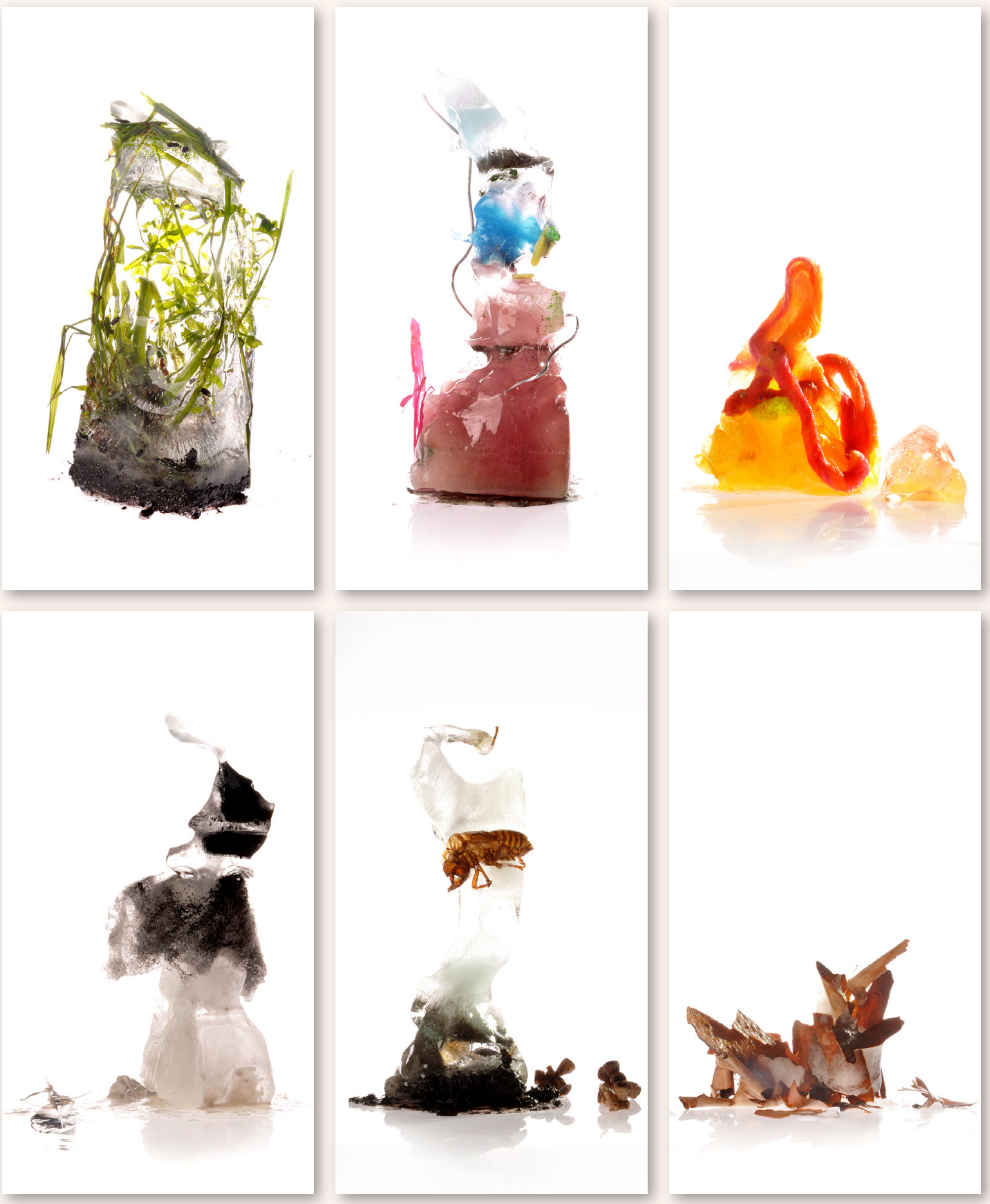


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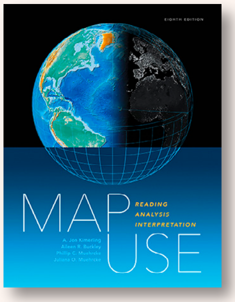
Figure 8. *TRANSITORY NATURE OF TIME. Large scale digital prints on paper.*

Visual Fields focuses on the appreciation of cartographic aesthetics and design, featuring examples of inspirational, beautiful, and intriguing work. Suggestions of works that will help enhance the appreciation and understanding of the cartographic arts are welcomed, and should be directed to Section Editor Matt Dooley: mapdooley@gmail.com.

MAP USE: READING, ANALYSIS, INTERPRETATION, 8TH EDITION



by A. Jon Kimerling, Aileen R. Buckley, Phillip C. Muehrcke, and Juliana O. Muehrcke; foreword by Jack Dangermond

Esri Press, 2016

664 pages, 550+ illustrations. $99.95, softcover.

ISBN: 978-1-58948-442-9

Review by: Daniel G. Cole, Smithsonian Institution

This hefty book, now in its eighth edition, has evolved over the past 40 years from an entertaining read about map use, reading, analysis, and interpretation into a formidable textbook on these subjects. The Preface tells us that "this book offers a comprehensive, philosophical, and practical treatment of map use in three primary ways" (ix). "First," the authors write, "we define a map as a graphic representation of an environment that shows relations between geographic features … second, we make a clear distinction between the tangible cartographic map and the mental or cognitive map of the environment … third, we reference commercial products and services of special interest to the map user" (ix–x). As an afterthought, they also promise to show how map use is relevant to daily life. This review will look to see if this book achieves its goals.

The text is organized into three parts: Map Reading (eleven chapters), Map Analysis (seven chapters), and Map Interpretation (four chapters). Each section has a two-page preface, and every chapter is led with a preamble somewhat less than a page in length. Rather than providing a single reference section at the end of the book, the authors place lists of selected readings at the end of each chapter. In addition, the authors note that "several of the new illustrations are linked to online animated and interactive maps through QR codes" (x).

