

California Hardwood Rangeland Use and Productivity Changes, and the Economics of Regional Livestock Production¹

Gerald L. Horner James H. Cothorn²

Abstract: Changes in the availability, productivity and cost of hardwood rangeland affects the production and location of range-fed livestock. The California Range Livestock Model (CRLM) was developed to determine the effect of proposed policies and alternative economic conditions on the range-fed livestock industry generally and hardwood rangeland in particular. Three possible changes in range conditions were analyzed with the CRLM. Eliminating grazing on 9.7 million acres of Federally owned rangeland in California reduced annual livestock production by \$80 million and producer's incomes by \$9.3 million. Increasing productivity on privately owned and grazed rangeland by 5 pct increased the state's annual cattle production by \$70 million. Developing 1.3 million acres of rangeland in Southern California for urban uses would decrease annual livestock production in that region by \$50 million. The model has the potential of being used in conjunction with other existing forest and rangeland models to provide more comprehensive policy information for range managers.

The California Range Livestock Model (CRLM) is a spatial and market equilibrium model designed for economic and policy analysis of managing California's hardwood rangelands (CH2M Hill 1989). This model projects how changes in public policy or economic conditions affects the amount of regional livestock production, production costs, producer incomes and rangeland use. Spatial equilibrium models such as CRLM are not designed for probabilistic forecasts of the future, but rather for static analysis of comparative conditions of policies. Comparative statics explains how a contemplated policy or economic change can affect a sectors long term equilibrium production patterns.

CRLM was developed to augment the current planning analysis being conducted by the Forest and Rangeland Resources Assessment Program (FRRAP) of the California Department of Forestry and Fire Protection. The model design is influenced by current issues facing FRRAP. These issues include how the economic and institutional force affect the range livestock industry and the related demand for, and supply of forage from hardwood rangeland. This paper examines this model, whose purpose is to project the effect of alternative hardwood range management and use policies on livestock production. In addition, the movement of livestock among range types, by location, and markets will be estimated.

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²Consulting Agricultural Economist, Davis, California: and Professor of Agricultural Economics, California State University, Fresno.

MODEL DESCRIPTION

The production of range livestock is specified for cow-calf, sheep and stocker operations for eight California regions (fig 1). The model uses 1987 as a base year and simulates decisions regarding the number of livestock put on available rangeland, specified by five owner classifications and nine cover types.

Range carrying capacities (Animal Unit Months (AUMS)/acre) were derived for nine cover types, four owner classifications and eight regions by dividing the number of AUMS available for grazing by the number of grazed acres (Huntsinger 1988). Total regional range livestock production was constrained by the amount of rangeland available for grazing by cover type and owner. Grazing fees reported by Bowie and Watson (1986), Bartlett and others (1983), McKean and others (1986) and US Dept. of Interior (1988) were used to derive grazing fees by AUM for each rangeland cover type, owner and region.

Range livestock numbers were estimated by FRRAP for 1985 (Huntsinger 1988). Since this is the last estimate made and the number of livestock remained stable between 1985 and 1987 and the 1985 estimates were used to represent 1987 range use (table 1).

Production costs were estimated for 1987 by size of operation and region. Significant cost differences were observed for small and medium cow-calf herd size operations. Livestock produced in California are assumed to be marketed at five major state markets with varying market prices and transportation costs. These markets are located in Dixon, Cottonwood (Redding), Stockton, Visalia, and El Centro. Stocker calves can be purchased from the same five markets and from two out-of-state markets representing the northwest and southwest regions. Average 1987 livestock prices observed in the five markets were used in the model (Federal-State Market News Service 1987). Cattle produced in any region can be sold in any market depending on varying prices and transportation costs.

Positive Mathematical Programming (PMP) is employed in CRLM (Howitt and Mean 1983). A model used for optimization of problems of this type will optimize subject to exogenously specified constraints. PMP allows the model to reproduce observed activity levels without using arbitrary constraints. This allows the model to seek optimal levels based on economic criteria and not on constraints that may not be justified. Policies simulated in the model are compared with 1987 conditions. A more complete description of the model is given in CH2M HILL (1989).

