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Eye on the Environment

## **Map Making in the Modern World: From Ptolemy to GIS**

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Claudius Ptolemaeus, better known as Ptolemy, was a Roman citizen who lived during the first and second centuries A.D. He was an astronomer, astrologer, and mathematician, but in the field of geography he is best known for his work *Geographike Hyphegesis*, or *Geography*

The work is an amalgamation of what was known about the physical and political boundaries of the land during the second century, and it included a map of the world as it was known at that time.

People had been making maps for many thousands of years before Ptolemy, but what made Ptolemy's maps special was the introduction of a grid system, or lines of latitude and longitude, to describe locations on the Earth's surface. He also made improvements upon map projections.

His work was copied and emulated for more than a thousand years after his death, and it served as a cornerstone for the development of the highly precise and accurate cartographic techniques employed today.

Whether we're aware of it or not, cartography plays an active daily role in all of our lives. We're probably most familiar with the maps we carry with us in the forests and mountains of the Seeley-Swan—the USGS topographic quadrangles that show us where we are, where we want to go, and how best to get there—but maps are used for much more than route finding and navigation.

Maps are important tools employed in resource management, land development, determination of land ownership, environmental impact assessments, understanding spatial relationships, urban planning, analyzing scientific data, criminology, marketing, logistics, examining temporal changes to the landscape, and projecting future events. We use them to design buildings, forecast the weather, assess wildfire danger, land airplanes, and locate the bathroom. Without them... well... we'd be lost.

So what is a GIS? And just what does any of this have to do with that?

A GIS is a Geographic Information System. Hundreds of different definitions have been formulated and formalized to describe just what exactly comprises a GIS, but for simplicity's sake it can be thought of as a spatial database and mapping program.

The first true Geographic Information System was developed in Canada in 1962 and was designed to store and analyze data from the Canada Land Inventory. Since then, numerous different companies and computer applications have emerged and evolved that specialize in the analysis and manipulation of spatial data. GIS courses are now taught at most colleges and universities, with some schools offering undergraduate and advanced degree programs in Geographic Information Science, or GIScience.

Modern-day GIS platforms offer an immense array of spatial data analysis, digitization, and manipulation tools, such as three-dimensional modeling, watershed delineation, and contour mapping. The flagship GIS software package, ESRI's ArcGIS 9.3, is presently being used by a number of entities working within and around the Swan Valley, including Northwest Connections, Swan Ecosystem Center, The Clearwater Resource Council, the Swan Valley Community Council, The Trust for Public Land, The Nature Conservancy, and the Missoula County government.

I was hired as a summer intern with Northwest Connections to help increase our capacity to use GIS to benefit both the land and the community. Brief summaries of some of the GIS-related projects that I've recently been involved with are given below, with a sample GIS mapping project illustrated on the Northwest Connections website at [www.northwestconnections.org](http://www.northwestconnections.org). The five maps presented on the website are intended to illustrate how a simple map is made using ArcGIS 9.3, and in particular to highlight the defining characteristic of a GIS: the ability to overlay one set of spatial data on top of another.

### **Northern Divide Grizzly Bear DNA Project**

GPS coordinates were obtained for each grizzly bear rub set by Northwest Connections for the 2009 Northern Divide Grizzly Bear DNA Project. These coordinates were then downloaded into a GIS, with the locations of all bear rubs then overlaid on maps showing other features such as roads, lakes, streams, elevation, habitat type, and infrastructure.

The coordinates and maps were then used to identify holes in the data collection effort and to ensure data collection integrity and accuracy. More information about this project can be found on the Northwest Connections website.

### **Highway 83 Wildlife Tracking and Carnivore Monitoring**

Wildlife track data were obtained from six segments along Highway 83 and various segments along other routes. The data were then entered into a database and plotted using GIS software. With these data, areas of high traffic wildlife crossings and wildlife use can be determined.

This information can then be used to help identify lands suited to either conservation or development (depending on presence or absence of species) and to aid with future improvements to Highway 83.

### **Swan Valley Community Council Land Use Planning Sub-committee**

Various maps were produced showing land ownership, road maintenance jurisdiction, well locations, hydrological features, watershed boundaries, soils, and geology to aid with community discussions of appropriate land use.

### **Swan Valley Conservation Strategies Working Group**

Land ownership data was overlaid with other map layers showing natural and man-made features to help the Working Group visualize the current subdivision of lands within the Swan Valley. Acreages for various parcels of land were also calculated and sorted to help identify key parcels of land for voluntary conservation efforts.

### **Water Howellia Surveying and Monitoring**

Water Howellia (*Howellia aquatilis*) is a small freshwater wetland plant that grows in the Pacific Northwest and has been considered a threatened species since 1994. Using currently existing data, maps were produced showing the locations of known and potential Water Howellia locations in the Swan Valley.

These maps were provided to a contractor with The Nature Conservancy who is currently surveying wetlands in the Swan Valley for Water Howellia.

### **Landscape and Livelihood Field Semester Maps**

GIS software was used to create a map for GPS and compass navigation practice during Northwest Connections' Landscape and Livelihood fall field semester. A second map was also made showing the route for the Landscape and Livelihood backpacking trip, with an elevation profile cross-section and three-dimensional route representation produced for further reference.

We've come a long way since Ptolemy!