

# USE OF THE 1990 CENSUS TO DEFINE WILDLAND URBAN INTERFACE PROBLEMS

James B. Davis<sup>\*</sup>

**Abstract**--Predicting the movement of people into rural wildlands previously has been limited to studies of population and housing growth in counties or other large geographical areas. In these studies, the areas of high fire danger that contain dispersed rural housing cannot be distinguished from the areas less vulnerable to wildfire (small towns and adjacent urban areas) because the data and the analysis procedures associated with the 1980 census does did not give sufficient information about rural and wildland areas. Analysts studying rural demographics supplement census data with information from such sources as local tax assessors' records or building permit files.

## INTRODUCTION

If we are going to effectively manage the wildland urban interface fire problem we need to know where people live, work and play within the interface area. We also must know something about their knowledge and attitudes toward the environment and its management and protection (Davis 1990; Irwin 1987, 1988). We need to know where people obtain their knowledge and how they formulate their ideas and attitudes--a rapidly developing field called psychographics. If we know what our customers want and what benefits they perceive, we can be more effective in communicating with them.

We can help develop a firesafe community by influencing the location of housing within fire-prone areas and help regulate the design of homes and other structures in those locations most likely to burn. The interrelationship between the factors that result in a choice of a building site and the factors that matter in fire spread and suppression, such as vegetation type, slope class, and aspect, access and proximity to water and roads need to be understood. Reasonable estimates can be made of housing to be built five or more years in the future when these factors are included in population projection models (Bradshaw 1987). These estimates can be mapped and overlaid on fire risk and hazard maps to allow a fire manager to display to local policy and planning officials detailed information on the areas likely to be threatened by future wildfires and the homes and population that will be at risk unless mitigating measures are taken. The ability to display this information will enable fire managers to be proactive rather than reactive in their contacts with public leaders.

## PROBLEMS

### Rural Growth

Many foresters are surprised that they must cope with the most rapidly changing and dynamic segment of our nation's population. Although the increase in rural population has slowed somewhat since the 1970's when rural counties were

growing three times as fast as the urban counties, population growth in many of the Nation's forest and range counties continues to exceed urban population growth and will probably continue to do so past the turn of the century (Long 1983; Rice 1987).

California, for example, has traditionally doubled its population every 20 years since statehood. However, it will not double its 1970 population again until at least 2020, a period of 50 years. Yet, the population of 1.5 of its counties--all forested with the exception of one--is continuing to double in 20 years or less--the areas that are increasing in population most rapidly are those most prone to wildfires.

### Problems Beyond Local Control

Another problem is that rural area population dynamics are influenced by socioeconomic factors well beyond the borders of the area involved. California has long appealed to Americans who move for one reason or another. By the late 1960's, however, California gained migrants from fewer states than previously, and it began to send migrants to Oregon, Washington, and Nevada, as well as to Oklahoma and Virginia (Hobbs 1986). Between 1975 and 1980, California had a net loss of 420,000 people in migration exchanges with its ten western migration partners. But this loss was offset by a net gain of 534,000 people from the rest of the U.S., chiefly from the Northeast and Midwest because of the decline of the iron and automobile industries and because young professionals were being attracted to California's aerospace, computer and other high-tech industries, resulting in a total gain of 114,000 to California's population.

In the late 1970's Oregon residents sported bumper stickers asking Californians to visit but not to stay. By the mid 1980's such fears were allayed because Oregon began exporting people to California due to the decline in the woods products industry and rising unemployment in the Northwest (Sweeney 1979).

This continually changing economic situation has made population growth projections into fire prone areas difficult.

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<sup>\*</sup>Research Forester, Fire Planning and Economics Research, Forest Fire Laboratory, USDA Forest Service, Riverside, CA

