

A TRANSHUMANCE BEEF INDUSTRY
OF SOUTHERN OREGON

by

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ABSTRACT

The Upper Klamath Valley and Klamath Marsh areas of south-central Oregon comprise the summer range for a modern system of transhumance agriculture. Approximately 72,000 head of cattle are annually trucked from these relatively small Klamath pastures to winter pastures scattered throughout the Sacramento Valley. Field research indicates that the development of this system results from characteristics of the physical base and past and present economic conditions. Topography, soils, climate and water supply combine to produce rich pastures in an area otherwise incapable of supporting intensive summer grazing. Economic factors, in particular favorable transportation rates and local production costs, have encouraged the seasonal use of these pastures in a transhumance system. The resulting "beef monoculture" appears stable but may be subject to radical revision should the economic factors change adversely.

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INTRODUCTION

The Study Area

The Upper Klamath Valley and Klamath Marsh areas of south-central Oregon comprise the summer range for a modern system of transhumance agriculture.¹ Approximately 72,000 head of cattle are annually trucked from these relatively small Klamath pastures to winter pastures scattered throughout the Sacramento Valley. Field research indicates that the development of this system resulted from features of the physical base plus both historical and existing economic conditions. Local characteristics of topography and water supply combine to produce rich pastures in an area otherwise incapable of supporting intensive summer grazing. Conversely, soil and climatic characteristics prevent alternative uses and discourage the local wintering of cattle. Favorable economic factors, in particular transportation rates and local production costs, have further encouraged the seasonal use of these pastures in a transhumance system. The area thus provides a case study of both a locally adapted transhumance system and its adaptation to the physical base and the economic environment. (Fig. 1)

THE KLAMATH PASTURES

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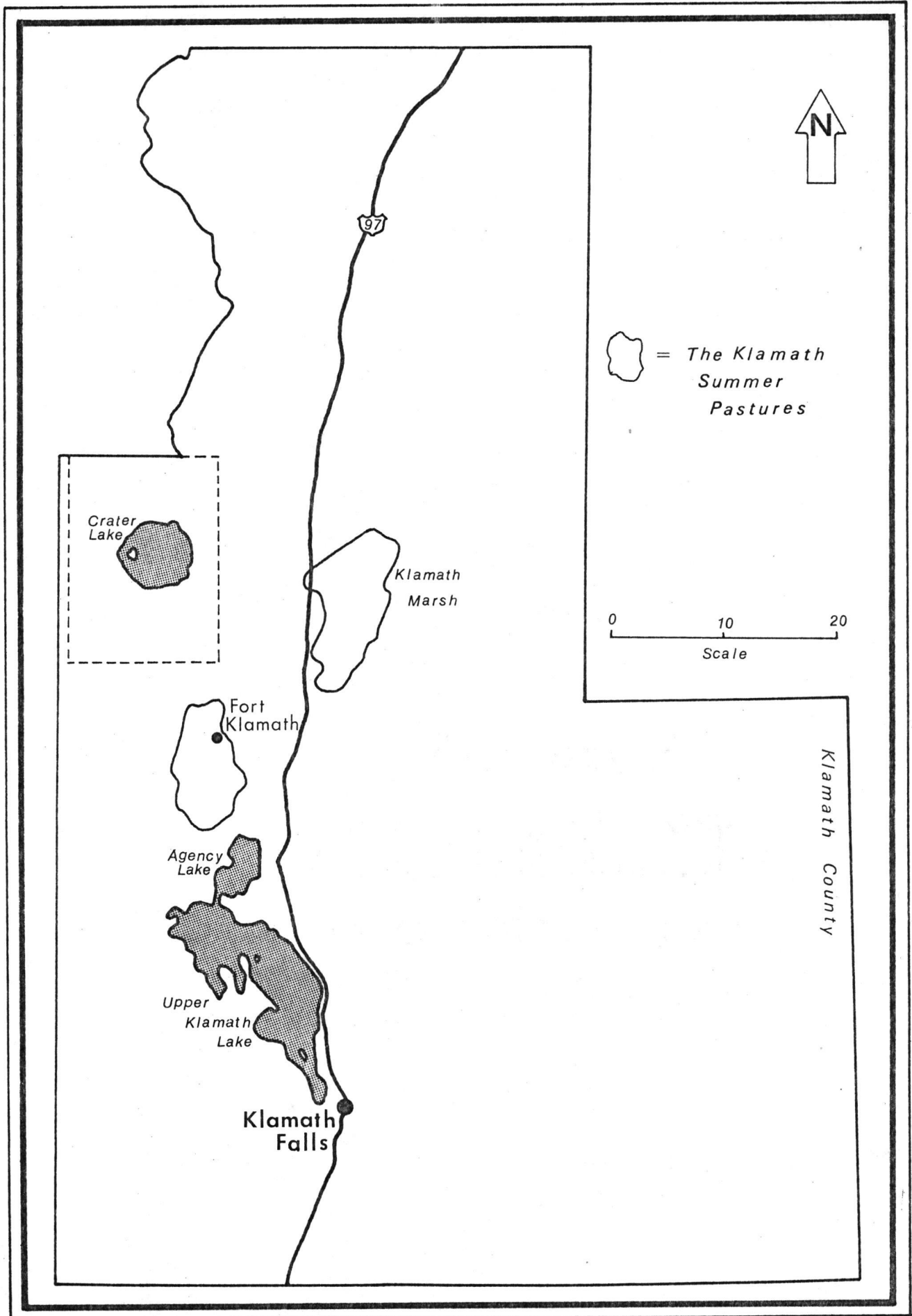


Figure 1

Focus of the Paper

The purpose of this research paper is to examine the Klamath pastures with regard to the physical, economic and historical factors which have encouraged the development of the present system of land use. Emphasis is placed upon the Upper Klamath Valley's role in the system for two reasons:

- 1) The compact and homogeneous Klamath pastures are more readily studied than would be the widely scattered and physically more diverse winter pastures in northern California.
- 2) Despite both proximity to the Upper Klamath Valley and parallels between their systems of land use, the Klamath Marsh differs significantly from the Upper Klamath Valley in both its physical base and land use system. The environment and economy will be examined, however, to provide a comparison with the Upper Klamath Valley.

Methodology

The transhumance cattle industry of the Upper Klamath Valley and associated Klamath Marsh has not been the focus of previous researchers. This investigation was therefore heavily dependent upon primary sources of information with specific information obtained from personal observations and published materials.

Interviews and correspondence with local ranchers and the officials of appropriate federal, state and local agencies were undertaken during late 1973 and early 1974. Of particular help were the Soil Conservation Service, the Klamath County Cooperative Extension Service, the Klamath Agricultural Experiment Station, the Bureau of Reclamation, the Klamath County Assessor's Office and several county extension agents in northern California.

Field observations were made coincident with the interviews. These verified the information obtained from interviews and published data, while assisting the author in understanding the local beef industry as a functioning system. Personal observations also brought to light several aspects of the subject which otherwise might not have been considered.

Published materials of use were the 1969 County Agricultural Census, Klamath County Reviews Plans for the Future, the History of Klamath County, "Klamath Echoes", and pertinent articles in the Oregon Journal, the Klamath Herald and News, and the Oregon Agri-Record. Excepting the Klamath Herald and News these were all available in the Oregon State University library.

Map references consisted of U.S.G.S. topographic maps of the study areas, Soil Conservation Service soil maps, and the 1936 and 1962 editions of the Metsker County Atlas for Klamath County. The topographic maps were particularly

useful as base maps and for examination of the physical base, while the Metsker County Atlas maps provided basic land ownership data and trends.

Organization of the Chapters

The chapters are arranged to proceed from background information through analysis of the components and operation of the transhumance system. Emphasis is placed upon the Klamath pasture. Chapter I examines the physical environment which any land use type must operate within. Chapter II reviews the history of settlement and agriculture in the Klamath study areas up to the development of the present system. The physical and economic factors which most directly contributed to the development and success of the present system are discussed in Chapter III. Chapter IV examines the operations of the transhumance system as it exists today, and Chapter V concludes with a discussion of the system's viability in regard to the physical base and economic factors.

