BEGIN BOX #1=====================================
What is a spatial relationship?

Spatial relationships may be important in understanding the resources of concern when developing habitat management strategies (Schroeder et al. 1998). Spatial relationships describe the association among landscape features, and may be characterized in both topological and directional aspects. When developing the topology among landscape features, one is using methods that develop and remember associations among landscape features. Research into spatial relationships has been driven by the work of mathematicians, cognitive scientists, and designers of software for GIS. In GIS it may not be sufficient to know just the position of a landscape feature, but also to know how the landscape feature relates to other features in the same (or other) databases. For example, it may not be sufficient to just be able to locate a patch of optimal habitat; it may also be important to locate other patches of good or optimal habitat nearby.

Some examples of spatial relationships include:

Polygons that share a common boundary (e.g., adjacent polygons).

Polygons of a certain type (e.g., optimal habitat) nearest to other specific polygons (e.g. proposed harvests).

Polygons that overlap other polygons (e.g., the intersection of soils and timber stands).

Lines that cross one another (e.g., roads that cross streams).

Lines that logically flow into one another (e.g., stream networks).

Lines that are within a certain distance of other landscape features (e.g., roads within a certain distance of streams).

Points contained within polygons (e.g., bird point sample locations within timber stands).

Points that can be seen from certain other points (e.g., as in defining viewsheds).

END BOX #1==

BEGIN BOX #2==================================

Box #2. An example of integrating habitat relationships into a forest planning process

To demonstrate the process of integrating habitat relationships into a forest planning process, we illustrate an example provided in Bettinger et al. (2001). Wildlife habitat goals can be either qualitatively or quantitatively defined. Quantitative goals can also reference spatial information provided by GIS databases, allowing spatial goals to be developed. Spatial goals may include configurations such as requiring minimum patch sizes, or complementary habitat types, and thus may indicate that, for optimal benefit to a particular species, one type of habitat should be placed next to another. Great gray owls (*Strix nebulosa*), for example, prefer early seral stage forests (clearcuts) for foraging, yet these areas should be adjacent to single-story open-canopy forests containing snags or large trees with broken tops.

Within a forest-planning environment, one can use a complementary patch goal (one where a patch of one type [e.g., nesting habitat] must be next to a complement - a patch of another type [e.g., foraging habitat]) to guide development of a forest plan that seeks to provide the greatest amount of habitat over time, while also achieving other economic or commodity production goals. The criteria used to measure whether the objective was achieved consist of measuring the percentage of land in each planning period that meets habitat requirements of great gray owls. A further quantification of the habitat goal is required, and Bettinger et al. (2001) assumed the following: maximization of the percentage of land in patches ≥ 20 ha, and ≥ 90 years old, that were adjacent to patches ≥10 ha, and ≤ 10 years old would suffice. In addition, a few practical constraints were added to the forest planning problem: clearcuts were limited to ≤ 48.6 ha, minimum clearcut harvest ages were 40 years, a minimum volume of about 19,000 m^3 per 5-year period was required from the landscape, and only one regeneration harvest was allowed during the planning horizon.

A heuristic planning technique (i.e., one that locates good, feasible solutions to problems, yet not necessarily the best solution to problems), tabu search (a deterministic search process based on remembering choices that have been made), was used to develop the forest plan using a spatial arrangement of great gray owl habitat (Fig. 3). The amount of timber volume produced per 5-year planning period averaged 9.5 million board feet (60,000 m^3) (Fig. 4). Harvest volume was relatively high in the last few time periods because some cutting was required to create early seral patches to complement the older forest patches.

END BOX #2 ==

BEGIN BOX #3 ==

GIS in the International Community

GIS is becoming a commonly used tool to study, understand, and manage environmental issues at local, regional, national and international levels. Initiatives, which are of particular interest at the international level, are the spatially related information programs of the United Nations Environmental Program (UNEP). The first is UNEP's Global and Regional Integrated Data (GRID) program. From its conception at UNEP headquarters in Nairobi, GRID has evolved into a still expanding network of environmental data centers around the world, each with a particular regional focus but coordinated in their efforts at a larger global scale. The centers facilitate and promote the development, documentation, archiving and dissemination of environmental GIS and statistical information. With a concentration on environment, conservation, and natural resource issues, the centers' databases and analytical capabilities are designed to assist researchers and analysts in making reliable environmental assessments in support of public policy dialog (UNEP—GRID Europe 2003).

UNEP-GRID centers typically have datasets and information on such environmental issues as biodiversity, ecology, climate, soils, land cover, hydrology, and human impacts, as well as general information concerning geology, atmosphere, oceans and political boundaries. Partly because of its association with such prominent information sources as NASA, NOAA, and USGS, the North American node of UNEP-GRID, located at Sioux Falls, South Dakota, plays a very prominent role in the larger network of centers, providing a number of datasets on a global scale (UNEP—GRID North America 2003). Much of the information is available on-line through the Internet and downloadable to individual GIS workstations.

