# Mapping Indigenous Lands

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## Key Words

Indigenous mapping, indigenous peoples, participatory GIS, mapping methodologies, cartography

## Abstract

The mapping of indigenous lands to secure tenure, manage natural resources, and strengthen cultures is a recent phenomenon, having begun in Canada and Alaska in the 1960s and in other regions during the last decade and a half. A variety of methodologies have made their appearance, ranging from highly participatory approaches involving village sketch maps to more technical efforts with geographic information systems (GIS) and remote sensing. In general, indigenous mapping has shown itself to be a powerful tool and it has spread rapidly throughout the world. The distribution of mapping projects is uneven, as opportunities are scarce in many parts of the world. This review covers the genesis and evolution of indigenous mapping, the different methodologies and their objectives, the development of indigenous atlases and guidebooks for mapping indigenous lands, and the often uneasy mix of participatory community approaches with technology. This last topic is at the center of considerable discussion as spatial technologies are becoming more available and are increasingly used in rural areas. The growth of GIS laboratories among tribes in the United States and Canada, who frequently have both financial and technical support, is in sharp contrast to groups in the South—primarily Africa, Asia, and Latin America—where resources are in short supply and permanent GIS facilities are rare.

## Contents



## INTRODUCTION

GIS: geographic information systems

This review addresses mapping done by and for indigenous peoples to achieve political goals. The main purpose of mapping of this sort has been, and will continue to be, to assist indigenous peoples to claim and defend ancestral lands and resources. Yet other purposes are invariably included and play important secondary roles. These include strengthening indigenous political organization, economic planning and natural resource management, and the documentation of history and culture to salvage and reinforce cultural identity for use in schools and throughout the broader public.

Mapping that fits this description has only made its appearance in Canada and the United States over the past 30 or 40 years, and in most other parts of the world the timeframe has been much shorter, not more than a decade and a half. In a very real sense, indigenous mapping represents a shift in the way cartography is both undertaken and used. Whereas those in power have employed maps over the centuries to mark off and control territories inhabited by indigenous peoples, indigenous peoples are now putting together their own maps and wielding them to defend their ancestral lands from encroachment by those in power.

Literature on the subject is uneven and spotty. Canada and Alaska, taken as a whole, share the most complete body of work; since the 1970s, there has been a steady flow of multi-volume studies, atlases, guidebooks, and historical-analytical pieces. Although not all of this work is open to the public—Usher et al. (1992, p. 130) note that "some of the research has been published, but much more remains inaccessible" (see also Weinstein 1998)—the available work is considerable, enough to provide a relatively comprehensive understanding of the issues, context, and methodologies at play in that part of the world. Other regions—primarily the tropical areas of Latin America, Africa, and Asia, but also the United States—have less even coverage. Many of those doing the mapping have either no incentive (or time) to write about their work, or they are reluctant to broadcast their activities because of the political, legal, economic, and cultural sensitivities involved. Reluctance to publish maps and accompanying data in the more politically volatile Third World countries, where the rule of law is often weak or nonexistent, is even more pronounced.

Consequently, although this review is based on published literature, we have filled in some of the larger context with informal discussions with practitioners over the years, reviews of conferences, summaries of mapping projects (many of which contain information on undocumented projects or difficult to find documentation), and the increasing flow of information on the Internet. It should be noted that much of the writing available has been produced by nonindigenous people, with academics and, most recently, GIS specialists in the lead; therefore, the indigenous view is often incompletely represented. There is a small number of summaries of indigenous mapping projects, such as *Indigenous Peoples, Mapping & Biodiversity*

*Conservation: An Analysis of Current Activities and Opportunities for Applying Geomatics Technologies* (Poole 1995) and more specifically for Canada and Alaska in *Subsistence Mapping: An Evaluation and Methodological Guideline* (Ellanna et al. 1985; see also Flavelle 1993b, Weinstein 1993); but these are isolated and few in number, and they need to be updated. McCall and Rambaldi have recently posted useful bibliographies of works on participatory geographic information systems (GIS) and other mapping that are being periodically updated (McCall 2004; Rambaldi 2004); although not all of the entries on these lists involve indigenous peoples, many are relevant for work with them. The Internet offers a rapidly expanding selection of sites with information on mapping with indigenous and traditional peoples, such as the Open Forum on Participatory Information Systems and Technologies (**http://ppgis.iapad.org**), the Philippine Association for Intercultural Development (PAFID) (**http://www.pafid.org**), and the Aboriginal Mapping Network in Vancouver, British Columbia (**http://www.nativemaps.org**), to name a few.

In this review, we discuss the growth and dissemination of indigenous mapping methodologies in various corners of the world; the different types of indigenous mapping and their objectives; the difficult and often strained relationship that exists between community participation and technology; the influence of GIS technology on indigenous peoples; and the practical matter of finding and choosing the appropriate methodology for mapping one's lands. But before we begin, a bias must be mentioned. Most of our experience with mapping has been in Latin America and parts of Southeast Asia, and we have had some exposure to work in Canada and Alaska. By contrast, we have little or no direct experience in Africa and South and Central Asia. Although we have made an effort to seek out sources from these regions, the reader will note our geographical bias.