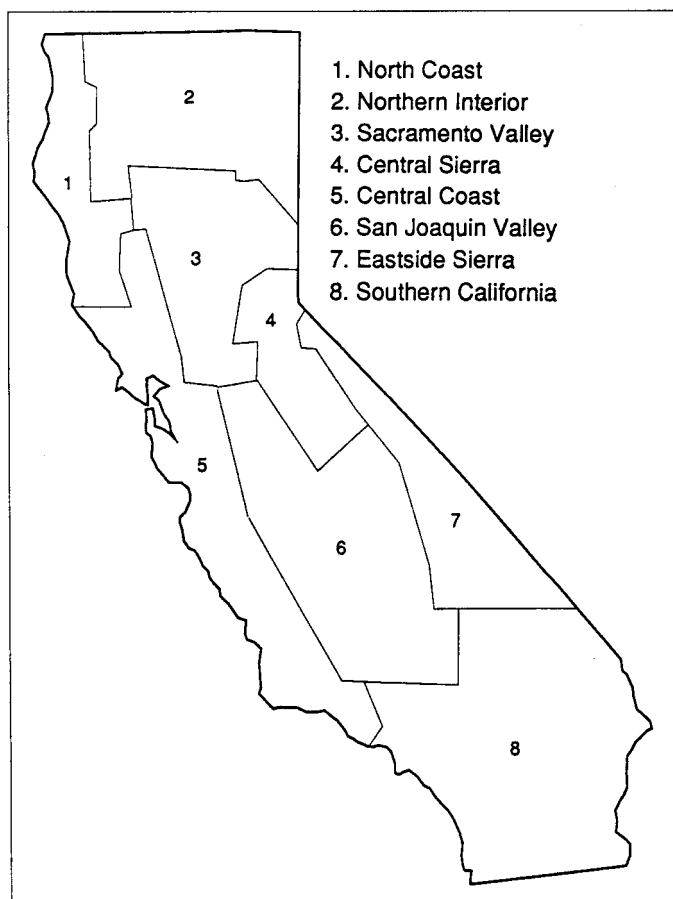


Figure 1—Forest and range Land Resource Assessment Program Regions, California Department of Forestry and Fire Protection.

Table 1—Range Livestock by Region, 1987

Region	Cows	Stockers	Ewes
		(1,000 Head)	
North Coast	48	26	43
Northern Interior	175	38	23
Sacramento Valley	143	103	207
Central Sierra	74	14	19
Central Coast	247	162	80
San Joaquin Valley	272	412	295
Eastside Sierra	20	4	9
Southern Calif.	36	48	93
TOTAL	1,015	806	769

RESULTS

Three different potential policy considerations were simulated in the model and results compared with 1987 livestock production levels, incomes, and rangeland use. The first considered a withdrawal or elimination of all livestock grazing on Federal lands, the second specified range improvements, while the third considered the problem of urban encroachment. These policies have not been formally proposed by any agency group and policy recommendations are not intended by these results. The scenarios were formulated solely to demonstrate the capabilities of the CRLM as well as the type of information which can be generated by the program.

Eliminate Livestock in Federal Rangelands

BLM and Forest Service grazing permits were assumed to be withdrawn for all cover types in all regions. This amounts to about 9.7 million acres of the 30 million acres estimated to be grazed in California in 1987. Although this represents 32 pct of the total grazing land in the State, it provides only 7 pct of the AUMS grazed. Federal leases are vital to the livestock industry in some regions. About 41 pct of the total grazing land leased by the Federal government is classified as desert land located in Southern California and managed by the BLM. The Forest Service leases large acreages of conifers in the Northern Interior, Sacramento Valley, San Joaquin Valley and the Eastside of the Sierra, and oak woodland and chaparral in Southern California. Federally leased rangeland accounts for 49 pct of the total AUMS in the Eastside of the Sierras, 27 pct in Southern California, and 25 pct in the Northern Interior.

Projected livestock, numbers, production and income levels for the State without Federal grazing are as follows:

	1987 (1,000 Head)	Pct Change from 1987
Cows	1,015	-4
Stockers	806	-17
Ewes	769	<1
Value of Production:(\$million)		
Cattle	797	-11
Sheep	84	<1
Income:		
Cow-calf	209	-3
Stocker	22	-18
Ewes	32	<1

A \$9.3 million decline in California livestock income is projected by CRLM if grazing on Federal lands is eliminated. This represents a 3.6 pct decline for the industry. Cattle production

is projected to decline by \$80 million. Income from cow-calf operations is reduced by \$5.3 million and by stockers by \$3.9 million. The overall impact on the livestock industry is not severe but regional impacts are drastic. Producer incomes in the Eastside Sierra are projected to decline by \$1.2 million or 33 pct. A 24 pct decline (\$4 million) in Northern Interior incomes is projected due to the large acreage of Federal grazing land and a shortage of alternative range supplies.