The Introduction covers, in variable depth, several basic topics, including: Mental Maps, Cartographic Maps, The Map Transformation Process, What Makes Maps Popular?, Functions of Maps, and Map Use. It cautions the reader that "maps, even more than the printed word, impress people as authentic. We tend to accept the information on maps without question. This blind acceptance is potentially disastrous when using maps indiscriminately…You should also question the credibility of maps" (8). This warning is to alert the reader to the range of possible distortions, errors, generalizations, and biases on the cartographer's part. It should be noted that these topics are discussed without ever mentioning the term "critical cartography."

Part I starts with map reading, which involves determining what the cartographer has depicted and how to discover the map's message. As the introduction to Chapter One points out, maps "tell you where things are and let you communicate this information efficiently to others" (25). In the first two chapters, the authors succinctly and logically cover the Earth & its coordinates and map scale, respectively. In Chapter One, they discuss the Earth as a sphere, the graticule, the Earth as an oblate ellipsoid, the differences between geocentric versus geodetic latitude and longitude, and the Earth as a geoid; the explanations are clear and useful. Likewise, Chapter Two features good explanations of expressing scale, large and small-scale maps, converting scale, and determining an unreported scale. Table 2.1 "Commonly used ways of expressing map scale" (43), is especially helpful by covering not only US, but also UK and Canadian practices.

Chapter Three covers projections—a difficult subject for many map users—with sufficient clarity to allow the reader to understand map projection processes, as well as their properties, families, and parameters. Illustrations in this chapter are quite well designed and informative. The fourth chapter discusses different types of grid coordinate systems. The text deals with Cartesian coordinates, UTM, Universal Polar Stereographic, state plane, state grid, and other grid systems (although the Ordnance Survey National Grid [OSNG] dominates the "other" category), and how these systems are used and determined around the world. Grid coordinate determination on maps and grid cell location systems, such as the Military Grid Reference System, US National Grid, OSNG, and proprietary grids are also described. Land partitioning, described in Chapter Five, covers the history and logic behind irregular systems such as metes and bounds, French long lots, Spanish and Mexican land grants, and donation land claims. Discussions of regular systems follow this section with the ancient Roman centuriation system, the US Public Land Survey System (including its problems) and the Canadian Dominion Land Survey. Lastly, the authors efficiently deal with various types of legal and technical documents: surveyed land records, subdivision plats, the cadaster, cadastral maps, engineering plans, and land information systems.

The sixth chapter, new to this edition, is on map design basics, and begins with an introduction warning readers against the use of tools that enable quick and cheap map production, but which do not "automatically result in well-designed maps that communicate your message clearly and accurately" (121). The chapter divides its discussions into three sections: Cartographic Abstraction, Map Design Considerations, and Web Map Design. Cartographic abstraction is broken down into the elements of cartographic selection, vector and raster generalization, classification, and symbolization. In the first element of the first section, the authors promote personal responsibility on both sides of the cartographic transaction: "Although it is the responsibility of the mapmaker to choose the themes and features wisely, it is the map reader's responsibility to understand that only a limited selection of all possible features is shown on the map" (123). The map design considerations section is separated into 12 components with appropriate discussions. The third section, on web map design, outlines the ways web maps are special and provides four basic design considerations (size and resolution, geographic extent and scale, projection, and symbols and text) of concern for maps used on desktop and laptop computers versus tablets and smartphones.

Nearly all of Chapter Six is well written, and would likely instill in students a desire to seek out and pursue a full map design course. However, minor complaints about several figures intrude. Figure 6.2, borrowed from *Thematic Cartography and Geographic Visualization* (Slocum et al. 2009), is unjustifiably fuzzy, with badly degraded text. The scale-dependent effects of generalization operations shown in Figure 6.3 practically disappear because the illustration has been reduced in size by some undisclosed, but apparently dramatic, amount (it was "resized to fit the page" [125]). The resizing renders the whole illustration nonsensical. Figure 6.7 is another that caught my eye: the figure caption and the text state that map is "centered correctly at 96 degrees" (128) and "positioned correctly with the central meridian" (129), respectively, but this is clearly untrue. The central, vertical, meridian is obviously the 90° line.

Chapter Seven considers qualitative thematic maps, with helpful presentations of the concepts of homogeneity, principles of symbolization, single-theme, and multivariate maps. The chapter finishes with introductions to mapping qualitative change on static and dynamic maps. Again, scan resolution is problematic in Figures 7.8 and 7.11, two maps from the *Atlas of Oregon* (Loy et al. 2001). The eighth chapter deals with quantitative thematic maps. Unfortunately, three more figures copied from the *Atlas of Oregon* (Figures 8.2, 8.4, and 8.46) display the same problems as the examples in Chapter Seven. Nonetheless, Chapter Eight quite adequately covers the differing types of quantitative data for points, lines, and areas, as well as the variety of classification schemes available, noting the advantages and disadvantages of each. The important distinctions between choropleth and dasymetric maps are covered, while cartograms, prism maps, and continuous surface maps are also presented in their various types and styles. Plenty of warnings are given, such the authors' note that "incorrectly made dot density maps can be confusing, if not downright misleading" (200). In addition, multivariate maps and multiple display maps are presented in their many forms, and several varieties of quantitative change maps are discussed.

Chapter Nine treats the topic of relief portrayal and presents a logical overview of the different absolute and relative relief mapping methods, oblique perspective maps, combined methods, and stereoscopic views. Examples of different relief shading views of Mount Saint Helens provide clear demonstrations of relief reversal and single versus multidirectional hillshading. I would suggest, however, that the image pairs in Figures 9.18 and 9.19 could have been combined in one three-image figure, because both use the same left-hand image and yet are placed side-by-side. Specific digital and dynamic portrayals of relief are handled with discussions of fly-throughs, interactive methodology, Shuttle Radar Topography Mission data, the National Elevation Dataset, Coastal Relief Model, and Lidar.