Much of the mapping we discuss has been either carried out or facilitated by geographers, not anthropologists—a point perhaps worthy of note because this review is appearing in the *Annual Review of Anthropology*. Maps have never been much used by anthropologists, except as a visual accompaniment to ethnography. Over the years, anthropologists came to use maps primarily to locate groups geographically, show spatial relationships of social organization, and document subsistence patterns. Boas was one of the first to use sketch maps in his work on Baffin Island, Canada, in 1883–1884 (Boas 1964; see also Boas 1934), and during his long teaching career he promoted mapping as an important tool for fieldwork. His student Kroeber developed the culture-area concept and mapped indigenous groups according to their habitats (1939), and Steward followed with mapping that related human populations more specifically to ecological niches (1955). One of the most detailed examples of mapping by an anthropologist was done by Conklin among the Ifugao in the Philippines (Conklin et al. 1980); but again, this was done for ethnographic, not utilitarian, purposes. It is only recently that a handful of anthropologists have become involved with indigenous mapping for political purposes (Eghenter 2000; Chapin & Threlkeld 2001; Gordon et al. 2003; Smith et al. 2003; Stocks 2003); but their models have come more from geography and the participatory rural appraisal (PRA) and participatory action research (PAR) approaches of Chambers and his colleagues (Chambers 1994a–c, 1997) than from anthropology.

Since the 1960s and 1970s in Canada and Alaska, where the first indigenous mapping began, geographers have been the primary movers in advancing the causes of indigenous peoples with maps. (It should be noted that anthropologists played a major role in Canada's now defunct Traditional Land Use Study Program and Alaska's Division of Subsistence, but they were not the ones doing the mapping.) It was not always this way. Cartography has been, over the centuries, a tool used by the powerful to carve out empires and maintain control over them. "As much as guns and

**PAFID:** Philippine Association for Intercultural Development

**PRA:** participatory rural appraisal

**PAR:** participatory action research

**TLUOS:** traditional land use and occupancy studies

**TLUOM:** traditional land use and occupancy mapping

warships," observes Harley in one of his more frequently quoted statements, "maps have been the weapons of imperialism" (Harley 1988, p. 282). Nations and empires are not natural features of the landscape; they are human constructs that have been imposed over the centuries to convert large tracts of the world's surface into real estate. Cartography has rightly been dubbed "the science of princes," used by governments and elites to stake claim to valuable land and resources, a science of which the indigenous peoples have been the most common victims.

Yet in the second half of the twentieth century a generalized indigenous movement appeared and gained strength, and the cry for land rights, together with control over natural resources, grew louder. Changes in policies and the growth of the rule of law, still imperfect but improving in many regions, have allowed indigenous peoples to create their own maps and use them to defend their lands. Cartography is no longer the sole province of princes—although Peluso (1995, p. 387) correctly notes that in the real world, mapping is "unlikely to become a 'science of the masses' simply because of the level of investment required by the kind of mapping with the potential to challenge the authority of other maps."

## METHODOLOGIES AND TERMINOLOGIES

The first matter is that of terminology. Although throughout this review we use the term indigenous mapping to cover the wider field, over the short span of a few years a number of different methodologies for mapping done by and for indigenous peoples have been developed, along with a wide array of descriptive labels. Many of these labels are little more than alternative terms for the same or similar methodologies, yet there are also some real differences in context and approach, split into three rough geographical regions. The first of these is located in Canada and Alaska, which have jointly developed one set of methodologies and terms that can be seen as a relatively coherent body of work. The second encompasses much of the rest of the world, made up largely of the Third World, where a more diffuse set of methodologies has evolved, along with numerous terms to describe them. The third takes in the tribes of the lower 48 United States, which have been strongly influenced by advanced geospatial technologies since the early 1990s; they have not produced a distinctive set of terms that sets them apart from the mapping work of nonindigenous people. The character of the methodologies of these three areas is a result of different legal structures, land use traditions, and political and economic realities.

In Canada and Alaska, indigenous mapping has been done almost entirely with hunting/gathering/fishing/trapping groups and has frequently figured as one of the elements in larger, more comprehensive studies of native subsistence. The broader studies have variously been called traditional land use studies (Honda-McNeil & Parsons 2003), traditional knowledge and land use studies (Garvin et al. 2001, Honda-McNeil & Parsons 2003), traditional land use and occupancy studies (TLUOS) (Robinson et al. 1994), "land use and occupancy studies" (Tobias 2000), traditional use studies (Weinstein 1998, Honda-McNeil & Parsons 2003), and "aboriginal land use and occupancy studies" (Weinstein 1998). The mapping component has generally taken its name from the larger studies; thus TLUOS have contained TLUOM and so forth. Other terms commonly used are "subsistence mapping" (Ellanna et al. 1985), "subsistence use area mapping" (Schroeder et al. 1987), and "resource use mapping" (Stratton & Georgette 1985).