CHAPTER I

THE PHYSICAL BASE

Upper Klamath Valley

Location

The Upper Klamath Valley lies between the northern edge of Agency Lake and the south boundary of Crater Lake National Park in south-central Oregon. The valley floor, upon which the grazing is concentrated, forms an irregularly shaped triangle with the long axis oriented north-south. The western edge of the valley's grazing land is sharply defined by the Cascade mountains which rise abruptly 3000 to 4000 feet to elevations of 7000 to 8000 feet. To the east a low ridge rises just as steeply, but only to about five thousand feet. From the edge of Agency Lake to the forest bounding the northern end of the valley is about 11 miles; valley width ranges from about four miles in the northern half of the study area to about eight miles in the south. The total of over 40,000 acres is almost entirely devoted to transhumance pasture. (Appendix A)

Geology and Topography

The Upper Klamath Valley is a graben, or rift valley which sunk in relation to the ridge just to the east. The northern end of the valley was subsequently partially filled by quantities of volcanic ash from the Mt. Mazama

eruptions; ash found in the soil horizons is associated with the final eruptions, which occurred about 4,600 B.C. The combination of poor drainage and relatively high precipitation during and after the last period of glaciation created a lake much larger than the present Klamath Lake. The area's soils were thus formed by a combination of volcanic ash deposition, lacustrine sedimentation and the accumulation of aquatic plant material.

As befits a former lakebed the valley floor presents an extremely flat profile within its natural boundaries. (Fig. 2) Along the valley's north-south axis the surface dips slightly to the south, dropping from 4,250 feet to 4,140 feet in the 11 miles length of the study area. East-west traverses across the valley's width indicate total changes in elevation on the order of ten feet, while the change per mile of traverse ranges from one foot to five feet. A slightly concave profile places the most rapid changes toward the eastern and western edges of the valley, while on the long axis concavity is noticeable only toward the northern end of the valley. Micro-relief seems relatively more important than macro-relief; ten inch changes in elevation are common along random 100 foot transects.

Hydrology

Corresponding inversely to the valley's southward dip is an increase in water table height. The July water



Figure 2. The Upper Klamath Valley, July 1974. Looking south from the northern end of the valley. The flat valley floor contrasts with the Cascades in the right background, which rise abruptly to 8,000'. Although the valley is a natural grassland it is fringed on the edges by Ponderosa and lodgepole pine forests mixed with aspen. The stands of pine on the valley floor were planted by early settlers.¹

¹ Source: Klamath Echoes, #6, 1968.

table may be 36 inches at the north end of the valley and rise to ground level at the north edge of Agency Lake. Also, the water table shows distinct seasonal variations. The zone of saturation is at or near the surface throughout the valley in early spring, but under natural conditions drops steadily during the summer due to limited summer precipitation and increased evapotranspiration. The present system of summer flood irrigation, however, tends to maintain the water table at higher levels than occur naturally.

The Upper Klamath Valley has four sources of water supply: precipitation, inflowing streams, natural springs and artesian wells. Precipitation averages 20-23 inches per year, most falling as winter snow. Only 15-18 percent of the total occurs during the five month period of heaviest grazing, May through September. Irrigation water is primarily drawn from Sevenmile Creek, Annie Creek and the Wood River; the creeks flow in from the Cascades and from the national park, respectively. Wood River rises from springs situated at the base of Sun Mountain to the northeast of Ft. Klamath. Numerous other springs are situated along the eastern and western edges of the valley, but these tend to be relatively small. Artesian wells also play a minor role in the overall water supply. The U.S.G.S. maps indicate two such wells in the southern end of the area, and the author has knowledge of two more near the northern end of Sevenmile Canal. Whereas a potential for much greater production from artesian

wells may exist, the abundance of surface water would make such development pointless.

Klamath Marsh

Location

The Klamath Marsh pastures fringe the northern, western and southern margins of the Klamath Marsh, which is located some 15 miles east of Crater Lake National Park. The southern edge of the pasture is sharply defined by a Ponderosa pine forest; to the north and west the boundary is less distinct due to interfingering of forest and grassland. The pasture-marsh boundary varies slightly with the water level, but, in general, grazing does not extend past the sedge and rush vegetation zone into the bullrushes and standing water. The irregular shaped pasture area is about 12 miles in length on the north-south axis and a maximum of five miles in width on the east-west axis. The 30,000 acres of Klamath Marsh are virtually all utilized for beef production. (Fig. 3)

Geology and Topography

The Klamath Marsh and associated pastures are situated on the gentle slope which forms the eastern margin of Mt. Mazama's base.² The Marsh itself lies on the lowest section of this slope, abutting the hills and ridges to the east



Figure 3. The Klamath Marsh, June 1974. Looking north-northeast from the Silver Lake highway (Route 676), near the contact zone between permanent marsh and the surrounding pastures. The high water table is evident at this point, although the higher ground to the west has already begun to suffer drought stress. (Fig. 4)

and southeast. The pasture occupies the zone between the marsh edge at about 4518 feet elevation and the forest edge, which approximates the 4540 foot contour. Surface profile is very similar to the Upper Klamath Valley: the grazing area is situated on an almost flat, pluvial lakebed which dips slightly to the east. Surface relief is minor, with variations of only a few feet in a mile transect. Slight hummocks, particularly in the wetter areas, provide micro-relief of about 10-12 inches in 100 yard transects.

Hydrology

Slight slope, poor soil drainage and a winter precipitation maximum combine to produce a very high water table in the spring. As summer progresses evapotranspiration causes the water table to drop below the root zone of the pasture vegetation, which is first noticeable on the highest edges of the grassland. By late July most of the pasture is suffering water stress and forage production has dropped far below the spring levels. (Fig. 4)

Unlike the Upper Klamath Valley, the Klamath Marsh must rely on precipitation to supply soil moisture. Natural springs are not present, and both the inflowing streams and artesian wells are insufficient to provide adequate irrigation water for the area's pastures. Moreover, total precipitation is approximately 18 inches per year, 20 percent less than in the Ft. Klamath area. Thus, while the Klamath



Figure 4. The Klamath Marsh, July 1974. Looking west across the higher, and consequently drier, portion of the marsh's grazing land. The lack of sufficient water for intensive irrigation plus a dropping water table results in the loss of pasture productivity during the latter half of the summer. Mt. Scott, Crater Lake National Park, rises to 8,926' in the background.

Valley is kept green and productive through the summer by the frequent application of irrigation water the Klamath Marsh pastures rapidly lose their productivity once the water table begins to drop. Prospects for the development of widespread pasture irrigation are not bright; the discharge of the Williamson River at the south end of the Marsh is insufficient for extensive irrigation. While the Marsh itself remains a National Wildlife Refuge the possibility of utilizing its water for irrigation purposes is slight.

Klamath Valley and Klamath Marsh

Soils

The soils of the Klamath pastures are composed of two associations, the Yamsay-Moyina and the Kirk-Ck (unnamed). Although these associations share basic physical traits, their differences are sufficient to make the two distinctive. (Table 1)

The Yamsay-Moyina association occupies the lowest and wettest areas of the Upper Klamath Valley and the Klamath Marsh, fringing the areas of continuous standing water. This association consists of deep diatomaceous alluvial sediments and peat frequently lying on a pumice substrate. The upper horizon contains a high level of organic material, a feature common to cool, boggy soils. The combination of seasonal flooding, poor workability, a high water table and low rates of permeability and infiltration create severe drainage and utilization problems.

TABLE 1 - SOILS OF THE KLAMATH PASTURES

Physical Parameters	Yamsay	Moyina	Kirk	Ck (unnamed)
Elevation	4140-4525'	4140-4525'	4160-4540'	4140-4325'
Average Annual Precipitation	16-24"	16-24"	16-24"	15-18"
Slope	$\leq 2^\circ$	$\leq 1^\circ$	$\leq 1^\circ$	$\leq 1^\circ$
Average Frost-Free Period	<50 days	<50 days	<50 days	50-90 days
Average Annual Temperature	42°F	42°F	42°F	44°F
Major Soil Limitation	Wetness	Wetness	Wetness	Wetness
Temperature Limitations	Very severe	Very severe	Very severe	Severe
Workability	Very poor	Very poor	Good	Good
Runoff	Very slow	Very slow	Very slow	Very slow
Permeability	Moderately slow	Moderate	Rapid	Moderately rapid
Effective Root Zone	60"+	60"+	17-40"	40-60"
Irrigation Suitability	Fair	Fair	Fair	Fair
Erosion Hazard	Minimal	Minimal	Minimal	Minimal
Flooding Frequency	Seasonal	Seasonal	Seasonal	Seasonal
Alkali Status	None	None	None	None

Source: Oregon's Long Range Requirements for Water, Appendix 1-14, State Water Resource Board, 1969, Agricultural Extension Service, Corvallis, Oregon.

Drainage canals and pumping lower the water table sufficiently for this fringe area to support improved pastures and grazing. However, high soil moisture combined with poor stability and high compressibility limit the utility of modern agricultural equipment.

