of effort, particularly manual editing of text, is roughly cut in half.

	Data				
Shape Type	**Hydro 1M**	**Physio-graphic**	**Soils 25K**	**Hydro 5K**	**Vegetation 5K**
Round-ish	364	278	445	1786	14380
Oblong	592	211	1261	950	870
Long	11	14	8	931	70
Long & Skinny	0	0	0	157	0
Splotch	35	2	30	26	14
Snaky or Pronged	33	7	39	135	17
Snaky or Pronged & Skinny	2	1	2	489	5

Table 1. Feature counts for each type for five data sets. The datasets are: (1) Hydro 1M: Hydrography for 1:1,000,000 of the northeastern United States, (2) Physiographic features of North America, (3) Soils for Ada County, Idaho, (4) Hydro Areas for Ada County, Idaho for 1:5,000 scale maps, and (5) Vegetation for Ada County, Idaho for 1:5,000 scale maps.

CONCLUSIONS & FUTURE WORK

This method of identifying shape types for labeling has worked well in creating general reference maps at scales ranging from 1:5,000 to 1:1,200,000, on natural and built hydrographic polygons, and on physiographic features. This method could also be very useful in labeling vegetation type, soil type, surface geology type, and many other such features. A more complicated adaptation of this method is also being tested as a basis for identifying features to be eliminated or generalized on maps at scales smaller than the data was originally intended. Initial results of this work are quite promising.

In general, the ability to enhance GIS data that were not captured with the intent of creating higher quality cartography in a highly automated fashion is valuable. Many cartographic operations in GIS are conducted by attempting to directly and often simplistically translate GIS features that were captured independently of any cartographic product requirements into a product-specific semantic and graphical context. The result, not surprisingly, is an awkward mix that defies stylistic and semantic expectations. The method described in this article successfully adds additional meaning to the GIS features before attempting a requirements-based transformation into a cartographic solution.

REFERENCES

Abdelmoty, A. and El-Geresy, B., 2004. Schema Visualization Using a Metadata Approach for GIS. *Proceedings of the GIS Research UK 12th Annual Conference. Norwich, UK. 160-162.*

Papadias, D., Sellis, T., Theodoridis, Y., and Egenhofer, M., 1995. Topological Relations in the World of Minimum Bounding Rectangles: A Study with R-trees. *Procedings of the ACM SIGMOD Conference 1995*: San Jose, California, 92-103.

Zhou, X., Krumm-Heller, A., and Gaede, V., 1999. Generalization of Spatial Data for Web Presentation. 2nd Asia Pacific Web Conference (APWeb99). Hong Kong. September.

reviews

Applied Environmental Economics: A GIS Approach to Cost-Benefit Analysis

Ian J. Bateman, Andrew A. Lovett and Julii S. Brainard
2005; Paperback edition, 335 pages, $43
New York: Cambridge University Press
ISBN-13 978-0-521-67158-3

Reviewed by Grace Wong
Advisor, Corridor Economics and Strategies
People, Protected Areas and Conservation Corridors
Conservation International

In a decision-making process, economics plays a role to finding the most efficient and cost-effective solution amongst various options. The efficient solution is typically one where resources will be properly allocated based on their economic value in markets. This very basic economic assumption has proven to be a thorn, particularly in decisions relating to land use and land cover change, as these changes impact the natural landscape and have wide ranging environmental consequences that often cannot be adequately measured nor traded in markets.

The book by Ian Bateman and his colleagues from the University of East Anglia seeks to address this issue by incorporating the non-market environmental values of land use and land cover change into standard cost-benefit analysis (CBA) to support decision-making. In addition, they push the analytical boundaries further by incorporating Geographic Information Systems (GIS) in the analysis to account for spatial and geophysical differences that are likely to impact on those values. This book demonstrates a number of ways that GIS can be employed to improve the way in which real world complexities are incorporated into CBA, thus reducing the need for simplifying assumptions.