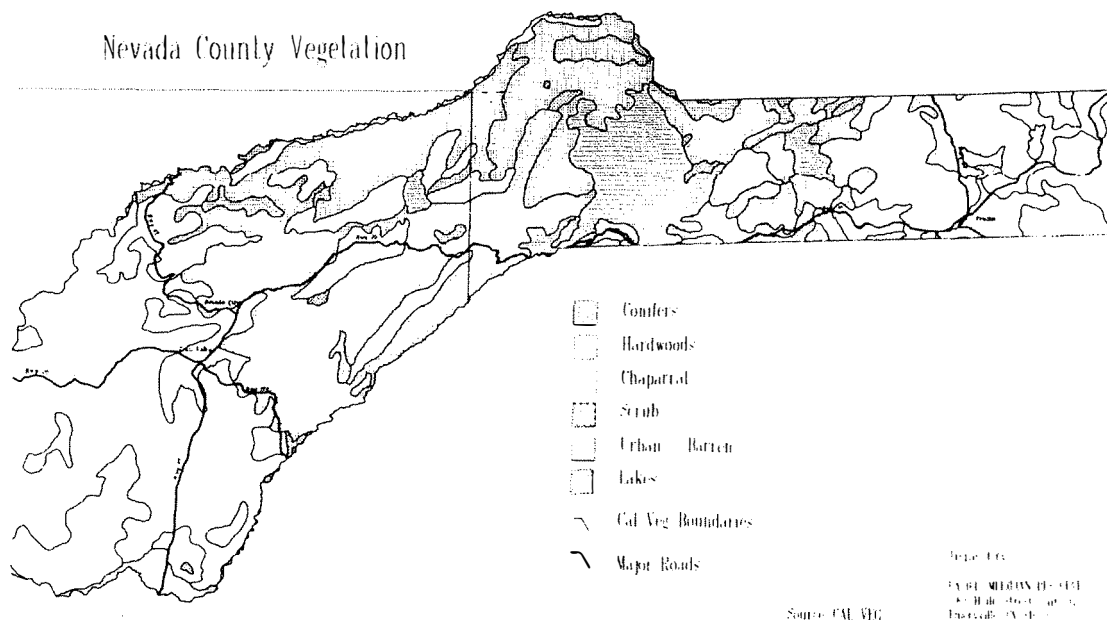


Figure 1--Broad categories of vegetation found in Nevada County. The vegetation changes from mostly grass, chaparral, and hardwoods at the lower elevations in the western part of the county, to heavy stands of conifers in National Forests covering the higher elevations in the east. Major highways are indicated on the map as well.

### Limitations on Population Growth Estimation

For foresters, the 1980 census has not been helpful because of the poor level of resolution in wildland areas; the tracts are very large areas in most instances and often include diverse demographic characteristics within a tract. For example, the twelve tracts in Nevada County, California range from thinly inhabited National Forest Land to urbanized residential areas (Fig. 1).

### Analysis Models Are Limited

While knowing "what is there now" is difficult, it is only part of our battle. We need to know "what will be there in the future." The census information does the local planner little good unless it can be interpreted for his or her needs in both a temporal and spatial manner. This is a particularly difficult problem in the wildland urban interface because there have been few predictive models. Although such models exist for urban areas--the projections needed for the construction of a shopping center, for example--we know of no case in which they have been used to predict the location and number of households at risk from wildland fire. Population analysis in rural areas has usually been concentrated on estimating the movement of population to urban areas as farm and lumber industries decline, or in predicting the broad overall change in a county level population.

Extensive literature exists on the population change of particular rural counties, and permits extrapolation of this information to many potential rural growth situations (California Department of Forestry and Fire Protection 1988). However, virtually no micro-level studies have been done to understand where people in rural areas choose to live (Lindhult and others 1988). Much of the rural demographic research--if it has been done at all--has been in the northeastern United States where counties are generally small

and relatively homogeneous. Counties in the western United States, on the other hand, are large, heterogeneous, and require a much more rigorous analysis.

Regional development models are similarly underdeveloped outside of metropolitan areas. Although they have been used to establish the regional growth within urban areas, they are less adequate for rural areas for which data and economic conditions are less well understood (Belfort and others 1988). The interrelation between economic conditions and housing development has been posited in the literature, and evidence in rural areas indicate that people often commute long distances in order to take new jobs. Economic conditions go hand in hand with changes in the housing supply, but little is known about how economic growth affects the distribution of housing in wildland interface areas which often include a high number of retired persons.

## RESEARCH ON WILDLAND DEMOGRAPHICS

The Riverside Forest Fire Laboratory, in cooperation with the University of California's Institute of Governmental Studies in Berkeley, is making an effort to solve the problem of wildland urban interface demographics. Dr. Ted Bradshaw is the principal investigator from the University for the project.