The Kirk-Ck (unnamed) association is found on the slightly higher and better drained areas of the Upper Klamath Valley and Klamath Marsh. The upper horizon developed from water deposited pumice ash and sand plus diatomaceous sediments weathered from other volcanic rocks. The substrate is a porous layer of unsorted pumice materials. Drainage is significantly better than for the lower Yamsay-Moyina association; greater permeability and higher infiltration rates combined with the porous substrate facilitate drainage plus both flood and sub-irrigation. Although workability is better than for the lower association soil stability and compressibility problems continue to hinder machinery use.³

Climate

Although the Upper Klamath Valley and Klamath Marsh areas lack reliable climatic records, interpolations may be drawn both from nearby stations and from the physical parameters of the indigenous soil associations. (Table 1) Data from Chemult, Chiloquin and Sand Creek, (Table 2) indicate average annual temperatures of about 41-43°F,

CLIMATIC STATIONS

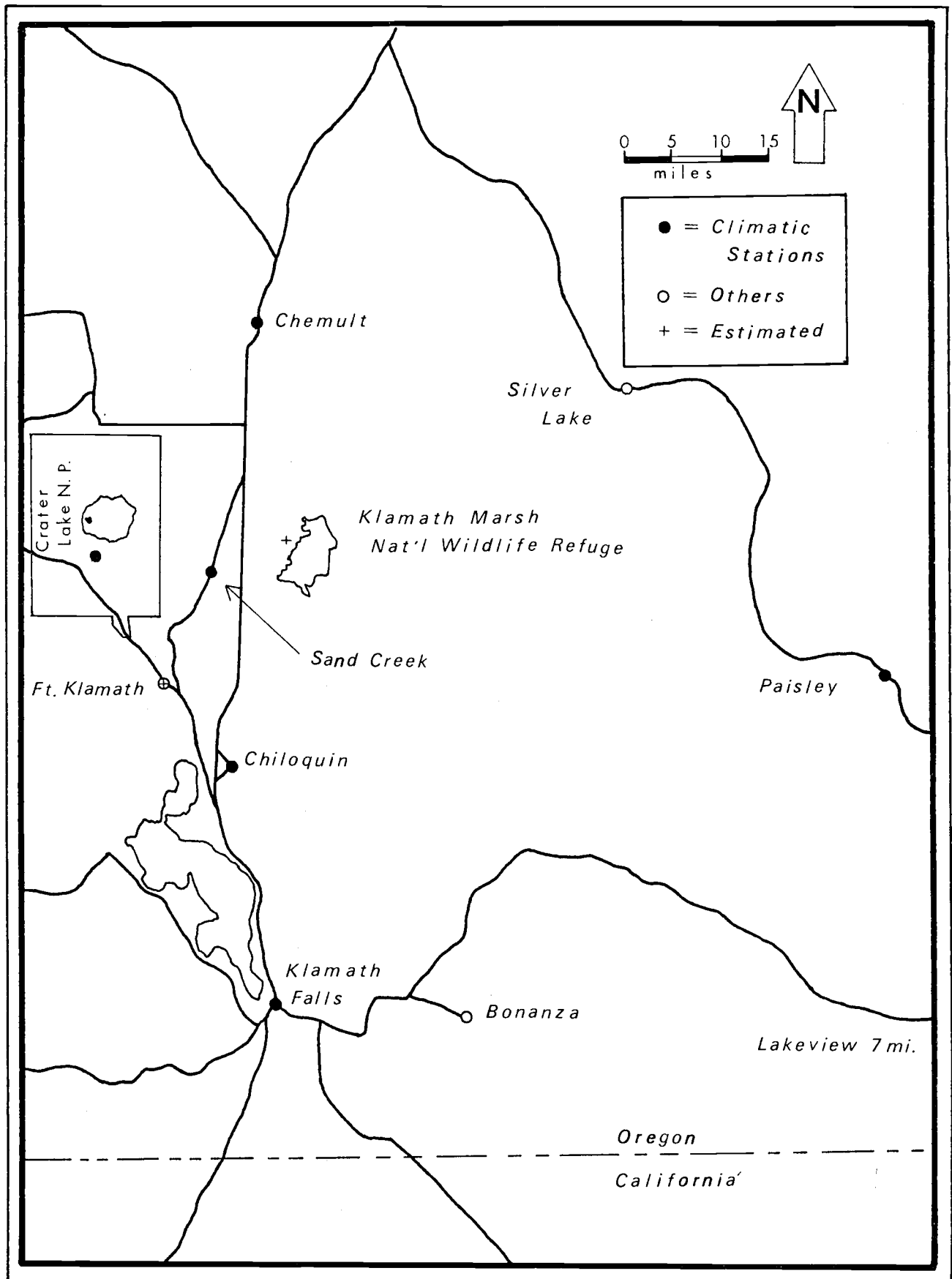


Figure 5

TABLE 2 - TEMPERATURE AND PRECIPITATION REGIMES FOR AREA STATIONS

	CHEMULT	CHILOQUIN	SAND CREEK
Elevation	4,758'	4,200'	4,682'
Average Annual Precipitation	26.5"	17.3"	27.5"
Average Annual Temperature	41.4°F	43.0°F	41.8°F
<u>Average Monthly Precipitation/Average Monthly Temperature</u>			
January	3.54"/25.1°F	2.68"/26.0°F	5.00"/23.8°F
February	3.73"/28.7°F	1.92"/29.9°F	3.32"/28.7°F
March	2.41"/33.3°F	1.32"/36.4°F	2.78"/34.0°F
April	1.34"/39.7°F	1.23"/42.2°F	1.64"/40.2°F
May	1.43"/46.8°F	1.09"/48.3°F	1.47"/47.1°F
June	1.50"/51.3°F	.93"/54.1°F	1.04"/52.7°F
July	.71"/59.4°F	.40"/60.7°F	.38"/59.9°F
August	.50"/57.4°F	.21"/59.6°F	.33"/58.1°F
September	.70"/50.9°F	.64"/52.6°F	.55"/51.7°F
October	1.86"/42.5°F	1.25"/44.4°F	2.05"/43.8°F
November	2.99"/32.8°F	2.69"/34.4°F	3.78"/33.4°F
December	4.81"/29.2°F	2.89"/27.7°F	5.16"/27.8°F

Source: Climatological Data by Sections, Summary, U.S. Weather Bureau,
Asheville, North Carolina, 1956.

while average annual precipitation is probably 20-23 inches at Ft. Klamath and 2-3 inches less for the Klamath Marsh. Most of the precipitation falls as snow during the winter, with approximately 10 percent of the total falling in June, July and August.

Average annual temperatures for the study areas appear slightly anomolous when compared to other stations at similar elevations to the east and south. (Table 3) The Upper Klamath Valley and Klamath Marsh average only about 3°F warmer than Crater Lake National Park headquarters, but 6-8°F cooler than Klamath Falls, Paisley and Chemult. The evening and nighttime drainage of cold air from the slopes of Mt. Mazama and the Cascades into the adjoining basins appears to be responsible for this. One might note the disparity of average freeze-free periods between selected stations. Klamath Falls, Paisley and Lakeview have much longer freeze-free periods than do Chiloquin and the study areas; significantly they are all located in relatively open areas and lack large mountain masses in the vicinity. While pasture grasses will thrive under a short frost-free season, most other crops are effectively excluded.

Vegetation

Vegetation in the study areas is closely controlled by soil type and its moisture content characteristics.

TABLE 3 - SELECTED CLIMATIC DATA FOR AREA STATIONS

	Crater Lake Nat'l. Park	Chemult	Klamath Falls	Lakeview	Paisley	Chiloquin	Sand Creek	Ft. Klamath- Klamath Marsh (estimated)
Elevation	6,475'	4,760'	4,098'	4,774'	4,347'	4,198'	4,682'	4,100-4,500'
Average Annual Precipitation	68.46"	27.38"	13.83"	14.01"	9.26"	16.70"	28.68"	17.22"
Average January Precipitation	11.51"	3.69"	2.00"	1.69"	.92"	2.55"	5.24"	2.5-3.0"
Average July Precipitation	.78"	.61"	.33"	.18"	.33"	.25"	.45"	.35-.45"
Average Annual Snowfall	589.3"	165.0"	48.0"	53.8"	16.6"	58.2"	166.8"	80-100"
Average Annual Temperature	39.3°F	41.3°F	48.6°F	46.2°F	48.5°F	44.6°F	41.7°F	42-44°F
Average January Temperature	25.2°F	24.1°F	28.9°F	26.7°F	29.6°F	27.1°F	24.5°F	25-27°F
Average July Temperature	56.4°F	59.3°F	69.0°F	66.7°F	68.6°F	62.5°F	59.7°F	60-62°F
Average Freeze-Free Season	<50 days	<50 days	117 days	125 days	100 days	<50 days	<50 days	<50 days

Source: Climatic Summary of the United States - Supplement for 1931 through 1952,
Oregon, U.S. Weather Bureau, Asheville, North Carolina, 1952.

