FIA Forest Inventory Data for Wildlife Habitat Assessment

David C. Chojnacky

Abstract.—The Forest Inventory and Analysis (FIA) program of the USDA Forest Service maintains a network of permanent plots to monitor changing forest conditions. These plots were originally established to monitor the nation's timber supply; however, these data have great potential for evaluating other forest resources. To demonstrate a wildlife application, an assessment of Mexican spotted owl habitat was done with FIA data from the Gila National Forest, New Mexico.

The Forest Inventory and Analysis (FIA) program in the Interior West monitors forested plots in a 3-mile grid for all land ownerships in Idaho, Montana, Nevada, Utah, Wyoming, Colorado, New Mexico, and Arizona. A *double sampling for stratification* design (Chojnacky 1998) is used to combine the ground plots with a more intensive data grid from aerial-photo plots to produce resource statistics. Plot locations in both phases sample about an acre. Individual trees are measured on ground plots with a subplot design.

Historically, FIA data have been used to compile tables of statewide statistics primarily describing tree attributes such as volume, growth, and mortality for numerous land ownership and classification categories (Conner *et al.* 1990, Van Hooser *et al.* 1993). The FIA summary tables and accompanying database (Woudenberg and Farrenkopf 1995), although useful for many timber applications, have had limited use for assessing wildlife habitat. However, there is great opportunity to use FIA tree attribute data—the backbone and strength of the FIA program—to develop new analyses and indices tailored to specific wildlife needs. The challenge is establishing clear linkages between the FIA tree data and structural habitat arrangements used by wildlife.

In this paper, stand density measures are used to link FIA tree data to Mexican spotted owl (*Strix occidentalis lucida*) habitat on the Gila National Forest in New Mexico. Information on habitat for Mexican spotted owl has been in high demand since the U.S. Department of the Interior Fish and Wildlife Service listed the owl as *threatened* in 1993 (under authority of the Endangered Species Act of 1973 and amendments) (USDI 1995).

Research Forester, USDA Forest Service, Rocky Mountain Research Station, Logan, UT USA (also adjunct faculty, Forest Resources Department, Utah State University).

METHODS

The FIA data for this study were gathered from the 3.3-million acre Gila National Forest, which was inventoried in 1993 to 1994 by private contract using standard FIA field procedures in a *double sampling design* (USDA 1993). First-phase stratification included sampling about 13,500 map and aerial-photo points in a 1-km grid. In the second phase, 464 permanent field plots were established in a 5-km grid (fig. 1).

Two stand-density measures, q-factor (Meyer 1952) and SDI (Long 1998), were calculated from the FIA tree data:

$$q = \exp(-2*\text{slope}) \quad (1)$$

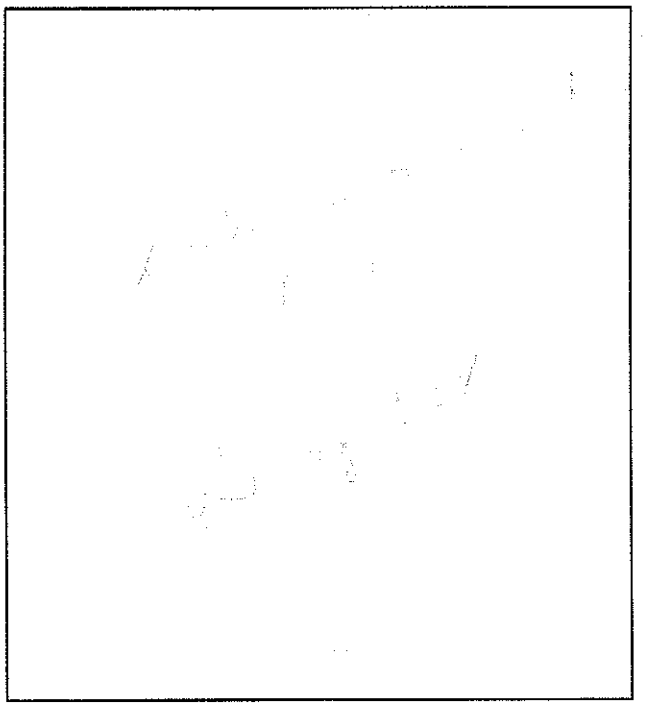

Figure 1.—*Map of 464 FIA plots established in 1993 and 1994 on the Gila National Forest in a 3.1-mile (5-km) grid for both managed forest and wilderness. UTM Easting is standardized to one grid zone for mapping.*