Image maps, or maps made from satellite imagery and aerial photography, are concisely considered in Chapter Ten. The authors provide appropriate coverage of black and white, color infrared, and high and low altitude photography, along with the potential geometric distortions to which photographs are subject. They also discuss orthophoto maps, and satellite image maps from various public and private sources. This chapter finishes with a discussion pointed at dynamic image maps, most particularly ArcGIS Earth. This seems unnecessarily limited, because, while many in the GIS community use this program, it is not nearly as widely used by the map reading public as Google Earth, or even Bing Maps (which at least gets a mention).

Chapter Eleven covers the critical issues of map accuracy and uncertainty on maps. The authors identify the differences between uncertainty, error, and bias, as well as between map precision and accuracy. The types of accuracy and the sources of error are also discussed. Because the sources of error are often difficult for the average map reader to detect, this chapter includes helpful sections on communicating accuracy and uncertainty through metadata, reliability diagrams, legend notes, symbols, and notations—the last of which are the means most likely noted and understood by map readers.

Part II deals with map analysis, the purpose of which "is to reduce what might appear to be a muddle of information on a map to some sort of order that you can understand and describe to other people" (294). Chapter Twelve covers distance finding, including the means of determining distances, whether by physical measurements on the map or by coordinate distance, along with the potential error factors of each. Also discussed is the concept of functional distance, including travel time maps and isochrones. Chapter Thirteen is concerned with direction finding and compasses, with the relations between true vs. grid vs. magnetic north, with magnetic declination, and with compass direction systems. This straight-forward chapter is completed with plenty of well illustrated guidance for direction finding and determination on large and small scale maps. The fourteenth chapter covers position finding and navigation with a map, and with how to estimate one's ground position and relative distances to other features. This chapter also includes a discussion of GPS use for wayfinding and navigation. There is an overview of GPS, describing how it works, its potential accuracy and errors, and how its outputs are expressed. Land, marine, and air navigation methods complete this chapter.

Chapter Fifteen, which deals with spatial feature analysis, covers areal determination with the use of grid cell counting while maintaining awareness of measurement accuracy. Coordinate methods are outlined, with the use of mechanical, electronic and polar planimeters discussed, along with the configuration of irregular surface areas. In addition, the authors explain the concepts of area, perimeter, and centroid. It is shown how volumes can be calculated using the discrete ordinate, grid cell, and random sample methods. Lastly, the computation of shape measure, area correspondence, and compactness values are described. Chapter Sixteen concerns surface analysis, touching on the means used to determine slope, gradient, aspect, illumination, curvature, profiles, and cross sections. The authors provide an important discussion of how much vertical exaggeration is appropriate for particular profile and cross section scenes. Visibility analysis, through the setting of viewpoints and viewsheds finishes off this chapter.

Chapter Seventeen presents spatial pattern analysis, starting with consideration given to the particular parameters captured by spatial pattern measures of point, line, and area feature counts. Most of this chapter, however, focuses on pattern analysis and on the mathematical tools involved, followed by a short introduction to using GIS for spatial pattern analysis. The eighteenth chapter covers spatial association analysis, including: an examination of the types of spatial association, how to judge association visually with bivariate maps and scatterplots, and how to measure it through a variety of formulas and statistics. The authors round off this chapter with a look at the movement and diffusion of point data.

Part III deals with map interpretation, and, despite being the shortest part of the book, it is as equally important as the others. The authors note that "interpretation is the most demanding of all map-use endeavors. It is also the most exciting" (478). Chapter Nineteen covers interpreting the lithosphere, or, more properly, geomorphic and geologic terrain analysis. The authors discuss and illustrate basic landform features and types, followed by a presentation on geologic maps and cross sections. The twentieth chapter, interpreting the atmosphere and biosphere, starts with basic weather maps, media weather maps, and weather satellite image maps. I would suggest that a future edition should include a link to **hint.fm/wind**, which provides a near real-time animated depiction of current wind flow. The next section of Chapter Nineteen covers climate maps, including average annual precipitation, monthly climate maps, climate types, heating degree-days, and solar radiation. The last section, covering the biosphere, deals with, and differentiates between, species distribution, range, and zone maps for species and vegetation.

Chapter Twenty-One, focused on interpreting the human landscape, provides an overview of human factors that influence the urban and rural landscapes in terms of settlements and land use/land cover, and then delves into the various means of viewing the sundry components of mapped demographics. The twenty-second, and last, chapter involves maps and reality, and opens with a caution against "putting too much faith in maps, of not realizing their limitations, and of forgetting to look beyond the symbols of the map to the real world beyond" (553). Numerous warnings like this, along with related statements largely drawn from works of fiction, make this a memorable essay. Recognition of the fact that maps have to lie, at minimum through cartographic generalization and abstraction, should remind the reader of the danger of treating maps as reality instead of as a cartographic interpretation of a selected portion of reality is a critical reminder for all. While this 12-page chapter is the shortest in the book, it is possibly the most important.

Two appendices, a glossary, and an index complete this book. The appendices include brief discussions of digital cartographic raster and vector databases from mainly US sources, some tables of measurement unit conversions (including length variations for a degree of latitude and longitude), coordinates for 50 US cities, and prime meridians used historically on some foreign maps (in DMS from Greenwich). The final 72 pages hold the glossary and index.

Overall, *Map Use* accomplishes is goals, despite my few quibbles. A review of the 6^{th} Edition by Julia Siemer (2011) criticized that book's loss of the section on cartographic communication theory that had been present in earlier editions. Her hope that it would reappear in a future edition remains unfulfilled. Siemer also criticized the lack of international content; a shortcoming that too has yet to be fully addressed. In closing, I would suggest that given that this edition of *Map Use* is also available as an e-book (for only $79.99: a $20 savings over the paper), it may seem likely that the digital version will be the primary form for future releases. That format will permit clickable links to high resolution maps, animations, and interactivity to provide a greater learning experience, and avoid the shortcomings I have pointed out in this review.