The cooperative effort is attacking the following three questions and is using Nevada County, California, as a field laboratory:

1. Can we identify reliable sources of demographic data for the wildlands.
2. Can we develop models to define and better understand the movement and eventual settlement of people in our wildland areas?

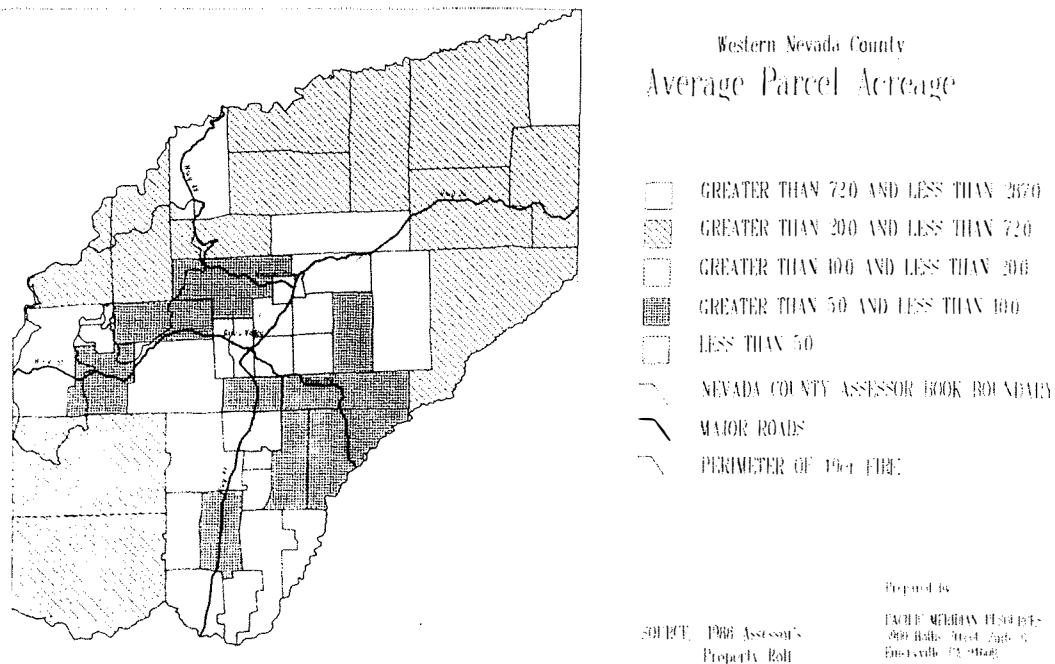


Figure 2--Patterns of population from the 1980 census. These data demonstrate the capacity of GIS to translate data on total population into density per acre. Current population densities are significantly higher due to an average annual county population growth of 6 percent since the census.

3. What must we do to take advantage of the much higher resolution data that will be available from the 1990 census and the commercially available data and analysis software that will spin off from it?

#### Identification of Data Sources

The data we are using in our research come from various sources with different geographical boundaries:

- The vegetation data are from a statewide species mapping effort called "CAL VEG" based on land and aerial data.
- Fire severity zones in Nevada County are based on a series of maps prepared by the California Department of Forestry and Fire Protection and determined from topographical, climatological, and fuel considerations (Phillips 1983).
- Census data from the 1980 census are given by enumeration district (Fig. 2). In selected areas we are examining the existing pattern of settlement by using census data, current updates, and aerial photos, when possible, and are seeking methods to estimate the accuracy of the statistical data. A major source of information has been county tax assessor's records. We have found that data on building permits are a key factor in determining patterns of growth since 1980.
- Property rolls contain information on the size, use, and value of property in the county. These data are shown for geographical areas defined by the county assessors' books.

Current research has enabled us to go from book to page level--a degree of resolution that normally will include 50 or fewer households. Also obtained from the assessors' records are data on the per acre value of improvements. The areas with the highest values usually are associated with residential construction and much of it is located in areas of high fire hazard.

Using assessors' data on average parcel size, trends in development are easy to identify. Further analysis will show the characteristics of these parcels with regard to fire dangers, roads, and physical amenities.