where

q = density factor calculated for each plot from trees per acres (*TPA*) within 2-inch diameter classes (*DCL 2*)

slope = slope (b) of linear regression for each plot: $\ln TPA = a + b\ DCL\ 2$

$$SDI = \Sigma\ (DBH_i/10)^{1.6} \qquad (2)$$

where

SDI = stamd density index calculated for each tree and summed, much like individual tree diameters are used to calculate plot basal area

dbh = diameter at breast height of the *ith* tree in a plot or stand

The q-factor and SDI were computed for each FIA plot.

SDI was expressed as percent of its maximum by using Southwestern Region Forest Service standards (for maximum SDI) applied to FIA defined forest types. The maximum SDI's used for the various forest types were: 420 for cottonwood, 450 for ponderosa pine, 595 for Douglas-fir, 830 for white fir, and 670 for spruce/fir.

SDI was also used to characterize stand structure within five diameter classes using classes defined the same as vegetation structure stages (VSS), which have been used in the Southwest (Reynolds *et al.* 1992, p. 2). The five diameter classes were used to calculate a *stand density diameter class index* (SDDI) by regressing percent SDI in a diameter class against diameter class (Chojnacky and Dick [In preparation]). This index (the regression intercept) rated plots according to how balanced SDI was among diameter classes. For example, an SDDI near 20 percent corresponded to a balanced or equal distribution of SDI among all five diameter classes. An SDDI below 20 percent meant *less* SDI in smaller diameter classes than in larger classes, and above 20 percent meant *more* SDI in smaller diameter classes than in larger classes. Therefore, an SDDI between 10 and 30 percent generally represented some SDI in all diameter classes.

The density data were classified for cover type according to Mexican spotted owl Recovery Plan guidelines (USDI 1995). Three classes corresponding to owl habitat were identified. The average species mixtures for each class were:

1 **Ponderosa pine**—62 percent *Pinus ponderosa*, 16 percent *Juniperus deppeana*, 8 percent *Quercus arizonica*, 6 percent *P. edulis*, and 5 percent *Q. gambelii*

2 **Pine-oak**—47 percent *P. ponderosa*, 33 percent *Q. gambelii*, 9 percent *J. deppeana*, and 7 percent *P. edulis*

3 **Mixed conifer**—34 percent *P. ponderosa*, 25 percent *Psuedotsuga menziesii*, 9 percent *Abies concolor*, and 5 percent *P. strobiformus*.

These three cover classes included 213 plots representing 1.4 million acres, less than half of the Gila National Forest.

RESULTS AND DISCUSSION

The density measures were graphed against each other to determine a range of possible habitat conditions suitable for owls. For example, SDDI less than 30 percent and percent of maximum SDI between 25 and 60 percent represented moderately dense plots that have balanced all-size tree distributions or more large than small trees (fig. 2). This range does not necessarily define true Mexican spotted owl habitat conditions, but it is a reasonable range for illustrating possible summary results with FIA data.

Given the hypothetical density range for owl habitat (fig. 2), area summary showed confidence intervals ranging from 20 to 35 percent for mixed conifer and ponderosa cover classes (fig. 3). These confidence intervals are probably too large to effectively monitor owl habitat for a single national forest, but regional estimates based on FIA data for several national forests are likely to narrow confidence intervals to more acceptable ranges.

Owl habitat was about evenly distributed between the Gila's wilderness and managed forest (fig. 3). FIA data contain many other classification variables that could be used to draw inferences about management implications from forest conditions or land use.

In summary, the FIA data show promise for monitoring Mexican spotted owl habitat at a regional scale. However, a critical linkage between owl habitat requirements and FIA tree density measures (functions of SDI or q-factor) is lacking. Owl demographics need to be compared to FIA data to determine appropriate ranges for suitable habitat. Nevertheless, the FIA network of plots is a ready source of information that could describe and monitor the owl's habitat needs.