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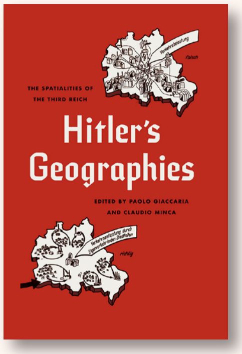
HITLER'S GEOGRAPHIES: THE SPATIALITIES OF THE THIRD REICH



Edited by Paolo Giaccaria and Claudio Minca

University of Chicago Press, 2016

378 pages, 15 maps, 2 plans, 3 charts, and other illustrations; $55.00. Hardcover, e-Book.

ISBN: 978-0-226-27442-3 (cloth);
978-0-226-27456-0 (e-Book)

Review by: Aimée C. Quinn, Central Washington University

From their earliest days, the ideological masters of the Third Reich viewed cartography and spatial politics as tools for conquest. Not since the Roman Empire has geopolitics seen such grand, imperial, unbridled ambition dominate the world order. *Hitler's Geographies*: *The Spatialities of the Third Reich* is a well planned, meticulously executed work that examines the Nazi mapping enterprise through a new level of interdisciplinary rigor. To this end, the editors, Paolo Giaccaria (Political & Economic Geography Professor at the University of Turin in Italy) and Claudio Minca (Cultural Geography Head Professor at Wageningen University in the Netherlands), have brought together the work of scholars from Canada, Germany, Italy, New Zealand, the Netherlands, Sweden, and the United States into a scant 378 well-written pages. These contributors provide a broad, academic examination of the way geopolitical and geo-economical concepts were employed as justification for Hitler's Nazi ideology of expansion and genocide.

The volume itself is well produced, like many monographs designed by the University of Chicago Press, with cream pages and black cloth boards. The dust jacket is bright red, with a pair of maps bearing the captions *Verkehrsbelastung* (traffic), and *Verkehrsbelastung durch Eigenverkehr in den Stadtteilen* (traffic within local city districts). There are few illustrations, all in black and white, and although no list of illustrations is included, the standard table of contents, index, and in-depth notes, plus three pages of contributor biographies (in very small type) are present.

The geographies of Nazism are presented as a patchwork quilt in the making. Germany was, at the time Hitler came to power, still a young country learning about its place in the broader world. This book focuses on the *zeitgeist* fostered and manipulated by this enigmatic leader who, it seemed to many at the time, managed to restore hope through an idealized sense of new purpose.

The body of the text is divided into an introduction section and two parts, each of which is further divided into two sections. The book holds, in all, seventeen chapters from various scholars. The first part of the book consolidates previously-published research from geographers and Holocaust studies experts who have considered what the editors term "streams of reflection" (4) related to Hitler's geographies and the spatial theories of Nazism. Entitled "Third Reich Geographies," this first section is composed of reprinted works in eight chapters. Citations for chapters previously published elsewhere are included in the Cataloging in Publication data.

The second part, "Geographies of the Third Reich," is composed of seven chapters theorizing that the geopolitical aim of the "Nazi Project" is to *intertwine Lebensraum (living space) with Weltanschauung* (worldview): essentially, that Germany must expand to allow Germans to be German.

Reading through this book, one encounters and explores the varied geographies used by the Third Reich to justify exterminating people. Each of these rationales—economic, social, cultural, linguistic, philosophical, scientific, historical, mathematical, rational, and even moral—is uncovered, examined, and dissected in this remarkable book. The contributors scrutinize Hitler's strategies and miscalculations bit by bit and thoroughly demonstrate the cold, brutal inhumanity of his unchecked, absolute power.

In the volume's introduction, "Spatial Cultural Histories of Hitlerism," the reader learns about the biopolitical (racialist/culturalist/nationalist) powers used by Hitler for spatial conquest and for exclusion. In particular, Chapter Two, "Holocaust Spaces," by Dan Stone, demonstrates the Nazi vision of the world as a sequence of spatial states wherein the Third Reich would spread their new world order:

> … killing Jews followed from the Nazi belief that Aryan prosperity required the elimination of the threat posed by the "international Jew" who therefore had to be removed in order that the Germans could have living space — "living space" understood now not as physical territory but as the possibility of cultural activity (in the sense that we commonly talk of "breathing space"). (47–48)

The concept of "place" goes beyond identity and nationality, requiring an ideology that ties in spatialities and the "spaces of exception" (27). This introduction sets the geographical, cultural, and historical structure for the rest of the book.

"Biopolitics, Geopolitics, and Lebensraum" is the first section in Part I, and offers four chapters examining how Germans viewed their place in the world. Progressing from the idea of colonialism to that of global conquest, these chapters explore the ideas of space and place as the scholars dissect, through the lens of modern-day spatiality, the socioeconomic rationales evoked in the rebuilding of Germany.

The second section of Part I is entitled "Spatial Planning and Geography in the Third Reich" and it focuses on the dynamics of politics and spatial order, beginning with an examination of Heidegger's writings related to calculation and machination. In this section, the intersection of spatial-geographical ideas of a central Germany and questions of National Socialist ideology are considered. For example, were these geopolitics based more on *Lebensraum*, or did the "central place theory" of geographers Walter Christaller and August Lösch more deeply influence the "Nazi Project"? Questions related to German identity and the myth of individuality are also examined in this section.