In other regions of the world—primarily Asia, Africa, and Latin America—where mapping has dealt with mixed hunting/fishing and agricultural societies and issues different from and far more varied than those of Canada and Alaska, an even greater number of terms has been employed. Terms used within this general arena are "participatory mapping"

(Chambers 1997, Brown & Hutchinson 2000), "participatory land use mapping," "participatory resource mapping" (Mbile et al. 2003), "community mapping" (Bennagen & Royo 2000, Eghenter 2000, Fox 2002), "community-based mapping" (Flavelle 2002), "ethnocartography" (Chapin & Threlkeld 2001, González et al. 1995), "counter-mapping" (Peluso 1995, Kosek 1998, Hodgson & Schroeder 2002), "self-demarcation" (Arvelo-Jiménez & Conn 1995), a term used in Venezuela, and "ancestral domain delimitation" (Prill-Brett 1997, Bennagen & Royo 2000), which is used in the Philippines.

The more technically oriented participatory mapping work began filling the field in the mid- and late 1990s, when computerized mapping technology became more widely available. Hybrid models have appeared in which PRA and PAR were combined with GIS, global positioning systems (GPS), and remote sensing. These various combinations gave birth to "participatory GIS" (Abbot et al. 1998), public participation GIS (PPGIS) (a term that was taken from the planning profession and has applications much broader than with indigenous peoples) (Obermeyer 1998, Jordan 2002, Weiner et al. 2002), community-integrated GIS (a variant of PPGIS) (Harris & Weiner 2002), and mobile interactive GIS (McConchie & McKinnon 2002). The term most commonly used is participatory GIS, and as a field it has been growing exponentially.

Other variations of indigenous mapping involve participatory 3-D modeling (Vandergeest 1996, Rubiano et al. 1997, Rambaldi & Callosa-Tarr 2000, Flavelle 2002, Hoare et al. 2002, De Vera et al. 2003, Rhoades & Moates 2003) and "participatory photomapping" (aerial photographs placed within a coordinate system) (Mather et al. 1998, Müller & Wode 2002).

The lower 48 states in the United States have not produced terms or methodologies with a distinct character. Early on, they were strongly influenced by the Bureau of Indian Affairs (BIA), the Earth Sciences Research Institute (ESRI), the National Aeronautics and Space Administration (NASA), and the U.S. Geological Survey (USGS), all of which assisted with GIS technology, essentially skipping the more participatory methodologies that developed in the other two regions.

**GPS:** global positioning systems

**PPGIS:** public participation GIS

**BIA:** Bureau of Indian Affairs

**ESRI:** Earth Sciences Research Institute

**NASA:** National Aeronautics and Space Administration

**USGS:** U.S. Geological Survey

## ORIGINS AND EVOLUTION OF INDIGENOUS MAPPING

### Canada and Alaska

The first indigenous mapping projects appeared in Canada and Alaska in the 1950s and 1960s and became a standard approach to First Nations' land claims during the 1970s (Ellanna et al. 1985, Usher et al. 1992, Flavelle 1993b, Berkes et al. 1995, Weinstein 1993). As noted above, they were components of larger studies documenting land use and occupancy for the purpose of negotiating aboriginal rights. They were designed to counter prejudices that were gaining strength during the latter part of the nineteenth century, when white colonists, with backing from the Canadian government, began moving with ever increasing frequency into territory occupied by the native population. During this period, the White majority held the belief that because the native population did not practice agriculture, they were not "using" the land (Dickason 1992, Usher et al. 1992, Berkes & Fast 1996).

The aboriginal peoples of Canada made little progress until the late 1960s. It was then that they began to react strongly against persistent attempts by the government to assimilate them into the general Canadian population and impose a number of megaprojects on their lands, such as the James Bay Hydroelectric Project in Quebec (Weinstein 1976) and the Mackenzie Valley Gas Pipeline Proposal in the Northwest Territories (Usher 1993). Negotiation and struggle brought about more favorable policies, but advancement has been difficult. "Gains have been made, but usually in the face of stiff resistance and considerable social and economic cost" (Usher et al. 1992, p. 129). During the 1970s, the Canadian government began opening up and "land

use and occupancy studies were designed to provide information for negotiation under the new policy, which accepted the legitimacy of unextinguished aboriginal rights to land" (Weinstein 1993, pp. 3–4). A similar scenario was developing at that time in Alaska with the Alaska Native Claims Settlement Act in 1971 (Usher et al. 1992).