The Chinchallo and Kirk-Ck (unnamed) soils currently support several native and introduced species: bluegrasses, alsike clover, alta fescue, meadow sedge, Nebraska sedge, meadow foxtail and Baltic rush are among the most common. The Yamsay-Moyina association supports various sedges and rushes under natural conditions; when drained it is capable of supporting improved pastures very similar to those of the drier soil associations.

The Upper Klamath Valley and Klamath Marsh areas are surrounded by coniferous forests, with the ponderosa pine type immediately adjacent the pastures. The only stands of any significance within the pastures are scattered patches of quaking aspen on the Kirk-Ck (unnamed) soils of the Upper Klamath Valley. These appear to be the remnants of once larger stands which have been partially cleared. Most of the Klamath Marsh is treeless; however, the northern and western boundaries are not precisely defined for the forest is broken into patches interspersed by grassland. This is in contrast to the abrupt and complete change found at the forest-grassland interface in other sections of the study areas.

Pasture experiments conducted by the Klamath Agricultural Experiment Station have examined several aspects of soil fertility and pasture response to fertilizers.⁴ Tests indicate that native grasses and meadow foxtail respond well to applications of 200 lbs./acre of 10-16-8

(N-P-K) fertilizer in regard to both gross production per acre and protein production per acre. However, not all species respond similarly; alta fescue and intermediate wheatgrass fail to significantly increase production when similarly treated. (Table 4) Also, a shortage of trace elements in the soil has been indicated by pasture and beef gain experiments.⁵ Pasture growth is stimulated by the addition of zinc, copper and particularly boron, while beef growth improves with the addition of selenium, copper, cobalt and phosphorous. The combination of fertilization and trace element experiments indicates the need for careful attention to such factors if pasture and beef production is to be maximized. Unfortunately data is not yet available as to optimum fertilizer and trace element addition levels for area soils.

Native Animals

Native animals are of little importance to the beef industry of the study areas. Deer and elk make some use of the Upper Klamath Valley, while deer and antelope occasion the Klamath Marsh. The level of competition for pasture, however, is slight. Coyotes and badgers, the only native predators of any size, are of little import to the ranching industry.

TABLE 4 - PASTURE RESPONSE TO FERTILIZATION

Pasture Type, Rate of Fertilizer Application and mix (N-P-K)	1st Cutting (in pounds of dry matter for four 3'x25' test plots)	2nd Cutting (in pounds of dry matter for four 3'x25' test plots)	Total (Tons per acre)
Native Grasses			
0 lb./acre	13.77	11.46	1.83
200 lb./acre of 10-16-8	20.05	13.00	2.40
600 lb./acre of 10-16-8	18.91	13.77	2.37
Meadow Foxtail			
0 lb./acre	13.05	9.25	1.62
200 lb./acre of 10-16-8	20.00	8.99	2.10
600 lb./acre of 10-16-8	17.53	9.53	1.96
Alta Fescue			
0 lb./acre	12.61	11.15	1.72
200 lb./acre of 10-16-8	15.91	9.38	1.84
600 lb./acre of 10-16-8	15.94	13.25	2.12
Intermediate Wheatgrass			
0 lb./acre	14.47	6.65	1.53
200 lb./acre of 10-16-8	14.79	6.44	1.54
600 lb./acre of 10-16-8	12.84	6.58	1.41

Source: Annual Reports of Forage Project, 1957-1962, Klamath Falls Experiment Station,
Klamath Falls, Oregon, 1962.

CHAPTER II

HISTORICAL DEVELOPMENT

Settlement

White settlement of the study area was delayed until 1863 owing to hostility of the Indian occupants and army problems. The combination of gold discoveries in the John Day and Powder River basins plus occasional violence between whites and Indians in the early 1860's prompted requests for a military post in the Klamath Lake-Tulelake region. The U.S. Army subsequently built a log fort near the present site of Fort Klamath in 1863, rebuilding with lumber in 1868.⁶ Although the Modoc War of 1873 was the fort's only major military action, it contributed substantially to local settlement. On one hand it served as a focal point for civilian settlement, on the other it introduced a number of soldiers to the locality who later mustered out and homesteaded nearby. (Fig. 6)

After the fort was abandoned in 1889 no local population node existed until the present townsite of Ft. Klamath was platted in 1902. The town soon developed into a service center for a local population of several hundred due to the difficulty of transportation to Klamath Falls and Jacksonville. During the period from beginning of settlement until World War I the Klamath pastures were divided into farms claimed and proven under the Homestead Act; thus population density



Figure 6. Ft. Klamath, Oregon. Although not platted until 1902, the town owes both its location and name to the army post built nearby in 1863 and abandoned in 1890. Originally a service center for the upper valley it now also serves the tourist flow to and from Crater Lake National Park. Although the population is less than 200, it contains two motels, a restaurant, grocery and filling station.

was relatively high. The prospect of well-paying factory jobs during World War I lured many small ranchers from the area. Their land was purchased by those who remained. Thus both the rural population and the number of individual holdings dropped sharply, while the average ranch size increased.⁷

Early Agriculture

The present land use system in the Upper Klamath Valley and Klamath Marsh areas developed after a period of experimentation and gradual concentration on beef production. Early attempts at crop production failed due to frequent summer frosts; by 1880 the study areas were dominated by beef, sheep, grass seed and hay production with some production of garden crops for home consumption. The cattle and sheep were wintered at the farmsteads on locally grown hay and pastured either locally or in the Cascades, occasionally ranging as far as Diamond Lake in search of grass. Mature animals were driven to railheads at Ashland, Oregon, Gazelle, California, or Montague, California, for shipment to slaughter houses. This pattern continued until World War I with only two major changes; grass seed production gradually disappeared and serious attempts at commercial dairying were made near Ft. Klamath. Despite early success at timothy and clover seed production the combination of army worms and field mice soon made it a marginal operation; the industry appears to have disappeared by about 1910.

Dairy operations were begun in the mid-1890's with the intention of utilizing the valley's pastures for the production of butter for the San Francisco market. Travel time combined with warm weather made that scheme unworkable and the dairy soon turned to supply the Klamath Falls and Medford areas. Although never an outstanding success local dairy production continued for a number of years, and the first dairy even diversified into cheese production before it closed in 1926.⁸ (Fig. 7)

Sheep raising enjoyed some popularity before World War I, with several thousand head involved in a summer pasture-winter feed system similar to the beef operation. Despite an uncertain market and potentially adverse winters,⁹ the sheep industry remained significant into the 1920's, when the beef industry received a strong boost when the railhead reached Chiloquin.

About the time of World War I the system of "taking cattle on gain" attained considerable popularity. This consisted of renting summer pasture to eastern and southern Oregon ranchers who drove the animals in on foot. The cattle were weighed when they went on, and again when they went off; the charge for pasture rent was on the basis of gain.¹⁰ This transition phase, which preceeded the Klamath-Sacramento Valley system by several years, anticipated some advantages of the transhumance system, particularly in the reduction of labor requirements and financial responsibilities.



Figure 7. The Loosley barn. Located south-west of Ft. Klamath, this formed the base of operations for the Upper Klamath Valley's budding dairy industry around the turn of the century. Due to a limited local market and the difficulty of transporting whole milk the dairy produced butter and cheese for the Klamath Falls and Ashland markets until 1926, when the land was dedicated to beef production. John Loosely and sons, the founders, originally lacked dairy cows and made do by milking beef cattle.¹

1 Source: Klamath Echoes, 1968, #8.

Development of the Transhumance System

Beef production in the period from settlement to the early 1920's was of less importance to the local economy than it is today. This was the result of several limiting factors. The summer pasture-winter feed system required large manpower inputs for hay production, because the industry was not yet highly mechanized. Likewise, the wintering of livestock in the area necessitated both high labor inputs for their care and high capital inputs for housing if the animals were to be fully protected. A large percentage of the best grassland was in hay production, and was consequently unavailable for grazing use; thus summer carrying capacities were significantly lowered. Finally, the long trek to accessible railheads was both time consuming and wasteful of beef. Although the situation improved somewhat in 1909 when the Southern Pacific reached Klamath Falls, the distance to the railhead was sufficient to discourage use of the railroad as anything but a transporter of mature stock to market.

This situation changed radically when the railroad reached Chiloquin in the early 1920's. With the railhead within easy driving distance of the Klamath pastures, rail transportation could be used for both the marketing and seasonal movement of stock.