Section 3 kicks off Part 2 with the thought-provoking topic: "Spatialities of the Holocaust." The editors themselves wrote the opening section chapter, examining Nazi genocide through a biopolitical lens. In this powerfully crafted chapter they piece together the "Nazi Project" from its inception and growth to its ultimate failure:

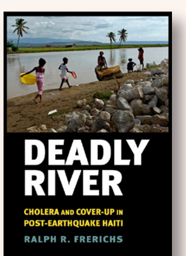
> What the ideologues of the Nazi Eden overlooked was that their envisaged radical separation between *selva* and *città* was pure (and poor) academic fiction. There is no Paradise on Earth; the human-in-us and animal-in-us are *always co-implicated*, with no "rest." (262–63)

The rest of this section examines the consequences of these Nazi spatialities, with issues ranging from the deliberate creation of new urban ghettos, through "spaces of engagement and geographies of obligation" (282), to how scholars of today connect with these places.

The final section, "Microgeographies of Memory, Witnessing, and Representation" has three chapters, all of which reflect on the future while looking back to the past. The authors ponder the deep significance and cultural geographies related to the silent cities left by the Third Reich. The questions examined and discussed are substantial. The last part of the book asks the readers to consider space and the bio-eco-politics of spatial theory. The closing chapter contemplates the ways monuments such as the rebuilt World Trade Center, the Vietnam Memorial, and the Holocaust Centers transcend their spaces to memorialize and commemorate in the aftermath of significant tragedies; effectively reconstructing a cultural geography of the past. "A relevant aspect of mobilities research relates to emotional embodiments of space and place… Likewise, place must be *felt* to make sense." (341)

This book is not for the casual, or the typical undergraduate, reader. For example, although there are recurrent references to the "Nazi Project" in several chapters, there is no explanation for the non-specialist of exactly what aspects of the National Socialist program are included in this "project." Instead, this book is written for those people who want or need to reach a deep understanding of how geopolitics was used as a weapon in an attempt to build a single, absolute, global power. If you fall into that category of reader, then, as mentioned earlier, *Hitler's Geographies: The Spatialities of the Third Reich* is a well-planned, meticulously executed work that should be considered required reading.

DEADLY RIVER: CHOLERA AND COVER-UP IN POST-EARTHQUAKE HAITI



By Ralph R. Frerichs

Cornell University Press, 2016

301 pages, 9 black and white maps, various illustrations; $29.95, hardcover.

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Review by: Tom Koch, University of British Columbia

Ralph Frerichs's *Deadly River* is, in no small part, an object lesson on the manner in which maps make sense of chaos in the midst of complex world events. A retired professor of epidemiology and public health, Frerichs's focus, and indeed his passion, lies with the microbial world and its periodic attacks on humankind.

Deadly River is the story of the worst cholera epidemic in recent history. It began in 2010 near Mirebalais in Haiti's interior, soon after the island was devastated by a magnitude 7.0 earthquake. That earthquake killed an estimated 300,000 people and left an estimated 3 million citizens, most of them desperately poor, without clean water, decent shelter, or food. By 2016, the epidemic had killed at least 10,000 Haitians and sickened an estimated 800,000 more who eventually recovered.

Frerichs's book is, at its simplest level, the story of how epidemiologists and public health officials struggled to understand and then combat the killer epidemic. It is secondarily a tale of obfuscation and a possible cover-up attempt by United Nations and World Health Organization officials who did not want to admit that the source of the epidemic might be United Nations Nepalese peacekeepers on mission in the island state.

This is also a heroic tale whose focus is the work of a French epidemiologist, Dr. Renaud Piarroux, who was invited by the Haitian government to investigate the epidemic soon after it began. In the telling Frerichs goes from being an interested and informed observer following the epidemic's course to a partisan supporter of, and eventually coauthor with, Piarroux.

MAPS

The story of Piarroux's investigation, and of the debate over the origins of this outbreak, is a story best told in maps. "On the day after cholera was officially reported in the country," Frerichs writes, "the first of many disease maps was published in an Emergency Operations Center (EOC) report by the Haitian Ministry of Public Health and Population, in collaboration with PAHO [Pan American Health Organization]" (68). From the start, and as updates became available, Piarroux made screen shots of those maps, mostly at the departmental (district) level, and carried them with him during his field work.

With that, Frerichs introduces maps as the invaluable assistants with which questions about the origin and spread of a disease are to be addressed. "Maps are closely entwined with epidemiology. They allow disease detectives to view illness or death patterns in space and time, showing gradual—or sometimes explosive—spread through a community, country, or even the world" (67). The entire book can be read as an argument for the map as an investigative tool that best explains complex outcomes in terms of their constituent parts. Again and again, the author refers to this or that map at one or another point in the story as not merely illustrative, or even persuasive, but as critical where not absolutely conclusive. At the least, maps were not only invaluable in the field but also as a way for Piarroux to present his findings to Haitian and international officials.

"It was with cholera maps," writes Frerichs, "that Piarroux was most persuasive. He had developed maps showing cholera mortality for each of Haiti's 140 communes. He first had used these maps in a presentation to President Préval and Health Minister Larson. He then used them at *Unité de Crise* meetings with representatives from WHO (World Health Organization), UNICEF, and the NGOs (non-governmental organizations) and to brief the Cuban Ambassador at [Haitian President] Préval's request and members of the *Brigada Médica Cubana*" (109). In this official, tri-lingual mélange of English, Spanish, and French, maps were a lingua franca amongst the parties engaged in combating and investigating the outbreak.

While medical cartographers and geographers will find *Deadly River* a useful introduction to the complexities of epidemic fieldwork, the general reader may feel that the story needs some narrative tension, and perhaps a villain. In this book it is the debate over the source of the epidemic, and responsibility for it, that provides the drama. The main villains are those who advanced origin theories that differed from Piarroux's.

"Most hypotheses put forward for how *Vibrio cholerae* had arrived in the country were in one of two categories: environmental or human activity—long points of contention among the world's cholera investigators" (58). Environmentalists argued the disease might have been dormant for years in Haitian waters and its estuarine zones until somehow activated by the earthquake that preceded it. Others suggested that perhaps an ocean vessel bringing relief supplies (or simply transporting goods) had dumped contaminated bilge water off the Haitian shore and thus introduced cholera to local waters.