Studies in the North had begun several years earlier in Alaska. A study by Sonnenfeld in the 1950s in the Inupiat region of the North Slope Barrows (Sonnenfeld 1956) was ". . .the first notable application of mapping methodologies to issues of public policy—specifically, conflicting land and resource use" (Ellanna et al. 1985, p. 64). A second, even more detailed mapping effort was carried out shortly after in the Cape Thompson area, also among the Inupiat, as part of a social and environmental evaluation for Project Chariot, an initiative that proposed to excavate a harbor with nuclear explosives (Foote & Williamson 1966).

The methodology of the "map biography," which charts the subsistence regimen of individuals spatially through time, grew out of these experiences and was refined in the 1970s with *The Inuit Land Use and Occupancy Project* (Freeman 1976). Covering 33 communities in the Northwest Territory, it documented past and present hunting, fishing, trapping, and gathering patterns by viewing them through the eyes of the Inuit. It recorded Inuit perceptions of their relationship to the land, compiling extensive data on history, place names, linguistics, subsistence techniques, campsites, and other cultural information.

Weinstein (1993, p. 10) describes the basic features of the map biography method, as it was used in the early studies:

> Hunters were asked to map the areas they had used for various harvesting and harvest related activities (such as hunting, fishing, berry picking, camp locations and so on) during their adult lives. The method documents the location of activities rather than success. . .where people hunted caribou rather than the kill site. A profile of an entire community's land use within living memory is then constructed by aggregating map biography information. The outer limit establishes the total area used within living memory. And the density of lines gives a crude estimate of the spatial intensity of use by the population as a whole.

Through time, the map biography "has become virtually the sole method of documentation in the official claims process," with notable modifications (Usher et al. 1992, p. 125). Differences in methodologies included within the map biography method, as tailored to the circumstances of each region, are discussed at length in Ellanna et al. (1985; see also Flavelle 1993b, Weinstein 1993).

Variations of this methodology were applied in a number of studies among the following groups: the Inuit of Labrador (Brice-Bennet 1977), the Beaver and Cree along the Peace River in Northern British Columbia (Weinstein 1979, Union of British Columbia Indian Chiefs 1980, Brody 1981), the Dene of the Northwest Territories, the Yukon, Northern British Columbia, Alberta and Saskatchewan in the 1980s (Nahanni 1977, Asch & Tychon 1993), the Northern Ontario Cree and Ojibwa (Kayahna Tribal Area Council 1985), the communities in the Kotzebue Sound, Alaska (Schroeder et al. 1987), the Northern Saskatchewan Chipewyan (Usher 1990), and in 20 Copper River Basin communities in Alaska (Stratton & Georgette 1985). This list, it must be noted, is just a sample of some of the more prominent studies; hundreds more have been carried out in every province and territory in Canada and Alaska with a multitude of ethnic groups.

## Asia, Africa, and Latin America

Mapping in other parts of the world—generally the Third World, with the notable exceptions of Australia and New Zealand—developed largely independently from the Canadian and United States experiences, with

different methodologies. Mapping with tribal and ethnic groups in Southeast Asia, Africa, and Latin America only began in the early 1990s and the primary purpose, as in Canada and Alaska, was to produce documentation for land claims. The work here has been with mixed economy agriculturalists, as opposed to hunter/gatherer groups—the Baka of Cameroon are one exception (Mbile et al. 2003)—and was influenced strongly, yet often indirectly and piecemeal, by the participatory field methodologies being developed by PRA, PAR, and similar approaches. Whereas some practitioners kept their approach simple, with community sketch maps on paper and on the ground, others ventured to add traditional cartographic techniques such as transects, compass readings, and modeling, and sought to produce maps that were both rich with local knowledge and georeferenced (Momberg et al. 1995, 1996; Eghenter 2000; Flavelle 2002). By the mid- and late 1990s, indigenous mapping began combining participatory techniques with the increasingly available technologies such as GPS, GIS, and remote sensing.

The most systematic indigenous mapping outside of Canada and the United States has been undertaken in several geographical areas simultaneously. During the 1990s, World Wildlife Fund and the Biodiversity Support Program (BSP) supported community mapping projects in East Kalimantan, Indonesia (Flavelle 1993a; M.T. Sirait, unpublished manuscript; Sirait et al. 1994; Peluso 1995; Momberg et al. 1995, 1996; Alcorn & Royo 2000; Eghenter 2000), as well as in West Papua (Eghenter 2000, Y.I.K. Deddy Muliastra, unpublished manuscript). Work with PAFID, also supported by BSP, began in the Philippines in the early 1990s and has since moved forward with mapping of Ancestral Domains, following legislation allowing indigenous groups to claim title to their lands (Prill-Brett 1997, Bennagen & Royo 2000, Rambaldi et al. 2002); PAFID has also been providing technical assistance with mapping in neighboring countries. About the same time, mapping with communities began to spread into China (McConchie & McKinnon 2002), India (Hoeschele 2000, De Vera et al. 2003), Nepal (Forbes 1995, 1999; Fox et al. 1996; Jordan 2002), Thailand (Tan-Kim-Yong 1992; Fox et al. 1994; Vandergeest 1996; Puginier 2000, 2002; Hoare et al. 2002), Cambodia (Fox 2002), Vietnam (Rambaldi & Lanh 2002), Australia (French 1998, Gibson 1999), and New Zealand (Harmsworth 1998, Laituri 2002). Participatory mapping was also being done on the African continent in Kenya (Lamb 1993, Smith et al. 2000), Cameroon (Ekwoge et al. 1999, Acworth et al. 2001; Mbile et al. 2003), Ghana (Kyem 2002), South Africa (Harris & Weiner 2002), the Congo Basin (Brown & Hutchinson 2000) and Tanzania (Hodgson & Schroeder 2002).

