MODELLING HABITAT CAPABILITY FOR FOREST WILDLIFE IN SOUTHEAST ALASKA USING A CORPORATE DATABASE

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Abstract: Information management in the USDA Forest Service is leading toward the development of corporate databases. Basic resource information is maintained in a single database and is made available to all resource specialists for interpretation. A corporate database has been established for southeast Alaska which includes information on vegetation, topography, soils, and streams. A geographic information system (GIS) is used to extract information from the corporate database for specific applications. Habitat capability models have been developed for 13 wildlife species for use in evaluating the effects of management activities. The data management methodologies we applied to implement the habitat capability model for Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) are presented as an example of use of the corporate database and the GIS.

THE PAST

Management of information by the USDA Forest Service through automated systems is a dynamic process. The Forest Service began using computers in the 1960's in a few locations primarily for number manipulation for accounting and engineering applications (Hartgraves 1989). Throughout the 1970's the Forest Service used a centralized computer system to support several nation-wide business, engineering, and resource-management applications that had limited on-the-ground application. The 1980's brought computer technology to all management levels in the Forest Service. Initial efforts were also made to bring essential information together in an integrated and managed information environment.

However, even though progress has been made in the area of data management in the Forest Service, specific types of data have traditionally been maintained and managed by specific resource areas (e.g., engineers have maintained road inventory data, foresters have maintained timber inventory data, and wildlife biologists have maintained information on wildlife habitats). Often different resource specialists would collect similar information and store it in their own databases resulting in redundancy in data collection and management and databases that are incompatible. Sharing of information was limited because access to each resources' database was limited. During project planning each member of the interdisciplinary team brought their own information into the planning process. This procedure was inefficient and often lead to misunderstandings and unnecessary conflict.

THE FUTURE

During the 1990's the Forest Service is moving toward integrated information management. The intent is to develop and maintain one set of natural resource information for each administrative unit that provides for the needs of all resources. Such a corporate database would maintain the integrity of each data set but all sets would be linked. An information needs assessment would be completed for each application. Information required for the specific application would be extracted from the corporate data structure, interpreted or modified if necessary, and placed in a project database through application of computer systems. This second, or processed database, is known as a "decoupled" database (Martin 1982). These separate, project-level databases can be small and easy to use but they are integrated by using data from a central database. Under this data management system, resource specialists would come together during project planning with access to the same information and with a better understanding of the complete resource situation. Critical components of the Forest Service's approach to integrated information management and the use of a corporate database on the Tongass National Forest in southeast Alaska are the use of a relational database and a geographic information system (GIS). A relational database simplifies data management and a GIS allows the data to be evaluated and displayed spatially.

THE APPLICATION

The Setting

The Tongass National Forest was designated as a pilot Forest to implement and test the corporate database concept and application of a GIS in a land management planning concept. The land management plan for the Tongass National Forest was implemented in 1979. The plan, which is currently undergoing a revision, provided a prime opportunity for this application. We will briefly describe the development of a corporate database for the Forest and present how a habitat capability model for Sitka black-tailed deer was applied to the data using a GIS.

The Tongass National Forest is the largest National Forest in the U.S. National Forest System at 6,880,000 ha. It is characterized by mountains, islands and peninsulas interspersed with numerous rivers, lakes, and saltwater channels. Vegetation communities in this area include upland old growth forests of western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*) with scattered red cedar (*Thuja plicata*) and Alaska cedar (*Chamaecyparis nootatensis*). These forests are interspersed with estuaries, riparian areas that include stands of red alder (*Alnus rubra*) and black cottonwood (*Populus trichocarpa*), muskeg openings with scattered shore pine (*Pinus contorta*), subalpine forests of mountain hemlock (*Tsuga mertensiana*), and alpine areas.

The Database

Successful application of a GIS in land management planning is predicated on efficient management of data (Johnston 1987). This was especially true on the Tongass National Forest where the database is made up of approximately 2,100 maps, making it one of the largest in the world that has been incorporated into a GIS. Thirty-nine kinds of data were identified as needed to manage the Tongass National Forest during the development of the database structure. However, only 11 of the 39 map layers, were considered essential to the current planning effort (Table 1).

Management Indicator Species

Thirteen wildlife species were selected as management indicator species (MIS) to provide a basis for evaluation during the revision process (Table 2). Population changes of MIS are believed to reflect the effects of land management activities. The total number of species occurring within a planning area can be reduced through this concept to a number that promotes meaningful evaluation. The evaluation of the effects of management practices on MIS and their habitats provides an additional basis for ensuring the maintenance of biological diversity. Interagency task groups developed habitat capability models for each of the MIS that were designed for implementation on the GIS. These models required information on several habitat variables and other information (e.g., buffers) available from the corporate database through the GIS (Table 3).

Sitka Black-tailed Deer.--The habitat capability model for Sitka black-tailed deer required information from the (1) vegetation map layer (i.e., overstory tree species, forest productivity, and successional stage; (2) stream channel type layer (riparian areas); (3) soil

Table 1. Mapped information required for the revision of the Tongass Land Management Plan.