Stocker production would be decreased by 60 pct in Northern Interior, Central Sierra, and Southern California if Federal grazing were to be terminated. In the State, about 140,000 stockers and 36,000 cows would be eliminated.

Improved Range Productivity

Increasing productivity of rangeland has been the subject of many research and educational efforts. To estimate the effect of increasing productivity on livestock production and producer incomes, a 5 pct increase in carrying capacity on the 17 million acres of privately owned and grazed rangeland was posed to CRLM. Grazing fees, other production costs and prices were assumed to remain unchanged from 1987.

Projected increases in livestock income and production resulting from increased rangeland productivity are as follows:

	1987 (1,000 Head)	Pct Change from 1987
Cows	1,015	<1
Stockers	806	19
Ewes	769	<1
Value of Production: (\$million)		
Cattle	797	9
Sheep	84	<1
Income:		
Cow-calf	209	-1
Stocker	22	18
Ewes	32	-

Total industry income is projected to increase by \$3.6 million (1.38 pct) with an increase of nearly \$70 million in production with the 5 pct increase in productivity. Again the most significant change is in the production of stocker cattle. In addition, grazing is reduced on some non- Federal public range-lands. Grazed acreage in the Central Sierra is projected to decline by 61,000 acres as cattle are moved from public to the more productive private range. Cattle production in the San Joaquin Valley is projected to increase by 69,000 head. Sacramento Valley cattle production could increase by 17,000 head.

Urban Encroachment

Urban growth can expand into rangeland being used for livestock grazing. Land use policy is currently redirecting development away from prime agricultural land to less productive classes of land. This policy could have important impacts on regional livestock production. The assumption of the scenario is that the supply of all classes of rangeland (nine cover types, five owner classes) would be reduced by 10 pct in those regions which amounts to 1.3 million acres.

CRLM results indicate that livestock production levels would be reduced by \$49 million annually which amounts to about \$2 million in income. As in the other scenarios, almost all of this reduction is in stocker production with cow-calf operators remaining at the same level of production. This scenario represents a large conversion of rangeland to other uses and it could have a significant effect on the overall viability of livestock production in those two regions even though only stocker production changes are projected. Some cattle operations attempt to split operations between cow-calf and stocker enterprises. Reductions in rangeland will probably reduce cow-calf operations in the long run if the split operational mode is maintained. The split operation is not specified in the CRLM.

CONCLUDING COMMENTS

The CRLM projects that eliminating grazing on 9.7 million acres of Federally owned rangeland in California will reduce annual livestock production by \$80 million and producer's incomes by \$9.3 million. Model results also indicate that increasing productivity on privately owned and grazed rangeland by 5 pct will increase the state's annual cattle production by \$70 million. The model projects a decrease in annual livestock production in Southern California by \$50 million if 1.3 million acres of rangeland are developed for urban uses. Such a decline may eventually lead to the demise of the region's live stock industry due to a lack of support services.

CRLM can provide rangeland managers with a quick method of assessing proposed policies and determining the effects of changes in economic conditions on livestock production and range use. The livestock industry has been steadily declining since the 1960's. The industry has been beset by a continued set of institutional, political and natural problems which have continued to make operating conditions difficult and uncertain for the typical livestock operator. Some of the past policies

impacting the industry are the Food and Security Act, the PIK program, the dairy program, particular aspects of the dairy termination program, and tax reform. This model is capable of quickly projecting production, rangeland use and income from such policy changes if they are again contemplated in the future.

The model is also intended to be sufficiently flexible to be able to include firm level management issues that may become more important in the future. One such issue is the recent decline of hardwoods on rangelands and the future possibility of not meeting public needs for open space and wildlife habitat. Whether this trend can be reversed voluntarily or by changes in public policy requires an evaluation of urban land use changes and the profitability of livestock production. Standiford and Howitt (1989) have developed a ranch level dynamic model to determine optimal amounts of oak harvesting, recreational hunting and livestock production. Results indicate that hardwood rangeland owners may reduce oak harvesting to capture returns from hunting. These results can be specified in the CRLM to be able to project the statewide significance of the emerging hunting market.

FRRAP has also developed a model called CALPLAN to assess the current and future condition of the state's forests and rangeland and to identify future policy actions (Davis and others 1987). CALPLAN uses detailed land use data from FRRAP's geographic data system to project the amount and timing of timber and livestock production by county, cover type, owner and owner behavior class. The model uses goal programming to assess the effect of public agency timber production, recreation, and wildlife habitat targets on forests and rangeland. The CRLM provides added detail on the livestock industry which could be easily integrated into CALPLAN.

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