The other prominent UNEP hosted initiative, relating to spatially referenced environmental information and analysis, is the World Conservation Monitoring Center (WCMC). In 1988 IUCN (International Union for Conservation of Nature and Natural

Resources), WWF (World Wildlife Fund for Nature), and UNEP founded a non-profit organization called the World Conservation Monitoring Center to monitor endangered species. This was an outgrowth of an earlier program by IUCN established at Cambridge, UK. In 2000, WCMC became a formal program of UNEP and has become its primary resource center for providing biodiversity information and assessments on conservation and sustainable use issues that have national, regional, and global impacts (UNEP—WCMC 2003). Its programs focus on species diversity, forests, protected areas, marine, mountain, and freshwater habitats, as well as habitats affected by climate change (UNEP—WCMC). Extensive use of GIS and spatial analysis helps recognize global trends, warn of potential sustainability problems, and identify priorities for conservation action in all of the earth's major ecosystems.

END BOX # 3 ===

BEGIN BOX # 4 ===

Sections of the Standard

1. Identification*
2. Data Quality
3. Spatial Data Organization
4. Spatial Reference
5. Entity and Attribute
6. Distribution
7. Metadata Reference*

<u>Supporting Sections (reusable)</u>

8. Citation
9. Time Period
10. Contact

** Denotes a mandatory section*

END BOX # 4 ===

BEGIN BOX # 5 ===

Recommendations for Writing Metadata

- Use Clear, Familiar Words
- Use and Informative Title
- Select Keywords Wisely
- Write Complete Sentences
- Use Bulleted Lists
- Ask Someone to Review Metadata
- Define and Describe Acronyms, Jargon or Technical Terms

END BOX # 5 ===

BEGIN BOX #6 ===

Box #6

GPS Satellites. Navstar GPS was developed by the Department of Defense and manufactured by Rockwell International. These 24 satellites are placed in 6 orbital planes at 10,900 nautical miles or 20,200 km above the earth. Each plane is inclined 55 degrees relative to the equator. They weight about 710 kilograms and are 5.2 meters wide with solar panels extended. Their orbital period is about 12 hours and they pass over one of the ground stations twice a day. The lifespan of these satellites is planned at 7.5 years. Using 4 or more satellites can yield 3-deminsional estimates while using 3 satellites can only generate 2-deminsional observations.

END BOX #6 ==

BEGIN BOX #7 =======================================

Box #7

Ground stations. Known as the “Control Segment”, these stations monitor each satellite’s health and exact position in space. They correct empheris errors like clock offsets and transmit corrections to the satellites. There are 5 stations worldwide, Hawaii and Kwajalein in the Pacific Ocean, Diego Garcia in the Indian Ocean, Ascension Island in the Atlantic Ocean, and Colorado Springs, Colorado, which is the master ground station.

END BOX #7 ===

BEGIN BOX #8 ==

Box #8

Receivers. GPS receivers can be carried by hand or installed in airplanes, boats, cars, or trucks. These receivers detect, decode, and process GPS satellite signals. The typical hand-held receiver is about the size of a cellular phone or palm computer, and they are getting smaller all the time.

END BOX #8 ===

BEGIN BOX #9 ===

Box #9.

Definition of terms for data capturing standards:

- Static Mode – points collected at 1-second intervals; a general guideline is to collect point positions at one-second intervals. The amount of data collected varies with the type of receiver.
- Kinematic Mode – time between measurements will vary depending on velocity at which you are collecting data. Measurement interval will usually not exceed 1 second, these data are stored in the receiver for later downloading and post-processing.
- Signal to Noise Ratio (SNR) –The SNR of a signal is a measure of its quality at the GPS receiver. The higher the value, the stronger the desired signal is compared with associated noise. A low value would indicate a weaker signal, and/or higher levels of noise; for example a setting of 6 might be used.
- Elevation Mask – to ensure the rover (field) receiver is using the same set of satellites as the base station. For a distance of $\leq$ 500 km to the base station use 15°, for a distance of $\leq$ 1000 km use 20°;
- Satellite Vehicles –minimum number of satellites required to record a position; usually 4 or more.
- Datum – a smooth mathematical surface that closely fits the mean sea-level surface for example NAD83.
- Spheroid – a spheroid of 'best fit' over the surface of the earth, for example GRS1980.

- ♦ Positional Dilution of Precision (PDOP) – an indication of the quality of the results that can be expected from a GPS point position. These values should be used as an indication of when GPS is likely not to produce good positioning results and, equally, should not be used as a measure that describes the quality of positioning that has actually taken place; a typical setting would be less than 6.0.
- ♦ Base Station – a stationary receiver at a known location that provides the data used in the differential corrections of GPS data acquired by a moving receiver; a rover (field) receiver should be within $\leq$ 500 km of the base station when using differential corrections.

END BOX #9 ==

BEGIN BOX #10 ==

Box #10.

Differential processing standards:

- ♦ A Data Format – the user must acquire the base station data in a format compatible with the software they will be use for differential correction, for example, ArcView® shapefile or ArcInfo® coverage.
- ♦ Unit of Measurement – 1 foot equals 0.3048m exactly.
- ♦ Coordinate System – typically collected in longitude and latitude coordinates, however, these can be converted to State Plane, Universal Transverse Mercator Measurements (UTM) or others.
- ♦ Elevation Mode – NGVD 29 (47).
- ♦ An approved Base Station – an example for western Oregon is Corvallis CORS ARP.

END BOX #10 ===