The specific origin of the Klamath system of transhumance agriculture, which originally utilized rail trans-

portation of cattle between winter pastures in the Sacramento Valley and Klamath area summer pastures, is unknown. Once devised, however, this system rapidly replaced the other systems of land use in the Upper Klamath Valley and Klamath Marsh. Sheep ranching, dairying, hay production and local wintering of livestock virtually disappeared in the following years.¹¹ The factors which encouraged this transition are well worth close examination, for they are responsible for both the system's origin and present viability. (Figure 8)

TRANSHUMANCE PASTURES

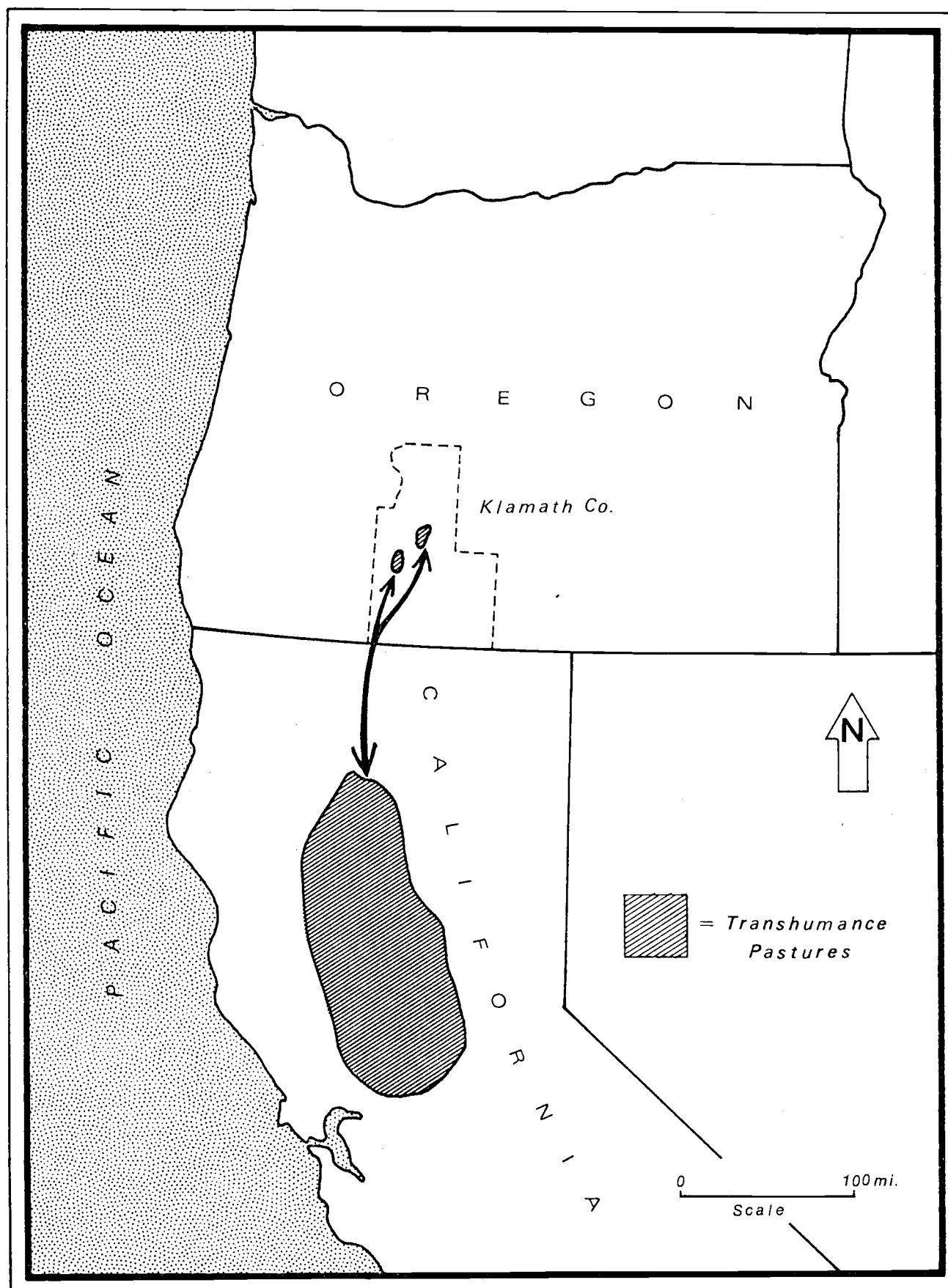


Figure 8

CHAPTER III

THE BASES OF THE TRANSHUMANCE SYSTEM

Introduction

The factors which encouraged development of transhumance agriculture were and are essentially economic, in that the transhumance system tends to maximize returns while minimizing inputs. The transhumance system takes advantage of the positive aspects of the physical and cultural environments while avoiding the negative. Thus the benefits are more closely associated with efficient land use than with market considerations.

The transhumance system exploits certain favorable qualities of the physical, cultural and economic environments while avoiding some of the less favorable aspects. An understanding of the existence and operation of the system is enhanced by an examination of the bases upon which it is built.

Transportation

The presence of a convenient railhead was critical to the development of a mechanized transhumance system. Once established, the railhead permitted both easy access and rapid transportation to the Sacramento Valley for winter pasture. Of even greater importance, with this mechanical movement the system proved economically, as well as physically possible. Rail transportation's low cost per head for the

round trip did not add intolerably to total production costs. Conversely, elimination of winter feeding costs and the recovery of hay land for pasture in Klamath areas substantially offset transportation costs and rental fees for winter pastures. Although stock trucks replaced the railroad during the 1950's, as will be discussed later, these economic considerations are still valid.

Complimentary Climates

The climatic types found in the Upper Klamath and Sacramento Valleys compliment one another with respect to livestock grazing. As indicated previously, the Klamath areas have warm, dry summers and cold, wet winters when plants are dormant. Topographic and hydrologic characteristics combine to produce lush spring pastures; where irrigation water is available high pasture quality is maintained through the summer. However, irrigability does not imply a potential for diversification; frequent summer frosts exclude most non-pasture crops. Hard winters necessitate the loss of considerable grazing land for hay production if cattle are to be wintered there. Conversely, the hot, dry summers of the Sacramento Valley are offset by mild, moist winters which form the area's only natural grazing season. The Sacramento Valley's area is huge in comparison to the Upper Klamath Valley pastures; since topography and water supply conditions are not universally favorable for irrigation agriculture, large amounts of land are available for winter