To Piarroux, however, the origin was obviously a massive discharge of contaminated human waste into the Artibonite River from the Nepalese peacekeeper barracks just up-river from the first cholera cases. The course of the disease, and its origins, could be read in the maps of the epidemic's progress.

In a real way, the Haitian epidemic thus replayed nineteenth century debates over the nature of the disease. Environmentalists of that time assumed cholera was a "natural," presumably airborne, disease. To prevent it would be, as one said, like stopping the wind. British physician John Snow, among others, insisted its origin and diffusion were anthropogenic. To make that case Snow famously mapped a cholera outbreak in his London neighborhood of Soho, and then, more ambitiously, a concurrent epidemic across South London. The story of his mapped arguments became the stuff of legend, a kind of origin myth for medical geographers and the methodology of modern public health (Koch 2016).

Frerichs is an ardent admirer of John Snow and has long maintained a website dedicated to his work (Frerichs 2017). Here was another cholera epidemic in which mapping seemed to provide crucial evidence permitting one theory of disease incidence to triumph over another. In both cases, one from the nineteenth century and the other from the twenty-first, maps were crucial evidentiary tools.

Reference to Snow is, in part, a way to introduce basic epidemiological methodologies and ideas, but the parallels are easily overstated. In the mid-nineteenth century the nature of cholera was unclear (was it airborne or waterborne?) and the methods of its investigation were evolving (Koch 2000). These methods weren't at issue in 2010. Then, too, while Snow did not succeed in convincing his contemporaries that the source of both local outbreaks and broader epidemics were local water sources, Piarroux successfully argued, on the basis of modern scientific techniques as well as cartographic evidence, his explanation about the origin of this epidemic.

Figure 1 is a map provided by Frerichs from a paper he coauthored in 2012 with Piarroux. It shows the progress of the disease from the Nepalese encampment near Mirebalais down the river. This map sequence is the end point of the study. It incorporates data from earlier fieldwork in which cholera incidence was mapped, district by district and town by town.

What Piarroux proved beyond any reasonable doubt was that the origin of the outbreak was proximate to the Nepalese peacekeeper's camp on the Artibonite River near Mirebalais. There was evidence—anecdotal but compelling—that sewage from the camp was spilled into the river, perhaps by a negligent local contractor, creating a toxic plume that infected downriver villages as it traveled to the sea. The disease could not have originated in coastal waters, traveling inland from there, because the rivers flow *into* the ocean, not away from it; even were the disease dormant in Haitian estuaries, it progressed downstream, *away from* the neighborhood of Mirebalais, rather than against the current, *towards* it.

A definitive element of the argument was the serology that eventually categorized the active bacterium as a specific Nepalese strain. The environmentalists were correct that varieties of cholera bacterium (and there are many: it's a family, not a single entity) may live in local waters for years. Most don't cause illness, however, and genetic analysis proved this specific and virulent cholera variant was indisputably Nepalese. The progress of the disease could *only* be explained by a massive discharge of waste from the Nepalese camp that progressed in a plume down the Artibonite River.

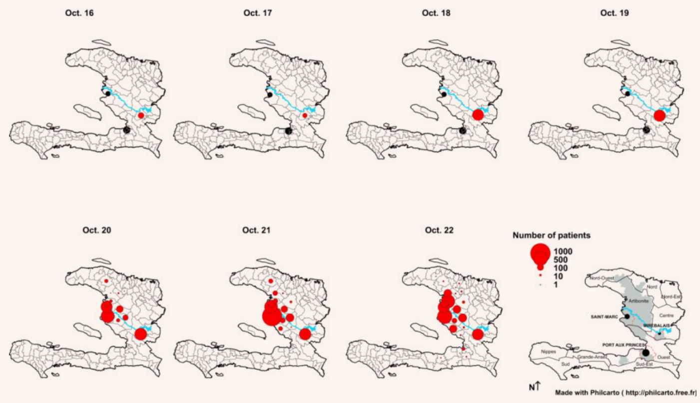

Figure 1. This map, from a paper by Frerichs and Piarroux (Frerichs et al. 2012), describes the spread of cholera along the Artibonite River, marked here in blue, from the Nepalese encampment near Mirebalais (used with author's permission).

From the start, UN and WHO officials insisted this couldn't be true. Nepalese soldiers weren't sick. They insisted camp sewage was properly disposed of and local sewage facilities were adequate. Local informants, however, suggested a waste truck may have emptied sewage tanks and simply dumped the waste in the river. What was clear from Piarroux's work was this: the camp was near the river; the progress of the epidemic was down river; villages along the river used its water for cooking, bathing, and washing; there were sewage leaks; and no other likely source of this epidemic could be proven. Only the plume from a massive spill into the river from the Nepalese peacekeepers' site would explain the cholera that killed so many Haitians in the months following the earthquake.

The results were widely consequential. Knowing the source of an outbreak permits health officials to predict its course and prepare for the care of those who will be infected. Knowing who is sick, and where, is a critical element of all disaster relief plans. As a National Research Council publication on disaster preparedness put it: *Successful Response Starts with a Map* (Committee on Planning for Catastrophe 2007). And, too, knowing the origin of an epidemic may both help limit its progress and prevent recurrences.

The cholera introduced in 2010 remains an ongoing health problem today. It took years for the United Nations to admit even qualified responsibility for the Haitian cholera epidemic. Having done so, officials have refused calls for compensation for the epidemic's victims. But then, as we learned during the West African Ebola epidemic in 2014, WHO—the United Nations' health agency—has been continually strapped for funds and its resources repeatedly pruned through years of budget cuts.

Here the problem was complicated by the fact that the source of the epidemic was a group of UN peacekeepers, dispatched to the island for humanitarian service after the earthquake. Investigation of their apparent culpability revealed, over time, broader problems with UN peacekeeping sites. In 2016, United Nations auditors reported that "poor sanitation practices remained unaddressed not only in its Haitian mission but also in at least six others in Africa and the Middle East" (Gladstone 2016). Haiti became an example of what happens when the best of peacekeeper intentions are undermined by basic infrastructure failures. As Frerichs implies in his writing on Snow and cholera, then and now, the Haitian epidemic echoes the nineteenth century understanding of sanitation infrastructure as a crucial barrier to disease transmission.