Largely independently, yet evolving in remarkably similar fashion, a number of mapping projects with indigenous peoples appeared at the same time in Central and South America. In Central America, indigenous mapping has been carried out in Belize (Toledo Maya Cultural Council & Toledo Alcaldes Association 1997), Nicaragua (Nietschmann 1995a,b; Dana 1998; Gordon et al. 2003; Offen 2003; Stocks 2003), Honduras (Herlihy & Leake 1997, Chapin & Threlkeld 2002), and Panama (González et al. 1995, Chapin & Threlkeld 2001, Smith 2003, Herlihy 2003). In South America, indigenous mapping has been undertaken in Venezuela (Arvelo-Jiménez & Conn 1995, Silva Monterrey 2000, Tomedes 2003), Guyana (James 2003), Suriname, Brazil (Brown et al. 1995), Ecuador (Villamil & Tsamaraint 2003), Colombia (Matapi & Velasco 2003), Bolivia (Jarvis & Stearman 1995, Chapin & Threlkeld 2001, Yubanore & Quiroga 2003), and Peru (CIPTA 2003, Shinai Serjali 2003, Smith et al. 2003, Tuesta 2003).

## The Lower United States

Although some United States tribes near the Canadian border were strongly influenced by

GDSC: Geographic Data Service Center

methodologies from the north, most bypassed the more participatory and informant-based models and headed straight for more sophisticated technologies as they were being developed during the 1990s. In 1990, the BIA established the Geographic Data Service Center (GDSC) in Lakewood, Colorado, with the mission of providing technical resources and training to interested tribes (Bond 2002). It was later in the 1990s, with rapid advances in personal computers, GIS, and database storage, that GIS capacity among tribes began expanding (Bohnenstiehl & Tuwaletstiwa 2001). By the mid-1990s, more than 50 of the 550 recognized tribes in the United States were utilizing the digital databases offered by the BIA's GDSC (Goes in Center 2000). The Intertribal GIS Council was founded in 1993 with assistance from the First Nations Development Institute, ESRI, NASA, and the USGS.

One example of the domination of sophisticated technology among United States tribes is found in a special issue of *Photogrammetric Engineering & Remote Sensing: Journal of the American Society for Photogrammetry and Remote Sensing* (2001). The topic is "Native American Uses of Geospatial Technology" and the articles, which are highly technical, cover various aspects of GIS, GPS, and remote sensing among the Hopi (Weber & Dunno 2001), the Blackfeet (Seagle & Bagwell 2001), the Leech Lake Band of Chippewa (Bailey et al. 2001), and others.

## Atlases and Atlas-Like Books

A small number of atlases and atlas-like books have been produced by indigenous peoples and their nonindigenous advisors and consultants in the Americas. The term atlas is used in a few cases, but there are other books and studies that contain large numbers of maps, along with accompanying material dealing with subsistence, natural resources, culture, and history, and that are functionally similar to formal atlases. Examples of these would be the early Canadian land use and occupancy studies of the Inuit mentioned above, as well as other detailed studies of aboriginal groups in both Canada and Alaska during that period. One thorough and very informative book of this type is *Shem Pete's Alaska: The Territory of the Upper Cook Inlet Dena'ina* (Kari & Fall 2003), which contains a wealth of information on the region's history and culture, along with an extensive annotated list of place names.

Volume 3 of Freeman's 1976 work among the Inuit is a land use atlas; and the Council for Yukon Indians has produced a 10 volume set titled *Yukon Indian Lands Potential Atlas* (Duerden 1985). The objective of these two atlases was to prove the legitimacy of aboriginal land claims. The *Nunavut Atlas*, published by the Canadian Circumpolar Institute and the Tungavik Federation of Nunavut, contains maps of the Nunavut settlement area, land use, and wildlife habitats (Riewe 1992). Another, more technical, type of atlas, which is used by a small number of First Nations in their negotiations with the government, is exemplified in the *Deh Cho Atlas* (Deh Cho Land Use Planning Committee 2003), which is part of a land use planning exercise with the Government of the Northwest Territories; it contains maps covering physical, biological, social/cultural, and resource potential aspects.