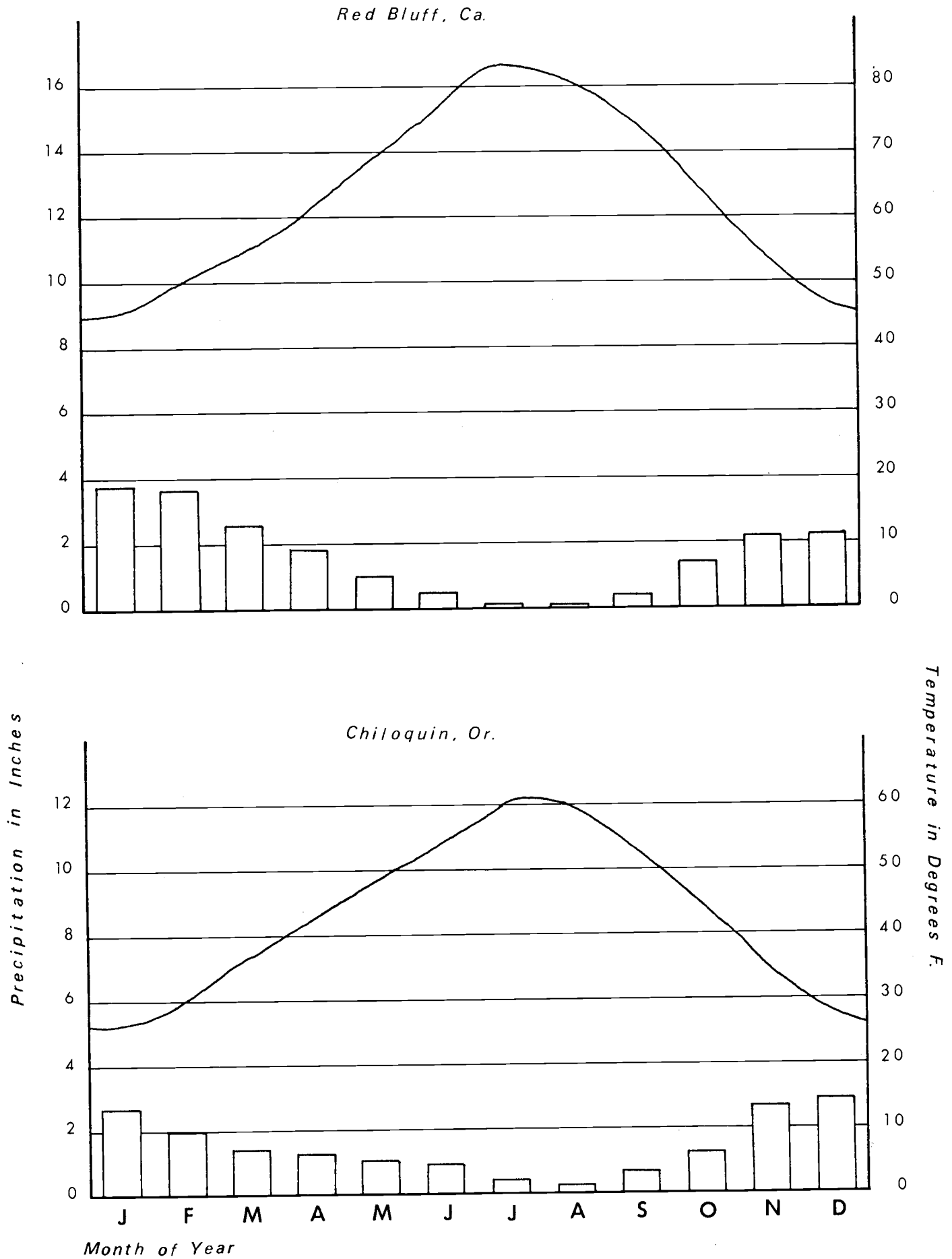


Figure 9

pasturage. Thus the Klamath pastures are naturally suited to summer grazing whereas the Sacramento Valley has both the mild climate and land available to pasture the transient herds during the winter. (Figure 9)

Irrigability and Pasture Quality

The key to the Upper Klamath Valley's ability to sustain intensive summer-long grazing lies in the area's irrigation system. Water is available in sufficient quantity from the Williamson River and several smaller creeks, while the valley's topography permits both easy distribution via open ditches and the use of inexpensive flood irrigation.¹²

(Fig.10) Thus forage production remains fairly constant through the summer and into the fall. Pasture quality, a function of pasture vegetation, soil fertility, and the availability of moisture, is in some respects more important than seasonal duration. The Upper Klamath Valley is normally stocked on the basis of one cow per acre, or a cow and calf per one and one half acres. This might be compared to the Sacramento Valley's winter range, which requires six to ten acres per cow or eastern Oregon's requirement of up to 60 acres per cow for unirrigated summer pasture. These figures reflect a high animal density in the Upper Klamath Valley, a density which makes the area an important beef producer far out of proportion to its size.



Figure 10. Sevenmile Canal. Originating at Sevenmile Creek, this canal provides primary drainage for much of the southern half of the Upper Klamath Valley study area. The canals in the northern half of the study area were originally constructed to provide irrigation water in the summer and served an incidental function of assisting spring drainage. The marshy land just north of Klamath Lake was not utilized until the development of heavy equipment after W.W. I permitted the excavation of drainage canals and economical pumping of large quantities of water.¹

¹ Source: Paul Wampler, personal correspondence, 1974.

At this point one might note certain differences between the Upper Klamath Valley and Klamath Marsh pastures. The Klamath Marsh pasture does not endure through the summer, as surface water is in short supply and irrigation is consequently limited. Also, much of the area is covered by sedge and rush vegetation of limited value as pasture. This combination of early loss of forage production due to drought stress and lower quality forage results in a stocking density of less than one cow per two acres.¹³

Wintering Problems

Transferring the cattle to northern California in the fall solves most of the problems related to wintering stock in the Klamath area. Although snowpack depths in the basins is normally less than two feet, at times it has accumulated to six feet or more in depth. As noted in the climate section the Klamath areas also suffer the consequences of cold air drainage from Mt. Mazama and the Cascades; summer frosts are not uncommon and temperatures occasionally dip to -20°F or below during winter. Livestock consequently require some shelter to assure high survival rates; at that late winter and early spring calving entails weather-related risks. Furthermore, winter feeding of cattle is expensive in regard to land and labor costs. A large percentage of the available grassland must be reserved for hay production purposes, which removes it from summer grazing.

Hay production, winter feeding and the care of stock quartered in confined areas require large labor inputs. Additionally, hay production in itself raises certain problems. Both native and improved pasture types are regarded to be of greater value as green pasture, since the hay produced is not of the best quality.¹⁴ Also, the flat topography, flood irrigation and high groundwater table create wet areas which severely limit the utility of mechanized hay making equipment.

The Availability of Land

The employment of a transhumance grazing system entails either the ownership of both summer and winter pastures or the rental of land in one or both areas. As discussed previously, the Klamath pastures were originally divided and claimed in accordance with the Homestead Act of 1862. Emigration during World War I, however, both reduced the rural population and increased the average ranch size for those who remained. The system of "taking cattle on gain", or renting pastures on the basis of weight gains, achieved popularity at about the same time. This effected a change in land use from general agriculture to specialized summer pasture. The advent of a railroad in Chiloquin in the early 1920's aided the change to seasonal pasturing by providing access to a complimentary winter pasture. A pattern of split ownership and rental quickly developed; some Klamath ranchers grazed cattle on their own land in

summer and rented winter pasture in California. Others simply rented their land to ranchers already based in the Sacramento Valley.

The availability of rental land in the Sacramento Valley is a function of climate and size. The hot, dry summers permit only irrigated crops and extensive dry farming; precipitation is insufficient for unirrigated pasture. The cool, moist winters promote moderate pasture growth but are not mild enough for winter cropping. Since a limited amount of land is irrigable, and this is normally devoted to row crops, tree crops, and alfalfa hay, the Sacramento Valley is unable to carry even a moderately heavy cattle population year-around. Consequently, significant acreages are available for winter grazing of transient cattle. Although the Klamath herds utilize some of this land, a large portion supports cattle from east of the Sierras and others which are locally owned but grazed in the Sierran national forests during the summer.¹⁵

Although the Klamath cattle utilize only a part of the Sacramento Valley's available winter pasture, one should note that cattle which require one acre per head in the Klamath Valley need six to ten acres in California. This translates into a seasonal occupation of approximately 600,000 acres of winter grazing land. Regardless of climatic suitability a significantly smaller area than

the Sacramento Valley would probably be unable to supply such quantities of seasonal pasture.

Relative Economics

The foregoing factors thus created a situation favorable to the use of a transhumance grazing system. However, the physical factors are at best permissive; they place the system within the realm of physical possibility. The system is closely related to the existence of transportation facilities, the favorable costs of transportation and complimentary pastures, in addition to other production cost factors shared with conventional beef systems. The non-shared production costs, balanced against the economic benefits of the transhumance system, determine whether the Klamath system can compete on the open market.

Any change in production costs for transhumance grazing which are not shared by the general beef industry will tend to destroy the Klamath system's viability. Thus general inflation would probably not harm this segment of the industry disproportionately; significant increases in transportation and/or land costs which outstrip the general rate of inflation probably would.

CHAPTER IV

THE FUNCTIONING OF THE TRANSHUMANCE SYSTEM

Location of the Winter Pastures

The Sacramento Valley exhibits neither the homogeneity nor the severely limited adaptability which characterize the Klamath pastures. Moreover, the valley is up to 50 miles wide and is utilized by the Klamath herds as far south as Sacramento, 150 miles from the northern limit at Redding. In consequence, they must share the valley with other land use types, such as dry and irrigated farming, in addition to other herds which are wintered there. Otherwise herd distribution is limited only by the physical barriers of mountains to the east, west and north and by rising transportation costs to the south.

Correspondence with several agricultural extension agents located in the Sacramento Valley indicates that the Klamath herds are widely, although unevenly, distributed throughout the valley. Tehama County, at the northern end of the valley, winters an estimated 25,000 head of Klamath cattle. This represents over 34 percent of the 72,000 head of mature and yearling transient cattle from Oregon, a figure in part attributable to Tehama County's proximity to southern Oregon and in part to its size, which is much larger than average for the Sacramento Valley. Glenn and Colusa counties are reported to winter about 7-8,000 head of

Oregon transients and another 8-10,000 are reported in Sacramento County. The remaining 29-32,000 head winter in other valley counties, with the majority in Butte, Yuba, Sutter and Yolo counties. However, no estimates of transient cattle populations were available from these or other counties.¹⁶

Herd Composition

Herd composition differs markedly between the two summer pastures, primarily due to differences in forage quality. While the Upper Klamath Valley tends toward grass pastures of high quality, the Klamath Marsh pastures are largely composed of sedges and rushes which make fair to good grazing for cows and calves but are considered poor for yearlings. (Figure 11) In consequence of differing suitabilities, cow-calf operations have declined in the Ft. Klamath area concurrent with a rise in the use of purchased yearlings. The Klamath Marsh has experienced a decline in the number of yearlings and a rise in the number of cow-calf pairs. The Marsh now supports about two-thirds of the system's cows and calves, while the Upper Klamath Valley carries approximately two-thirds of the yearlings. (Table 5)

Such distinct population compositions have an effect on population densities. As indicated in Table 5, the Marsh supports more cattle than the Upper Klamath Valley despite its less well endowed physical base. This is in



Figure 11. Yearlings and spring calves in the Upper Klamath Valley. Qualitative differences in forage tend to concentrate about two out of three spring calves in the Klamath Marsh, but almost two out of three yearlings in the Upper Klamath Valley. Herefords and Angus account for the majority of transient livestock. However, Charolais and Charolais-crosses, (the butter-colored calves), are becoming increasingly popular.