COMPLAINTS

Frerichs's authorial style is academic, and while that suits a part of his story, it doesn't quite contain the political and social messages he seeks to convey. As a result, there is a tension in the writing between the nuts-and-bolts story of the investigation and his outrage at the obfuscation of the environmentalists and of the United Nations officials who did not want to admit responsibility.

It is unfortunate that the text refers to, but does not include, most of the plethora of maps that were distributed by WHO, PAHO, and the US Centers for Disease Control and Prevention during the epidemic. Nor do we see those created by Piarroux and presented in his discussions with Haitian and other international agency officials involved in combating this outbreak. Worse, the few maps that are included are of uniformly low quality and in some cases barely legible. It should be noted that the illustration accompanying this review is *not* from *Deadly River*, but from a different paper by Frerichs and Piarroux.

While the quality of the maps in this book is lamentable, the author has, "independent of the publisher" (xi), provided web-based resources where some of the maps and other images central to the book's theme can be found: **www.deadlyriver.com**, and, more specifically, **www.deadlyriver.com/mmaps.html** (*note the double m*). The first is a general website for the book, and the second is a collection of bi-annual maps of UN camps in Haiti, 2004–present, with UN Security Council reports of Haitian activity.

Frerichs's repeated references to John Snow and the history of mid-nineteenth century cholera debates does resonate at some level here, but, again, it is easily overstated. There were, as I have argued elsewhere (Koch and Denike 2009), good reasons for Snow's contemporaries to question his findings, but there is no doubt, in this reading, that in Haiti environmental explanations did not serve and that Piarroux was correct. That said, the story of how critics, then and now, disputed the evidence of field epidemiologists and their evidentiary maps joins the nineteenth- and twenty-first-century stories.

Frerichs's narrative could have been effectively broadened with the introduction of some more general contextual material. The British geographer Peter Haggett has produced many books—for example, *The Geographical Structure of Epidemics* (Haggett 2000)—that would have served as useful models. Haggett is a master of making the technical seem simple and demonstrating the means by which maps and statistics together can uncover an epidemic's secrets.

This is not a great book. It is, however, a very useful one. The story it tells is important, and in the epidemiological unfolding of a disease study Frerichs is an old hand, a professional. Too, *Deadly River* is a reminder that even "scientific" work occurs within contexts that are at once political and social; to ignore that is to miss the greater story. And, of course, here is a book in which maps are a tool of choice successfully deployed by heroic researchers. For cartographers, the book sets modern disease events in a spatial frame they will appreciate, and, too, it might encourage some to develop the necessary expertise to apply their mapping to disease studies.

In an era of rapidly evolving infectious diseases, that end would serve us all.

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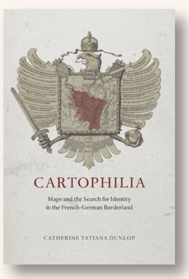
CARTOPHILIA: MAPS AND THE SEARCH FOR IDENTITY IN THE FRENCH-GERMAN BORDERLAND



By Catherine Tatiana Dunlop

The University of Chicago Press, 2015

257 pages, 16 color plates, 71 halftones (primarily maps), $45.00, hardcover.

ISBN: 978-0-226-17302-3

Review by: Leslie Wagner

Cartophilia: Maps and the Search for Identity in the French-German Borderland, focuses on the representation of the Alsace-Loraine region on European maps in the eighteenth and early nineteenth centuries. The author also provides an introduction which offers a general overview of the cartographic aspects she discusses, and an epilogue addressing changes that have been seen—and can be anticipated—since the period covered in the book.

Part I, "Mapping Borders," consists of three chapters. The first, "States Map Their Borders," examines cartography from a national viewpoint. The second chapter, "What Makes a Good Border?" provides an interesting discussion of natural and imposed boundaries. The third, "Language Maps," demonstrates the use of regional language and/or local dialect to distinguish the appropriate placement of national boundaries, along with the reactions and consequences at national levels.

Part II of *Cartophilia* represents the bulk of the book, and is devoted to close examination of the varied cartography of the Alsace-Loraine region and of its central city, Strasbourg. It particularly examines the development of regional identity in Alsace-Loraine as it progressed from a landscape of insular villages into a unified region centered on the cathedral city of Strasbourg. Dunlop thoroughly discusses the ebb and flow of French and German influence as they alternately exerted control over the region. The late nineteenth century also saw the rise of the bourgeois class, which brought changes in personal and social activities; in particular, the development of tourism. This resulted in the incorporation of regional landmarks and memorials into maps and other visual materials, and also spurred the growth of private organizations devoted to supporting touristic pursuits, further encouraging the blending of cultures. In Chapter 4, "Finding the Center," the author explores regional identity and the concept of a regional homeland (as distinct from a national identity), and how it affects communal perspectives on regional development. These concepts are closely tied with the difficulties that late nineteenth-century Germany had in projecting its own conception of *Heimat,* or homeland, into the Alsace-Loraine region. The introduction of geography into the region's German educational curriculum was seen as one remedy. It was thought that the concept of *Heimatort,* or hometown, would allow students to identify with their own unique village or town while at the same time conveying the idea of being a part of both a unified region and a greater, national whole.

In Chapter 5, "Maps for Movement," Dunlop brings us to the Vosges Mountains and to their role in the push and pull between French and German culture and nationalism. More than just a physical feature in the landscape, or a potential national boundary (as it was between 1871 and 1918), the Vosges were frequented by both locals and visitors from afar. These ramblers were encouraged by materials produced both by "citizen mapmakers" and organizations that produced maps of walking or hiking trails that often featured tranquil, scenic views.