ACKNOWLEDGMENTS

I wish to thank the reviewers of this manuscript: Sharon Woudenberg of Forest Inventory and Analysis at the USDA Forest Service, Rocky Mountain Research Station, Ogden, UT, USA, and Jim Dick of the USDA Forest Service, Southwestern Region, Albuquerque, NM, USA.

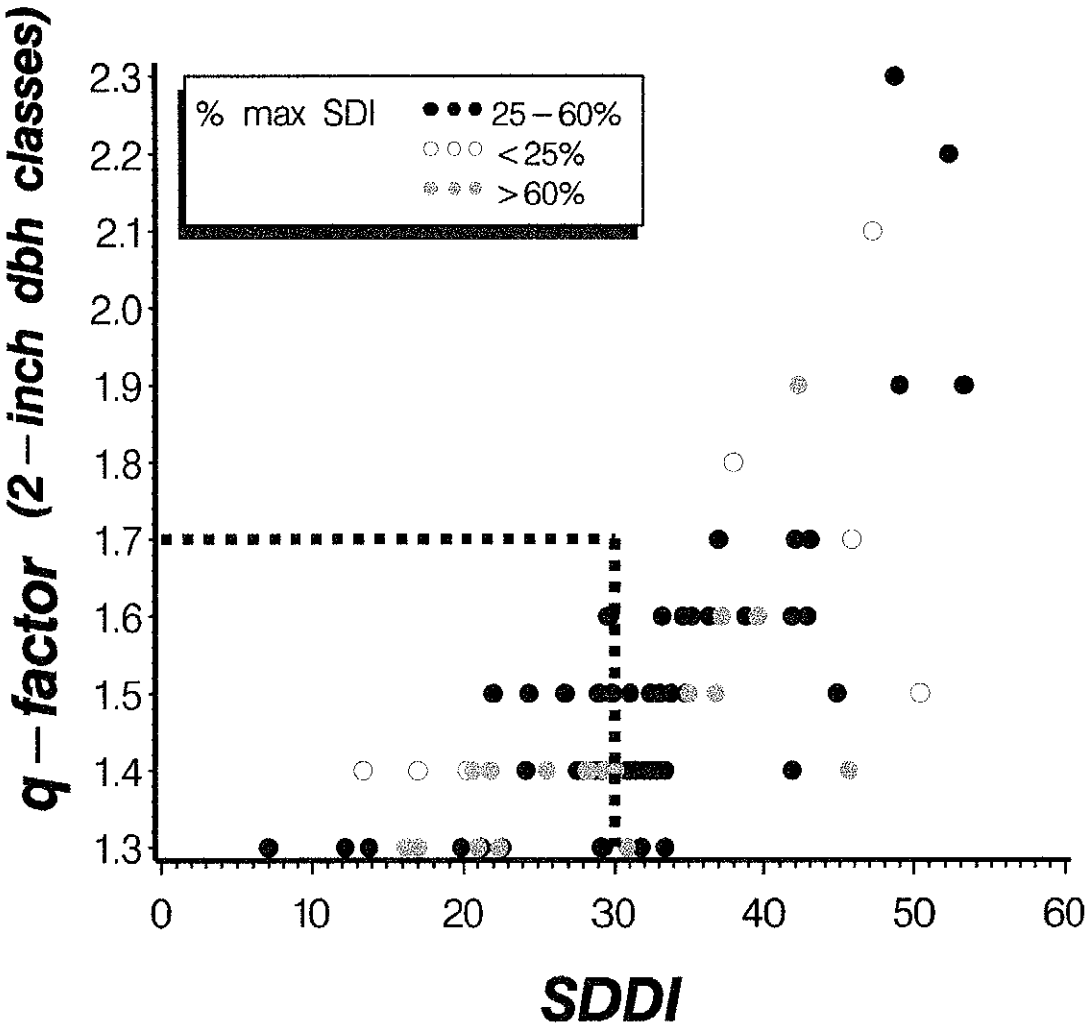

Figure 2.—*Comparison of three ways to measure density for the mixed conifer cover class in the Gila National Forest. More favorable stand density for Mexican spotted owl is highlighted within the dashed box.*