The Salish of Southern British Colombia, a small group with a 66 hectare reserve along the Fraser River, have produced *A Stó:lo-Coast Salish Historical Atlas* (Carlson 2001); it is an exceptionally elegant volume, replete with photographs and maps, whose primary purpose is to bring into view the Stó:lo-Coast Salish, who had been swallowed up and rendered invisible by the city of Chilliwack, along the Fraser River near Vancouver. The *Maya Atlas: The Struggle to Preserve Maya Land in Southern Belize* (Toledo Maya Cultural Council & Toledo Alcaldes Association 1997) had a similar purpose and is also a rich visual experience, yet it also carried the objective of securing land rights for the Mayan people. Finally, *Atlas: Territorios Indígenas en Bolivia* (Martínez Montaño 2000) was produced by the technical unit of Confederación de Pueblos Indígenas

de Bolivia to document indigenous areas of occupation and use to pursue land claims.

## Guidebooks for Indigenous Mapping

A number of manuals and guidebooks have appeared over the last decade or so. Most of these are focused on two regions: Canada and Southeast Asia. There is considerable difference in approach and content between the two sets of books.

In Canada, the guidebooks discuss political and ethical aspects of mapping, project design, and methods of data collection, with virtually no information on GIS and other spatial technologies. The Government of Alberta has produced two guidebooks for indigenous mapping (Garvin et al. 2001, Honda-McNeil & Parsons 2003) and assisted with the publication of a third (Robinson et al. 1994). Relations with government and matters of confidentiality, always points of contention, are treated diplomatically yet firmly—something that is simply not possible in many other parts of the world. Another useful guidebook is *Chief Kerry's Moose: A Guidebook to Land Use and Occupancy Mapping, Research Design and Data Collection* (Tobias 2000); a more detailed sequel to this book by the same author, also with a focus on project design and data collection, is scheduled to appear sometime in 2006.

By contrast, the guidebooks that have grown out of work in Southeast Asia, and more specifically Indonesia, are less political and more technical. Relations between indigenous peoples and governments are generally bad, even violent, and the guidebooks avoid sensitive areas, with very little emphasis on the organization of mapping projects, ethics, and the more bristly objective of claiming land. *Drawing on Local Knowledge: A Community Mapping Training Manual* (Momberg et al. 1995) was an early example of this, containing brief instructions on how to undertake basic cartographic techniques, including use of a compass and GPS, and how to draw contour lines, triangulate, and so forth. *Mapping Our Land* (Flavelle 2002) is a more comprehensive and up-to-date technical manual, a compendium of field techniques for working not only in Indonesia (where Flavelle has done much of her work), but worldwide. *Manual on Participatory 3-Dimensional Modeling* (Rambaldi & Callosa-Tarr 2000) is a lavishly illustrated, step-by-step guide to the construction of relief maps; produced in the Philippines, it and other similar guides have been used throughout Southeast Asia. Eghenter's book on Indonesia is something of a departure from this pattern, as it is less a guidebook than a discussion of dilemmas, ethical considerations, and political difficulties encountered in a series of mapping projects in various corners of the archipelago (Eghenter 2000).

Outside these two regions are *Giving the Land a Voice* (Harrington 1999), a collection of essays that deal with nonindigenous communities in the United States, which contains two useful chapters by Aberley (1999a,b; see also Aberley 1993) on creating a bioregional map atlas, with broad applications; and *Indigenous Landscapes: A Study in Ethnocartography* (Chapin & Threlkeld 2001), which derives lessons from three mapping projects in Latin America and lays out a specific methodology for mapping indigenous lands.

## Participatory Mapping and Participatory GIS

Before plunging into this topic, which is at the core of many discussions of indigenous mapping, we want to note that the term "participatory" has been overused and abused. In recent years it has been attached to so many disciplines and used as a modifier for such a range of practices that it has been rendered next to meaningless (it has invaded, for example, the fields of social psychology, development, conservation, business management, accounting, and even discourse analysis) (see Cooke & Kothari 2001). It means different things to different people and it is frequently difficult

to figure out where an author is located on the participatory spectrum and whether or not the "participation" spoken of is real. "Unfortunately, most participation associated with development planning is essentially *participation as legitimization*," comment Harris & Weiner (2002, p. 248). "Community meetings are held, local input is gathered, reports are produced, and top-down planning is maintained." Yet another type of bogus participation is that often generated by academics: "short-lived and stirred-up by researchers for exploring hypotheses and generating inputs for their publications" (Rambaldi & Weiner 2004).

With the exception of work in Canada and Alaska, much of the literature on indigenous mapping over approximately the last ten years deals with the marriage of participatory methodologies and GIS. A good deal of ambivalence revolves around the matter. Perhaps the best way to frame the discussion is with the titles of two articles: "Participatory GIS: Opportunity or Oxymoron" (Abbot et al. 1998) and "GIS for Development: A Contradiction in Terms?" (Dunn et al. 1997). Either directly or indirectly, many articles, papers, and books deal with the way participation and technology mix together, don't mix, or mix uneasily, and the compatibility of traditional knowledge and GIS (Abbot et al. 1998; Alcorn 2000a; Brodnig & Mayer-Schonberger 2000; Mohamed & Ventura 2000; Carver 2001; Puginier 2002; Jordan 2002; Weiner et al. 2002). Carver (2001, p. 8) writes about "the long running volley of articles and editorials. . .between the two camps of techno-positivist GIS-ers on the one hand and the GIS-hating social theorists on the other."