TABLE 5 - A POPULATION BREAKDOWN OF TRANSIENT CATTLE - SUMMER, 1974

Population Categories	Upper Klamath Valley	Klamath Marsh
Brood cows	9,600	19,200
Bulls	400	800
Spring Calves (6 months old)	8,000	16,000
Returning Yearlings (Total raised and purchased)	<u>27,000</u>	<u>15,000</u>
Total on Summer Pasture	45,000	51,000

Source: Mr. Ron Hathaway, Livestock Extension Agent, Klamath County Cooperative Extension Service, Klamath Falls, Oregon. Personal correspondence, 1975.

large part due to the concentration of cow-calf pairs on the Marsh pastures, as each pair requires little more land than a single yearling.

As mentioned previously, the Klamath Valley-Sacramento Valley transhumance system began in the early 1920's by utilizing the Southern Pacific Railroad to transport stock between the summer and winter pastures. Chiloquin originally served as railhead for the compact Klamath pastures, although the Klamath Marsh ranchers were soon able to use loading points on the western edge of the marsh when the tracks were extended north in the mid-1920's. Conversely, every loading dock in the Sacramento Valley was a potential railhead for Oregon cattle due to the wide scattering of the winter pastures.

Exclusive use of the railroad continued for some thirty years. During the early and mid-1950's, however, the railroad was abandoned in favor of truck transportation.¹⁷ Semi-tractors and trailers were by then of sufficient size and efficiency to compete favorably with the railroad in terms of cost per head per round trip. Moreover, trucks offered ranch-to-ranch service; cattle were picked up and delivered at the individual ranches rather than railheads some distance away. This system now accounts for all livestock moved into and out of the Klamath area.¹⁸

(Figure 12)



Figure 12. Stock truck in Ft. Klamath. Competitive freight rates and door-to-door service enabled trucks to replace the railroad in transporting the Klamath transients. The larger trucks haul over 40 head of cows or up to 100 head of calves on two or three decks.

An additional incentive to the use of trucks has been reduced rates for interstate hauls. Transportation rates for interstate movements are controlled by the Interstate Commerce Commission, while intrastate are controlled by the Public Utilities Commission of Oregon. During late 1973, and early 1974 the I.C.C. rate was \$.90 per loaded mile for a run of over 200 miles with a 50,000 lb. gross tractor and trailer. At the same time the P.U.C.O. rate was \$.65 per hundredweight for a 225 mile trip. In terms of stock transportation costs this resulted in a 15 percent savings for shipments across the state line.

The trucking is done by private operators hired from southern Oregon and northern California. Depending on the number of cattle he must transport, the individual rancher hires one to several tractor-trailers which haul for him until the herd is moved. This operation might typically require about two weeks of daily effort to move a 1,000 head herd 200 miles. Individual ranchers seldom own trucks larger than 1 1/2 - 2 tons rated capacity; these are used locally for minor transfers as in moving culls, diseased animals or horses.

Disease Problems and Livestock Care

The semiannual transportation of 96,000 head of cattle to and from the Klamath pastures engenders certain disease problems. Transportation in open trucks for 150

to 300 miles is alone sufficient to produce numerous cases of pneumonia.¹⁹ Moreover, the cattle originate from many different points and have consequently been exposed to various diseases. The concentration of large numbers of such cattle within the relatively small Klamath pastures provides ample opportunity for contagious diseases to spread. The animals are therefore watched carefully throughout the year; the loss of individual animals is often prevented by early treatment, while herd health is safeguarded by the treatment or elimination of sick animals.

The most common problems include calf scours in the spring, pneumonia after moves and during winter, and pinkeye. An effective testing program has limited brucellosis and tuberculosis so that the area is now certified free of both diseases. Four-way, seven-way, redwater and blackleg vaccinations are given to the calves to limit the more serious common diseases. However, losses and debilitation of animals by disease is still common; the worst offenders are anaplasmosis, hemorrhagic septicemia, enterotoxemia, and bovine rhinotrachitis, in addition to the previously mentioned problems. Despite the potential for major disease problems, close attention keeps the annual loss rate down to 2-3 percent per year.

A health-related problem involves the mosquitoes in the southern half of the Upper Klamath Valley. If not controlled the insects both feed on and irritate livestock to the point that the seasonal weight gains may be cut up to 50 percent. Ranches in these marshy areas have formed informal vector control districts and now hire commercial insect controllers to spray the area four or five times each summer, which all but eliminates the problem.

Care of the transhumance herds extends beyond the prevention and treatment of disease. Spring calves are normally castrated, branded and dehorned while on summer pasture. After the move to northern California the major considerations are spring calving and health. The Sacramento Valley's cool, damp winters necessitate constant surveillance of the herds, particularly for calf scours (diarrhea), and pneumonia.

The Klamath herds are on straight pasture during both grazing seasons; the use of supplements is very limited, although mineral blocks are used universally. As indicated previously, the Klamath pastures require both fertilization for maximum forage production and trace minimal supplements or injections for maximum beef production. 'White muscle', a symptom of selenium shortages, is common but easily cured by injections.²⁰

Trace shortages of copper, cobalt and phosphorous may retard weight gains if unattended, although the effects are not always apparent.

Pasture productivity is maintained by flood irrigation where sufficient water is available. The pastures are flooded with about 1/3 acre ft. of water every 2 - 2 1/2 weeks, usually via irrigation canals which are maintained by the concerned individuals. This is not possible for the Klamath Marsh pastures, as insufficient water is available.

Stock Movements

The timing of cattle movements between the Klamath pastures and the Sacramento Valley vary due to prevailing weather conditions. As a rule the brood cows, bulls and spring calves are transported from southern Oregon to Northern California between November 1 and December 1, depending on the arrival of snow to the summer pastures. These animals remain on winter pasture until between April 1 and June 1, when they are returned to the Klamath pastures. The spring migration involves brood stock, yearling calves, spring calves, and yearlings purchased as stockers to fatten on pasture.

The Klamath County Cooperative Extension Service estimates 72,000 head of cattle are involved in this transhumance system. However, this figure does not

include calves under six months of age. Thus approximately 96,000 head are moved from winter to summer pastures. In the fall some 54,000 brood cows, spring calves and bulls are trucked back to California, followed shortly by spring calves which have been purchased from eastern Oregon and Nevada as stockers for the coming year. The remaining 42,000 head of finished cattle are sold on the pasture and transported directly to various feedlots and slaughterhouses.²¹

Monfort Feedlots of Ft. Collins, Colorado, is the largest single purchaser, taking over 10,000 head from the study area each year. The Auburn Packing Company of Seattle, Washington, purchases approximately 10,000 head per year, followed by Western Pack of Topenish, Washington, which purchases approximately 4-5,000 head annually. The remaining feeder cattle go to smaller packing and feedlot operations in northern California, Washington and Oregon.

Approximately 53 individual ranchers are involved in this system; 23 in the Klamath Marsh and 30 in the Upper Klamath Valley. The majority provide stock to the same buyer year after year. The combination of a few large buyers dominating the market plus average annual sales of nearly 800 head per rancher appears responsible for this.

Gains and Costs

Assuming proper health care and pasture management, calves and yearlings average weight gains of approximately

250-300 pounds for six to seven months on the Klamath pastures. Cooler weather, extensive grazing conditions and a shorter grazing season limit gains to about 100-150 pounds for five to six months on the Sacramento Valley pastures. Most Calves weigh 300-350 pounds at the end of their first summer, 450-500 pounds by the following spring, and 700-800 pounds when sold in the fall at about 18 months of age.

Estimates of production costs vary, and individual expenses tend to rise on par with inflation. However, estimates for spring, 1974 might provide a baseline. At that time the pasture rental costs were about \$40-45 per calf for each seasonal pasture, or \$80-90 per year. Cow and calf pairs required about \$60-65 worth of pasture at each end, or \$120-130 per year.²² Truck transportation costs were about \$10-12 per cow and \$5-6 per calf for a round trip between pastures 200 miles apart. Mosquito control, where necessary, was about \$2 per acre; irrigation costs were about \$1.50 per acre and fertilizer costs varied depending upon applications. Direct costs were about \$150-160 to raise an 18 month old feeder calf, plus as much again for the cow. Labor and most fixed costs differ little from other eastern Oregon ranches. However, investment in shelter, machinery, and feed production and facilities tends to be quite low. These savings, coupled with land use efficiencies discussed previously, have over years more than offset transportation costs and rental for complimentary pastures.