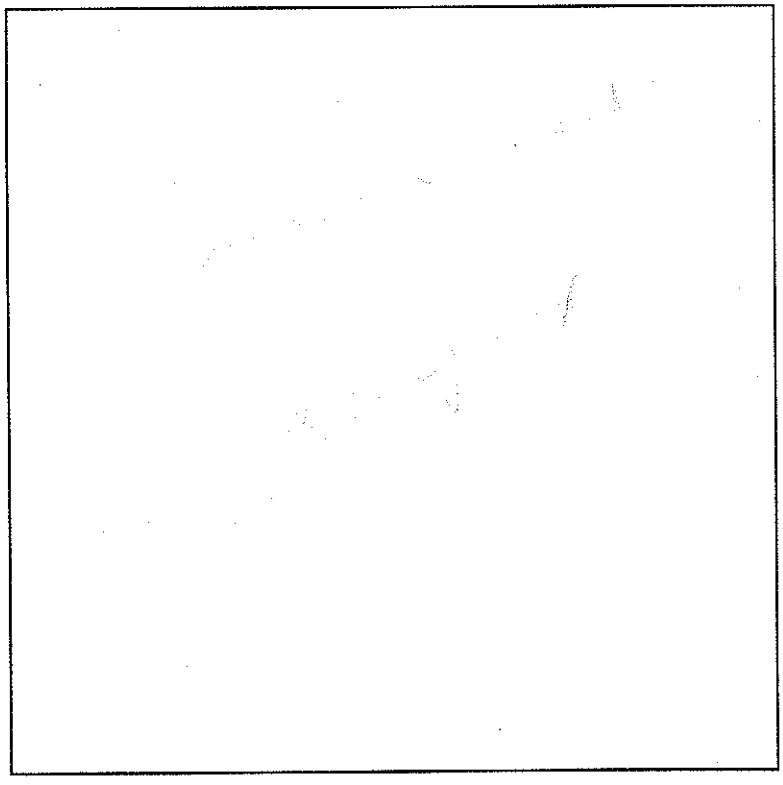

Figure 3.—*Example of Mexican spotted owl habitat where stand density conditions are selected for SDDI less than 30, and percent of maximum SDI between 25 and 60 percent, 1993-94 Gila National Forest inventory.*

LITERATURE CITED

Chojnacky, D.C. 1998. Double sampling for stratification: a forest inventory application in the Interior West. Res. Pap. RMRS-RP-7. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 15 p.

Chojnacky, D.C.; Dick, J.L. [In preparation] Habitat assessment for Mexican spotted owl using FIA forest inventory data. Logan, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Forestry Sciences Laboratory.

Conner, R.C.; Green. A.W.; Born, J.D.; O'Brien, R.A. 1990. Forest resources of Arizona. Resour. Bull. INT-64. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 92 p.

Long, J.L. 1998. Multiaged systems in the Central and Southern Rockies. Journal of Forestry. 96(7): 34-36.

Meyer, H.A. 1952. Structure, growth, and drain of balanced uneven-aged forests. Journal of Forestry. 50(2): 85-92.

Reynolds, R.T.; Graham, R.T.; Reiser, M.H.; *et al.* 1992. Management recommendations for the northern goshawk in the Southwestern United States. Gen. Tech. Rep. RM-217. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 90 p.

U.S. Department of Agriculture, Forest Service, 1993. Interior West forest land resource inventory field procedures. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Forest Survey. 180 p.

U.S. Department of the Interior, Fish and Wildlife Service. 1995. Recovery plan for the Mexican spotted owl: Volume I. Albuquerque, NM: U.S. Department of Interior, Fish and Wildlife Service. 172 p.

Van Hooser, D.D.; O'Brien, R.A.; Collins, D.C. 1993. New Mexico's forest resources. Resour. Bull. INT-79. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 110 p.

Woudenberg, S.W.; Farrenkopf, T.O. 1995. The Westwide forest inventory data base: user's manual. Gen. Tech. Rep. INT-317. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 67 p.