Our research is extending the field of investigation to include groupings much smaller and more specific than the usual national or regional aggregates. We are constrained by neither political nor administrative boundaries such as cities, villages, or natural regions, but our research is allowing us to study levels of human categories that are not territorially well defined (for example wildland urban residents).

#### Development of Models

While current population and attitudinal information should be useful to foresters and fire managers, our long-range objective is to develop predictive models. We are conducting analyses to estimate parameters of various models that include growth as well as attitude toward forest land and its management and protection. The attitude and growth are related to factors such as vegetation type, slope, aspect, attractive physical features, proximity to urban settlements, employment, subdivisions, infrastructure, roads, etc. We will determine whether our models accurately estimate growth at reasonable

levels of confidence by comparing our model determinations with patterns that have occurred over the past 5-10 years and with current building permit issuance and opinion surveys. We will select the most descriptive model and refine it as needed.

### How do we take advantage of the 1990 Census?

Although we are making headway with non-census data, the 1990 census data, when they become available in 1992 or 1993, promise to create a "desktop computer revolution."

**Along** with benchmark demographic data, the census includes a survey of housing and housing units. For our purposes the census of housing will be very important because it describes the location and demographic characteristics of the people living in each housing unit. It also details ownership, condition, and value of the property (Kirchner and Thomas 1989).

The 1990 census data will be available on four census computer "summary tape files" (STFs):

- STF-1 and STF-2 will contain data on household type, race, sex, age, marital status, and detailed information on the residence obtained from the "short" census questionnaire sent to every home in the country. This information for the first time will provide good resolution in rural areas and will be traceable to the equivalent of a city block.
- STF-3 and STF-4 will contain the same basic data as the first two summary files, plus the information from the "long" census questionnaire. The long form will be answered by a 17 percent sample of households. This form will contain demographic information that fire planners may need, including income, educational background, migration, language, type and place of employment and housing information such as availability of 3 telephone.

In fact, this high level of resolution has created somewhat of a problem to the Census Bureau in maintaining confidentiality. In rural areas it might be possible to identify the source of some data--the income of a single ranch family for example--and the Bureau has had to incorporate methods to screen out such information.

One objective of our analysis will be to determine whether the detailed 17 percent survey will give us all of the demographic information we need in very sparsely populated areas, or whether we will still have to depend to some degree on other sources such as building permits and assessors' records. Much of our research will be aimed at correlating information that we can obtain from census records with factors that cause people to move into the interface area.

### Micro Computers and Laser Discs

Although the 1990 census data will be available in several forms from hard copy reports to computer tapes, the most exciting improvement for computer-wise foresters will be that the information will eventually be available on laser read-only memory compact discs known as CD-ROMs, reflecting a decade of changing computer technology. By putting census data on laser discs, the Census Bureau will make great quantities of information available to the individual with a good personal computer **and** the computer capability to use the information. Compact discs have enormous potential because each 4-5/8-inch disc can store as much information as three computer tapes or 1,500 floppy disks. An expensive mainframe computer is not required to process information contained on a compact disc. However, one problem may be "data overkill." There is likely to be so much information that determining what information to use and how to use it efficiently will be difficult.

With the addition of a laser disc reader--available to almost every forestry or fire management headquarters office for less than \$1000--a microcomputer can become a desktop information system capable of printing STFs **on** demand.

However, despite the obvious advantages of compact discs, the Census Bureau is not releasing them as the basic medium for distributing 1990 census data because as yet, there is no standardization in disc technology. Until there is standardization as well as user-friendly software, much computer skill will be needed to use this new technology. To help users get started, the Census Bureau is making three CD-ROMs--Test Discs 1 and 2, and the 1985 American Housing Survey--available **now**. The discs sell for \$125 each and can be ordered from the Bureau's Customer Service Office.