As one would expect, those who come to the matter from the participatory rural appraisal side stress the participatory aspect, whereas the more technically oriented practitioners lean in the opposite direction. In the late 1980s, development practitioners introduced PRA and PAR; and sketch mapping, with little or no input from professional cartographers, became a prominent tool. The primary purpose of this mapping was to elicit local knowledge and facilitate discussion within communities, rather than linking villagers to government policy makers. Participation was seen as important in building local capacity, empowering communities, facilitating communication, breaking down entrenched power structures, and fostering democratic institutions. This was low-tech and of limited utility—for example, it worked well within the community but could not take on land tenure and legal battles with the state—and some have viewed the participatory adherents as Luddites. Dunn et al. (1997, p. 4) note that the participatory appraisal school "largely eschews GIS, regarding IT as integral to that power knowledge which is essentially urban-based, high-tech, capital-intensive and 'expert.'"

On the technical side, emphasis is often placed on the compatibility of spatial technologies and traditional thinking and the ways GIS can store and manipulate traditional knowledge (Duerden & Keller 1992, Johnson 1997). "It has been suggested," notes Johnson (1997, p. 4), "that GIS has the ability to reflect a worldview held by many aboriginal people; one that celebrates a holistic rather than reductionist conceptualization of the environment." A contrary view is held by Rundstrom (1995, p. 45), who writes: "the Western or European-derived system for gathering and using geographical information is in numerous ways incompatible with corresponding systems developed by indigenous peoples of the Americas. . .GIS technology, when applied cross-culturally, is essentially a tool for epistemological assimilation, and as such, is the newest link in a long chain of attempts by Western societies to subsume or destroy indigenous cultures."

By the year 2000, spatial information technologies had evolved and become much more accessible; prices for software and hardware had dropped and spatial information, which until this time had been tightly controlled by governments and elites, became more within the reach of the general public. It was at

this point that GIS not only merged with more participatory approaches, creating "participatory GIS," but signaled a shift toward greater emphasis on the new technologies. It has now become inevitable that spatial technologies will become far more sophisticated and reach deeper into the backlands in coming years, and this will bring with it consequences. The PPGIS network has been discussing ways, through conferences and by email exchanges, to ensure that the introduction of spatial technologies into rural communities unfolds in a truly participatory manner (Rambaldi & Weiner 2004).

Any attempt to carry out this agenda will be a challenge. Technicians are often unaware that they are imposing their wares, and indigenous peoples complain that their role is small in comparison to that of the outside technicians. For example, in the Effects on Aboriginals from the Great Lakes Environment (EAGLE) project, based out of Ontario, several participants noted that "there is too much Western science in the project. The community aspect of the 'blend' is simply used when convenient and when it does not interfere with the Western scientific approach," and "Native knowledge about the environment has not been well integrated in the partnership" (McGregor 2001, p. 11). McGregor concludes, "Reliance on the Western scientific approach was due in part to requests from First Nations for this type of research so that they could use the results to lobby government and industry. The Western scientific approach was also more familiar to the researchers with very few examples available on how to incorporate Traditional Ecological Knowledge into research." Likewise, in a participatory GIS project in Lebanon, participation was weak because researchers' biases "often imposed a priority that was not always important for local people" (Zurayk 2003, p. 5).

No matter what the advantages of GIS might be, the fact remains that they are complex, highly technical, and expensive, especially for rural villagers, who lack such basics as electricity. There is generally little or no access to the Internet in rural communities—the technology must reside outside the community, and it is controlled by outsiders (Dunn et al. 1997, Johnson 1997, Carver 2001, Jordan 2002, Weiner et al. 2002). When this occurs, "GIS actually works against participation and empowerment" and can be seen as an "elitist technology. . .that enhances existing power structures" (Carver 2001, p. 7). How to avoid these characterizations is a matter of much discussion and considerable concern.

**EAGLE:** Effects on Aboriginals from the Great Lakes Environment

## INDIGENOUS GIS LABORATORIES

Without doubt, GIS laboratories managed by indigenous peoples provide a number of benefits. Having the ability to store and manipulate large amounts of data, spatial and spectral technologies have numerous practical uses, including ". . .cultural and natural resource planning, community planning and infrastructure, monitoring environmental change, managing urban sprawl, treaty and rights protections, and integrating traditional ecological knowledge into the tribal decision making process. . ." (Goes in Center 2000, p. 2). One example of the systematic use of GIS technology is the EAGLE project, which examined the effects of contaminants on the aboriginal population of the Great Lakes between 1990 and 2000 (Bird 1995, McGregor 2001).