Primary base series information for shoreline, administrative areas, and ownership
Vegetation
Roadless areas
Quadrangle map boundaries
Existing and planned roads
Value Comparison Units[a]
Elevation ranges and aspect derived from digital elevation model
Soil polygons
Stream channel type
Third order watersheds
Recreation and visual polygons

[a]Value Comparison Units were derived in 1978 for preparation of the Tongass Land Management Plan and served as the basic area for analysis purposes. They are distinct geographic areas whose boundaries, in most cases, follow watershed divides.

Table 2. Wildlife management indicator species being used in the revision of the Tongass land management plan.

Common name	Scientific name
Gray wolf	*Canis lupus*
Black bear	*Ursus americanus*
Brown bear	*Ursus arctos*
Marten	*Martes americana*
River otter	*Lutra canadensis*
Sitka black-tailed deer	*Odocoileus hemionus sitkensis*
Mountain goat	*Oreamnos americanus*
Red squirrel	*Tamiasciurus hudsonicus*
Vancouver Canada goose	*Branta canadensis fulva*
Bald eagle	*Haliaeetus leucocephalus*
Hairy woodpecker	*Picoides villosus*
Red breasted sapsucker	*Sphyrapicus ruber*
Brown creeper	*Certhia americana*

polygons (riparian areas); (4) topographic map layer (i.e., aspect and elevation); and (5) value comparison unit layer (winter severity and presence of predators) (Table 4) (Suring et al. 1988).

The value of habitat for deer, under varying weather conditions, is directly related to the composition, structure, and productivity of vegetation on a site (Harestad 1985). During low snow conditions, when habitat selection by deer is not significantly influenced by snow, deer will select those habitats that provide the best foraging opportunities. Under intermediate and deep snow conditions deer will select those habitats that provide for snow interception and food availability. The combination of a dense canopy with scattered openings in old-growth forests allows forage

Table 3. Variables included in the GIS used to model habitat capability for the management indicator species for revision of the Tongass land management plan.

Management Indicator Species	Variables
Gray wolf	None (based on number of prey animals- black-tailed deer and mountain goat)
Black bear	Forest overstory type Upland Riparian Beach fringe Estuary Timber volume class Successional stage Stream class
Brown bear	Forest overstory type Upland Riparian Beach fringe Estuary Successional stage Stream class Disturbance/mortality
Marten	Forest overstory type Upland Beach fringe/riparian Timber volume class Successional stage Elevation
Brown creeper	Forest overstory type Timber volume class Successional stage
River otter	Forest Upland Riparian Beach fringe Timber volume class Successional stage Elevation Stream class Lake size
Sitka black-tailed deer	Forest overstory type Upland Riparian Timber volume class Successional stage Elevation Aspect Winter severity Predators Patch size
Mountain goat	Forest overstory type Timber volume class Successional stage Aspect Presence of cliffs
Red squirrel	Forest overstory type Successional stage
Vancouver Canada geese	Forest overstory type Beach fringe Riparian Timber volume class Successional stage Elevation
Bald eagle	Forest overstory type Upland Riparian Beach fringe Timber volume class Successional stage Elevation Stream class Lake size
Hairy woodpecker	Forest overstory type Timber volume class Successional stage
Red-breasted sapsucker	Forest overstory type Timber volume class Successional stage

Table 5. Effect of adding variables into the habitat capability model for Sitka black-tailed deer on the Port Alexander quadrangle in southeast Alaska.

Variables Considered	Average Capability Index	Estimated Habitat Capability (No. deer)	Change by Step	Cum. % change
Forested/nonforested	0.5	10,560	--	--
Forested/nonforested, Productive/unproductive	0.4	9,160	-13	-13
Forested/nonforested, Productive/unproductive, Successional stage	0.4	7,770	-15	-26
Forested/nonforested, Productive/unproductive, Successional stage Volume class	0.4	7,430	- 4	-29
Forested/nonforested, Productive/unproductive, Successional stage Volume class, Forest type	0.4	7,510	+1	-29
Forested/nonforested, Productive/unproductive, Successional stage Volume class, Forest type, Riparian	0.4	7,460	- 1	- 29
Forested/nonforested, Productive/unproductive, Successional stage Volume class, Forest type, Riparian, Elevation	0.3	5,550	- 26	- 47
Forested/nonforested, Productive/unproductive, Successional stage Volume class, Forest type, Riparian, Elevation, Aspect	0.2	5,220	- 6	-51
Forested/nonforested, Productive/unproductive, Successional stage Volume class, Forest type, Riparian, Elevation, Aspect, Predators/no predators	0.2	4,310	-17	-59

Table 6. Magnitude of effect of habitat variables on the estimation of habitat capability for Sitka black-tailed deer in southeast Alaska.