The use of GIS is well established in the field of land and natural resource management. It provides a powerful tool that can integrate and overlay spatial data from a range of sources, undertake a wide range of analytical operations, and produce results in mapped, graphed or tabular form. While its application in traditional economic analysis is less common, the flexibility and benefits of GIS are becoming readily apparent to many environmental and resource economists who are tackling land, resource and conservation issues.

The review and analyses presented in the book is based around a UK study that examines the economic potential for conversion of land from conventional agriculture to multi-purpose woodland in Wales, with the assumption that multi-purpose woodland is a more desirable land use from an environmental viewpoint. The book examines the possible economic returns from woodland and agriculture using a range of environmental, resource and agricultural economic methodologies, and it undertakes a cost-benefit analysis (CBA) that aims to incorporate a full range of economic values and the spatial element of those values. In this case, the total value of woodland is comprised of its recreation and timber values, and carbon sequestration potential.

The book is arranged into 10 chapters. The first four chapters are related to non-market valuation methods and their application to the recreational value of woodlands. The book begins by describing the basic economic theory underlying concepts of valuation and how ethical considerations may influence incorporation of non-use values in the analysis (Chapter 1). Having explored the question of ethics and sustainability, the authors ended up to using a methodology that is neoclassically utilitarian in its ethical basis. A brief introduction to GIS is also included. The next chapter (Chapter 2) reviews the different non-market methods for estimating recreation benefits; focusing in particular on the contingent valuation (CV) and travel cost (TC) methodologies. For readers who are unfamiliar with these techniques, the authors provide a useful critique of each method and highlight where their application is most appropriate. Chapter 3 reviews previous CV and TC valuation studies of woodland recreation in the UK, including those by the authors of this book, and identifies a number of problems with these studies in terms of methodology, data analysis and reporting. In their own applications of these valuation techniques, the authors improve upon the standard CV and TC techniques by using GIS mapping capabilities to standardize and improve the derivation of key variables such as travel distance and duration, but they are still unable to overcome some of their earlier concerns as their analysis generated large variations in the valuation estimates. These results are, nonetheless, transferred to the case study area and used to generate predictions of latent demand for visits (Chapter 4). GIS is used to manipulate the travel data to provide further accuracy of travel costs, and to generate a transferable arrivals function in order to predict the number of visitors to a particular woodland site. This information can then be extrapolated to other sites. The results from studies reviewed in the previous chapter are used to obtain the value of potential demand for recreation.

The book then turns to tree growth and the timber industry in its next three chapters. Chapter 5 provides a useful overview of the industry for those unfamiliar with the history and policy structure of the commercial timber industry in the UK. This information provides the basis for construction of a timber valuation model to assess the current social and private value of timber production. Costs and revenues are then determined for a softwood (sitka spruce) and a hardwood (beech) species, and a review of the appropriate discount rates for the various decision-makers are also considered. Timber yields are then estimated using yield class models and are mapped using GIS (Chapter 6). The strengths of GIS lie in its ability to incorporate bio-geophysical and environmental information such as elevation, soil type, temperature and rainfall, and its ability to display the results spatially. The analysis of woodland values also includes the net benefits of carbon sequestration (to offset the global warming effects of carbon dioxide emissions) provided by forests by extending the timber yield model to estimate net carbon storage (or emissions where appropriate) in live biomass, wood products, waste and soils (Chapter 7). The analysis is undertaken for both tree species to quantify their carbon sequestering potential in the land use change scenario from agricultural to multi-purpose woodland.

The subsequent chapters look at the opportunity cost of converting existing agricultural land to woodland in the case study area of Wales. The authors developed models to calculate farm-gate (financial) and social values for the two dominant agricultural production activities in the area: sheep and dairy farming (Chapter 8). Following a review of UK agricultural policy, the market and shadow values of sheep and dairy enterprises are estimated. It would appear that the low and declining levels of farm profitability during the study period would suggest that there are likely to be significant potential for efficiency gains in a change of land use from farming to woodland.