Most of the GIS facilities run by indigenous groups are located in the North, in the United States and Canada, where the tribes have money flowing in from the government, revenues from the sale of resources such as oil, natural gas, minerals, and timber, or the take from casinos.

In Canada, "First Nations have applied GIS technology extensively to planning applications and are proving to be one of the fastest-growing new user groups of GIS" (Johnson 1997, p. 2). In the United States and Canada, ESRI has been instrumental in getting GIS and geospatial technologies to tribal groups (Bohnenstiehl & Tuwaletstiwa

2001, Williamson & Goes in Center 2001). In 2004, it boasted ~20 tribal customers and was assisting native groups at the early stages "with grants of the (very expensive) ArcInfo software, training scholarships and extensive help" (ESRI 2004). Sometimes local firms help tribes set up their GIS; for example, the Squamish Nation hired Pacific Meridian Resources, a native-owned GIS consulting firm, in 1995 to facilitate implementation (Calla & Koett 1997), and the Makavik Corporation assisted the Nunavut Inuit with their GIS (Kemp & Brooke 1995). The most difficult part is to keep the system up and running after it has been installed. Hardware must be maintained and software upgraded, technicians must be kept abreast of new developments in the field, and networks must be in place (Dunn et al. 1997). Even in the North, GIS laboratories are often out of reach for many groups. "The use of a GIS requires a long-term financial commitment," notes Johnson, "yet in many cases adequate resources are simply unavailable due to the fact that GIS, as yet, is not considered a fundamental component of First Nations infrastructure"(Johnson 1997, p. 9).

If there are difficulties in the North stemming from lack of adequate resources, the obstacles to the South are substantially more formidable. Consequently, there are very few GIS installations housed within indigenous organizations in the poorer countries, and those few that exist are generally short on hardware, software, and trained staff. The primary deciding factor is money to cover long-range support. Because few Third World groups receive financial resources from their government, and they generally lack control of their natural resources, to set up a GIS laboratory they must be bankrolled by international donors. Examples of indigenous GIS laboratories in Latin America, for example, are found in Bolivia (Yubanore & Quiroga 2003) and Peru (CIPTA 2003), and both are supported by foreign agencies. A small GIS laboratory was set up—again by foreigners—in the office of the Amerindian Peoples Association in Guyana, but soon fell into disuse because of lack of funds. Another GIS facility, the Sistema de Información sobre Comunidades Nativas del Perú, had originally been part of an indigenous federation but was transferred in 1998 to the nonindigenous organization the Instituto del Bien Común, where it continues to provide assistance to indigenous communities in the Amazon region of Peru; it is also funded by foreign donors (Tuesta 2003; Smith et al. 2003).

## CONCLUDING REMARKS

Indigenous mapping has been in existence slightly more than 35 years in Canada and Alaska and no more than a decade to a decade and a half in other parts of the world. It has been a powerful tool for indigenous peoples in their struggles to defend and claim their ancestral lands, manage their resources, plan economic development, and preserve their cultures. Yet behind this general statement there linger a number of issues that need to be confronted and thought through, for once one "unleashes mapping's good magic," to steal a phrase from Alcorn (2000b), there are often complications and unanticipated consequences following in its wake (Fox et al. 2003). Before charging forward with what some consider a magic torch, we might sit back and examine more closely a set of issues that remain poorly defined. This task needs to be grounded in reality because indigenous mapping is taking place in a wide variety of political, economic, and cultural contexts.

How, for example, should the ownership of information, data privacy, and access and exclusion be handled? What are the risks of stirring up latent conflicts with mapping, such as when boundaries are drawn through areas of overlap? What measures need to be taken to avoid further stratifying communities with the introduction of mapping technologies? Why are women so weakly represented in mapping projects and why is so little written about this subject (Rocheleau 1995,

Rocheleau et al. 1995)? In what ways, and under what circumstances, do mapping projects serve to empower or marginalize indigenous peoples? Is it possible to employ the new technologies to preserve traditional knowledge, or do they serve to disfigure it with Western patterns of thought? And perhaps most importantly, what can be done to help indigenous peoples adapt to and accommodate the wave of electronic technologies that are about to inundate them in even the most remote corners of the earth?

Finally, groups in many parts of the world have taken advantage of various mapping methodologies, running from highly participatory approaches to the newer, more complex spatial technologies. Yet the demand is far greater than what can be delivered, and the distribution of indigenous mapping initiatives has been extremely uneven. Whereas indigenous peoples of Canada and the United States have been able to make permanent use of the new technologies, those in the poorer countries of the South have almost invariably found the benefits of systematic mapping out of their reach. What they have gotten is little more than a smattering of one-shot mapping projects, and few have had the luxury of being able to choose the methodology that has been used. What might be done to spread more widely, especially in the Southern reaches, the benefits of participatory mapping, GIS, and spatial technologies?

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