It occurs to me that this well-established practice of hiking through the region—with its clubs, formal routes, and organized walks in the Vosges Mountains—was quite possibly a precursor to the modern-day *Volksmarch* organization. These days, Volksmarch participants receive a medal for completion of their chosen distance, and I highly prize the *Schloss Neuschwanstein* medal from the Volksmarch event in which I participated during the late 1970s.

The bucolic atmosphere takes a turn, however, with the advent of World War I. In that conflict, the Vosges Mountains saw almost constant fighting and many destructive battles. After the war, however, both the French and German citizenry of the region banded together to repair the landscape, memorialize the battlegrounds, and provide special access to the battlefields—which were already being visited by thousands of people. Dunlop refers to the area as a "martyred landscape."

Chapter 6, "Visualizing Strasbourg," introduces us to Strasbourg—the regional capital of Alsace-Lorraine—and to its central role in the territorial dispute between France and Germany. Strasbourg was built at the confluence of several ancient Roman roads where they crossed the Rhine River, another major regional thoroughfare. Dunlop particularly notes the role of the Cathedral of Strasbourg, which provides impressive views of not only the city but of the entire region and beyond. Strasbourg Cathedral was deemed the tallest building in the world from 1647–1874, and has an observation deck upon which visitors can stand and peer around with awe: east to the Black Forest deep in Germany, south as far as Switzerland, and westward toward France and the Vosges Mountains.

The Rhine River and the city of Strasbourg served as a bulwark that the French frequently defended, and the city, which suffered frequently in battle, was depicted on maps as a fortress. Nonetheless, there were times when French and German governing bodies worked together, as when Napoleon III and leadership from the German state of Baden completed a bridge over the Rhine River for expanding railway lines.

The "trend toward fluid borders," as Dunlop phrases it, came to a halt from 1871 until 1918, when Strasbourg was handed over to exclusive German rule as a result of the 1870 Franco-Prussian War. During the war, the Germans had ruthlessly shelled civilian targets throughout Strasbourg, but once the city surrendered, the German army itself, as well as an influx of German civilians, brought on a program of rebuilding and expansion. This did not, however, unite the indigenous Alsatians with the invading Germans, who not only occupied the area as conquerors, but made their homes in Strasbourg, changing the city's appearance with new construction that was definitively German. It was only after 1910 that Alsatians were again able to have a say in the construction of new buildings, and to slowly put a halt to the German stamp that was pressed on the city over the four preceding decades. The concept of a regional Heimat was once again brought into play, albeit briefly, to return Strasbourg to its former uniqueness.

Once again, however, violent conflict put a stop to progress with the start of World War I. Afterwards, the region having returned once more to French control, the people of Alsace-Loraine were able to again work together toward their future: concentrating on port development along the Rhine River and establishing a permanent French foothold in the region. Although World War II again brought destruction to Strasbourg, I recall passing through Strasbourg in the early 1960s, by which time the ravages of World War II had been repaired. The city was once again bustling with industry and had regained its position as a major port on the Rhine.

In the book's epilogue, Dunlop provides an interesting perspective on a cartographic exhibition in Paris, *La France en relief,* which ran from January 18–February 17, 2012. She also briefly discusses the radical changes Europe has witnessed since the era she explores in *Cartophilia,* and how these developments might affect regional evolution and the European map.

Well written, thoughtful, thorough, and detailed, Dunlop's work introduces the reader to broad, inter-related concepts of regional and national identity before narrowing its focus to their development as seen in the region of Alsace-Loraine as it existed under both French and German rule. Dunlop applies French, German, and Alsatian cartographic perspectives to her observations on the creation and re-creation of boundaries and map content for the region. Her discussion of the development of educational geography under German rule was of particular interest.

Dunlop delves into the complex relationship between conflict and culture, and provides evidence of how their interweaving affected the area. The changes caused by the influence of French and German rule over Alsace-Loraine is reflected in the maps and materials produced over time, and can be seen in the way these maps and their contents evolved with changes in national dominance.

She discusses the wedge that violent conflict places between nations, and between individuals within a region, as well as the part played by a legacy of conflict in reuniting a region. This two-fold role is, in many ways, a surprising concept: we are familiar with the gaping wounds between oppositional forces that are brought about by war, but we do not usually consider the healing of those wounds and the reunification of enemies as fellow citizens once again. At some point a region must declare that enough is enough: that its people must rise above their differences and strive to work together to rebuild their lives and futures. In her epilogue, the author reminds us of the enormous changes that have occurred, not only just after World War II, but even during the 1970s and 1980s. Will new developments in mapmaking influence trends toward regional thinking? Will these, in turn, overtake national concepts?

I, myself, lived in the northern portion of the Alsace-Lorraine region as a young child, and later made a brief return visit along the French-German border in the 1970s while living in Germany as a military spouse. Stopping in the first small town to the west of the Rhine, we made a choice of restaurant in which to dine. My rusty high-school French, however, was not enough to bring a welcome from the staff. In the end, a woman who spoke both German and French was brought from the kitchen and through her we managed to communicate our order. *Cartophilia* gave me a new outlook on that interesting cultural encounter; I had not, in truth, expected to find a bilingual speaker in France, given the attitudes the French seemed to have toward most outsiders. Only thirty years removed from World War II, I anticipated animosity on the part of the French towards Germans, and finding a local who spoke German as her first language was a particular surprise. I now realize it was only because we were in Alsace-Loraine, where French and German citizens have mingled for decades and continue to do so, forming the truly distinctive culture found in Alsace-Loraine.

Not only did *Cartophilia* bring a new understanding to my own brief experience in Alsace-Loraine, I found Dunlop's research extensive and deep, providing the reader with fine examples of maps and regional brochures placed in their cultural context. The concepts are well-explained, well-supported, and thought-provoking. *Cartophilia* is a particularly enjoyable read for anyone with an affinity for nineteenth- and twentieth-century France and Germany.

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