Variable	Percentage Change
Elevation	-26
Predators	-17
Successional stage	-15
Productive/unproductive forest	-13
Aspect	-6
Timber volume class	-4
Riparian forest	-1
Forest type	+1

ability to consider multiple variables. Elevation, successional stage, and presence/absence of predators had the greatest effect on habitat capability in this application (Table 6). These three variables come from separate inventories that would have been difficult to access simultaneously without the corporate database and the GIS. Use of a corporate database also assures individual users that they have access to the latest version of all inventory data.

The corporate database and the GIS were used to also describe other resources (e.g., timber, recreation) in a similar fashion. Timber planners used several inventories (i.e., vegetation, soils, roads, administrative boundaries) to determine which areas on the Tongass National Forest were tentatively suitable for timber production (L.H. Suring, E.J. DeGayner, and W.H. Wilson, USDA For. Serv., Alas. Reg., unpubl. data). The results of timber evaluations and estimates of habitat capability can be overlayed to identify potential conflict areas and areas where timber harvest may not have a significant impact on habitat capability.

SUMMARY

The corporate database assembled for the Tongass National Forest provides information from several diverse resource areas to describe the Forest. The availability of such information through a GIS allows a thorough evaluation of habitat capability for several species on a Forest-wide or a project basis. The evaluation may be completed rapidly for several different management options. There is also the assurance

that the information used is consistent with that being used by other resource specialists. This promotes understanding of the needs of competing resources, helps display effects and tradeoffs, and enhances resolution of conflicts.

LITERATURE CITED

HANLEY, T.A. 1984. Relationships between Sitka black-tailed deer and their habitat. USDA For. Serv., Gen. Tech. Rep. PNW-168. 21 pp.

______, and C.L. ROSE. 1987. Influence of overstory on snow depth and density in hemlock-spruce stands: Implications for management of deer habitat in southeastern Alaska. USDA For. Serv., Res. Note PNW-RN-459. 11 pp.

HARESTAD, A.S. 1985. Habitat use by black-tailed deer on northern Vancouver Island. J. Wildl. Manage. 49:946-950.

HARTGRAVES, C.R. 1989. The Forest Service future information environment (using technology to get closer to the ground). Paper delivered to the Natl. Conf. on Geogr. Inf. Systems, The Concourse, Vienna, Va. 9 pp.

JOHNSTON, K.M. 1987. Natural resource modelling in the geographic information system environment. Photogrammetric Engineering and Remote Sensing 53:1411-1415.

KEITH, L.B. 1974. Some features of population dynamics in mammals. Proc. Int. Congr. Game Biol. 11:17-58.

KIRCHHOFF, M.D., and J.W. SCHOEN. 1987. Forest cover and snow: Implications for deer habitat in southeast Alaska. J. Wildl. Manage. 51:28-33.

MARTIN, J. 1982. Strategic data-planning methodologies. Prentice-Hall International, Inc., London. 236 pp.

PARKER, K.L., C.T. ROBBINS, and T.A. HANLEY. 1984. Energy expenditures for locomotion by mule deer and elk. J. Wildl. Manage. 48:474-488.

ROSE, C.L. 1982. Deer response to forest succession on Annette Island, southeast Alaska. M.S. Thesis, Univ. Alaska, Fairbanks. 59 pp.

SCHOEN, J.W. and M.D. KIRCHHOFF. 1985. Seasonal distribution and home-range patterns of Sitka black-tailed deer on Admiralty Island, southeast Alaska. J. Wildl. Manage. 49:96-103.

______, ______, and M.H. THOMAS. 1985. Seasonal distribution and habitat use by Sitka black-tailed deer in southeastern Alaska. Final Rep. Fed. Aid in Wildl. Rest., Proj. W-17-11, W-21-1,2,3, and 4. Job 2.6R. Alaska Dep. Fish and Game, Juneau. 44 pp.

______, ______, and O.C. WALLMO. 1981. Seasonal distribution and habitat use by Sitka black-tailed deer in southeastern Alaska. Vol. II. Fed. Aid in Wildl. Rest., Proj. W-22-1, Job 2.6R. Alaska Dep. Fish and Game, Juneau. 59 pp.

SURING, L.H., E.J. DEGAYNER, R.W. FLYNN, M.D. KIRCHHOFF, J.R. MARTIN, J.W. SCHOEN, and L.C. SHEA. 1988. Habitat capability model for Sitka black-tailed deer in southeast Alaska: winter habitat. USDA Forest Service draft document, Alaska Region, Juneau. 25 pp.

VAN BALLENBERGHE, V. and T.A. HANLEY. 1984. Predation on deer in relation to old-growth forest management in southeastern Alaska. Pages 291-296 *in* W.R. Meehan, T.R. Merrell, Jr., and T.A. Hanley (eds.). Fish and wildlife relationships in old-growth forests: Proceedings of a symposium. Am. Inst. Fish. Res. Biol., Reintjes Publ., Morehead City, N.C.