This intuition is confirmed in the CBA which assesses the net benefits of converting land from agriculture into woodland (Chapter 9). While current level of woodland grants and subsidies is still insufficient to catalyze land use conversion from the farmers' perspective, the authors suggest that a relatively modest increase in grants and subsidies would generate

substantially higher net social benefits to the broader society. The various strands of analyses from previous chapters relating to recreation, timber values, carbon sequestration and agriculture are synthesized and overlaid using GIS value maps. These maps illustrate that there is large spatial variation in net present values (NPV), which would not have been evident if a global NPV had been produced for the entire study area as in traditional CBA techniques. Both the market and social-environmental assessments are presented and, as can be predicted, the results demonstrate sensitivity to whether the analyses are restricted to market prices or extended to include the various non-market values. In addition to the spatial factors, the choice of discount rate, choice of woodland tree species to be planted, and other policy variables also impact the sensitivity of the results.

The final chapter (Chapter 10) summarizes the research findings, identifies some of the limitations of the analysis, and highlights the omission of certain critical non-market values (such as biodiversity and habitat values of woodlands) from the overall CBA.

Readers who are familiar with GIS methodologies and with expectations of substantial advancement and innovation in the application of GIS to applied economic analysis might be slightly disappointed, given the title of this book. While the overall application of an integrated environmental and economic CBA in this study is very sound and provides some interesting results, GIS is largely used only as a supporting tool to integrate multiple data layers for the economic analyses. A natural next step would be to build upon the book's current approach and use GIS as a scenario building tool to examine the potential levels of land use change under the different policy options, and to map their resulting social, economic and environmental consequences.

Nonetheless, the authors have provided extremely useful insights into some of the capabilities of this tool, and their comprehensive documentation of the study methodology allows for this approach to be readily adapted to other regions and contexts when considering land use change options at a regional scale, whether for development or conservation objectives. The authors should be lauded for their very strong, creative and expansive efforts.

Maps and the Internet, with CD insert
Edited by Michael P. Peterson
Oxford, United Kingdom: Elsevier, 2003.
ISBN 0-08-044201-3

Reviewed by Daniel G. Cole
Geographic Information Systems Coordinator
Smithsonian Institution

This multi-authored work, which was published three years before this review, addresses the issues and developments of internet-focused cartography at the start of the 21st century. Books of this type are often out-of-date relatively soon after going to print. While that can certainly be said for portions of this book, this reviewer can state at the start that this or a newer edition should still be on the shelf of most cartographers. The book is divided into four parts with 28 chapters written by 35 authors. The organization is logical, and, while some of the chapters could have been combined, the book is well-indexed, and progresses with the individual chapters usually able to stand on their own.

Part One (six chapters) provides the introduction and covers contemporary issues. The age of the book becomes evident with Peterson's introductory discussion on the historical background of maps on the web and their associated file types (PDF and JPEG). Had the book been published more recently, the JPEG2000 format would have certainly been included. He notes the University of Texas website as being popular, but now he would have to promote David Rumsey's website as well. His discussion of the popularity of MapQuest would now likely have been supplanted by Google Maps with Google Earth.

The second chapter [Krygier, Peoples] on geographic literacy addresses "the issue of map education in a world transformed by the WWW" (p. 17). The web enables students "to engage in diverse, active mapping" but "requires more than teaching about the latest WWW mapping sites" (p. 18). Indeed, since maps are often viewed uncritically, whether on paper or over the web, getting students and others to question what they see when maps are displayed is of prominent importance. Krygier routinely has his students check out the static historical map sites such as the Library of Congress and the University of Texas map collection sites, as well as five commercial websites. Krygier and Peoples bemoan that maps and graphics are rarely properly cited , and that a standard bibliographic guide for digital images and maps did not exist (although one can now check the Library of Congress for such a guide: http://memory.loc.gov/learn/start/cite#maps). The authors promote the Census Bureau's American Factfinder site as being very good for learning to use and produce choropleth techniques, classing systems, and map design. They also voice worries