### TIGER Files

A recent innovation, that may prove very valuable for model development and testing and for understanding wildland urban interface population dynamics, is the automated mapping system known as TIGER (Topologically Integrated Geographic Encoding and Referencing). This system has enabled the Census Bureau, working with the U.S. Geological

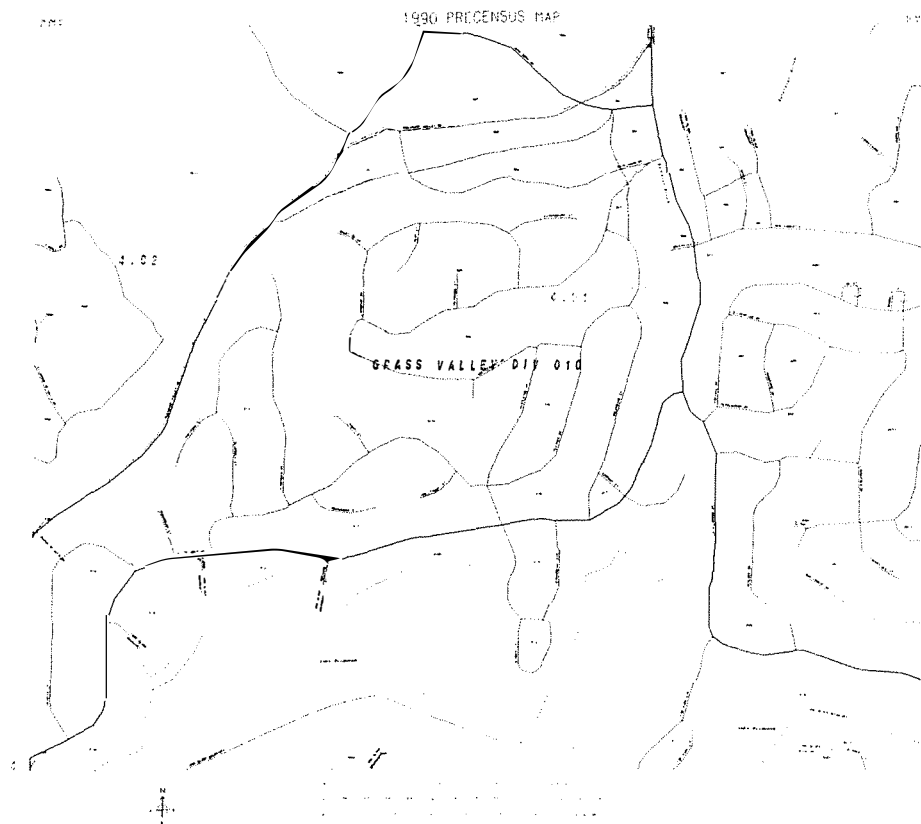


Figure 3--Section of preliminary map printed from the TIGER files. Map scale is about 4 inches to the mile. For many locations TIGER is capable of generating the most detailed and up-to-date maps available.

Survey, to develop computerized maps covering the entire United States (U.S. Department of Commerce 1985). TIGER is essentially a digital street map of the country (Fig. 3). The TIGER process uses geographical information system (GIS) technology that translates the intersection of boundaries of one type of information--census related information, for example--with information from another geographic feature.

The Bureau's preliminary plans envision TIGER boundary files for counties, census tracts, block numbering areas, and county subdivision. The road systems are so complete that forestry agencies should take a good look at them from the standpoint of updating their own transportation systems. The TIGER files currently are available only on magnetic tape, but the Bureau is looking at the possibility of releasing TIGER on CD-ROM as well.

As of now, TIGER files contain only geographical information--individual streets and other features digitally coded by latitude and longitude. They will not contain any 1990 census data. Several software companies are planning to combine the TIGER files with 1990 census data on compact discs.

### Geographical Information System Technology

Desktop demographic systems become even more powerful when linked to geocoding and mapping software--geographical information systems (GIS). GIS technology and the proposed

census data systems are virtually made for each other. Geographical information systems analysis can overlay many features about an area's population and urban development with data about the physical characteristics of the area (Thompson 1989). A GIS also provides a set of tools necessary to model and understand the flow of people, resources and commodities into and through the interface--essentially a depiction of the infrastructure.

### CONCLUSION

The ability to assign a latitude and longitude to in-house records will be a fast effective link between census information and our wildland urban hazard reduction and fire prevention efforts. GIS technology will allow land and fire managers to superimpose population forecasts and trends, fire behavior factors, and even past fire occurrence records, enabling projections of fire problems years before they actually occur.

Although this paper has been oriented to the wildland urban interface fire problem, the potential for demographic research is much greater. The dynamics of populations and their attitude toward wildlands and their management affect all phases of forestry. We expect that many of the concepts and models that we are developing will apply equally to other forestry problems from wildlife management to watershed management.

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