CHAPTER V

CONCLUSIONS

The physical base, historical development and certain economic considerations have combined to give the Upper Klamath Valley and Klamath Marsh areas a system of mechanized transhumance agriculture. Environmental constraints limit these areas to stock grazing, while land, labor and capital efficiencies encourage the use of complimentary winter pastures in the Sacramento Valley in lieu of winter feeding.

The continued existence of this system depends upon a delicate balance between costs and benefits. Thus far the savings and efficiencies derived from this system have offset transportation and land costs. While inflation drives up all costs at essentially even rates this grazing system can continue to successfully compete with other systems on the marketplace. The Klamath herds are unusually dependent upon transportation and land rental costs as determinants of final costs.²³ Should these costs rise out of proportion with other increases, the Klamath-Sacramento transhumance system would find costs rising above selling prices.

A 50 year record of viability in the marketplace encourages the involved ranchers to worry more about the overall state of the cattle industry than their own ability to compete. However, the Ft. Klamath and Klamath Marsh pastures may specialize in yearlings and cow-calf pairs, respectively, to increase their efficiency of land use.

APPENDIX A

COLOR INFRARED AERIAL PHOTOGRAPHS
OF THE UPPER KLAMATH VALLEY
AND KLAMATH MARSH STUDY AREAS



 = Klamath Pastures

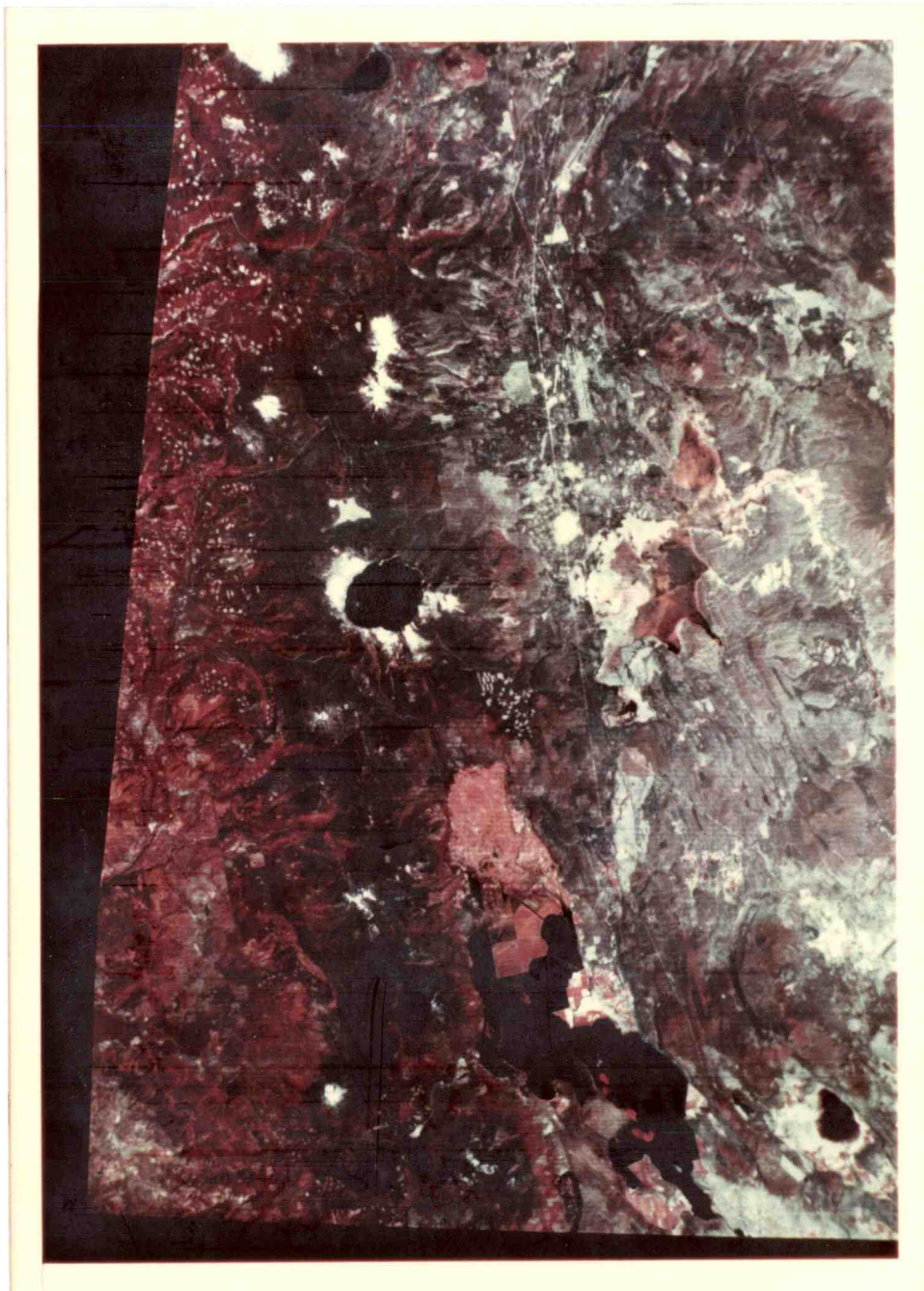


Figure 13. The Upper Klamath Valley and Klamath Marsh Study Areas, July, 1973. In this color infrared photo water bodies are black, the shallow Klamath Marsh is dark grey, conifer forests are dark red to purple and actively growing pastures are pink. Note that the Upper Klamath Valley study area is pink, while the western (higher) portions of the Klamath Marsh are white, indicating pasture under severe drought stress. Boxes on the overlay indicate approximate coverage of the following photos.

Scale=1:1,000,000

Source: ERSAL Lab, Oregon State University, Corvallis, Oregon. From high flight NASA U-2 photography.



Figure 14. The Upper Klamath Valley, July, 1974. Ft. Klamath and the Wood River are near the upper right hand edge of the photograph. Pink indicates actively growing forage, while light blue seems to indicate overgrazing and/or sparse vegetation. Note the intricate surface drainage patterns which are partially natural but enhanced by flood irrigation.

Scale=1:96,000

Source: ERSAL Lab, Oregon State University, Corvallis, Oregon. From high flight NASA U-2 photography.



Figure 15. Interface of the Klamath Marsh pastures with the standing water of the Klamath Marsh National Wildlife Refuge, July, 1974. The Silver Lake highway cuts across the bottom of the photograph; the rectangular network is formed by ditches for surface drainage and subirrigation. The Marsh appears dark due to the limited infrared reflectivity of water, while shades of red indicate growing vegetation and light blue to white signify dry, barren, overgrazed, or sparsely vegetated areas.

Scale=1:96,000

Source: ERSAL Lab, Oregon State University, Corvallis, Oregon. From high flight NASA U-2 photography.

FOOTNOTES

1. The use of seasonal pastures on a summer-winter rotation is referred to as transhumance agriculture. In accord with accepted Extension Service practice the cattle are referred to as transients.
2. Mt. Mazama is the composite cone which collapsed after a series of volcanic pumice eruptions to form the Crater Lake caldera.
3. State Water Resources Board, Oregon's Long Range Requirements for Water, Appendix 1-14, (Agricultural Extension Service, Corvallis, 1969), pp. 46,47,60,73,74.
4. Klamath Branch Experiment Station, Annual Reports of Forage Project, 1957-1962, (Agricultural Experiment Station, Klamath Falls, 1962), pp. 22-26, 148.
5. Agricultural Extension Service, Klamath County Reviews Plans for the Future, (Klamath Falls, 1968), p. 30.
6. Rachel Good, History of Klamath County, (Klamath Falls, 1941), pp. 25, 26.

Placement was dictated by political pressure rather than military considerations. Ashland's civic leaders wanted the fort built near Tulelake so that it might do business in Ashland; Jacksonville wanted it at the north end of Klamath Lake for similar reasons.

7. Devere Helfrich, Klamath Echoes, No. 6, (Klamath County Historical Society, 1968), pp. 34, 35.
8. Helfrich, op. cit., pp. 22-24.
9. Helfrich, op. cit., p. 73.
10. Helfrich, op. cit., pp. 34,35.
11. Helfrich, op. cit., p. 34.
12. Personal correspondence with Mrs. Leonard Meshke, Secretary of the Wood River District Improvement Company, indicates that irrigation water costs each of the 12 members about \$1.50/acre/year.
13. Personal correspondence with Mr. Ray Peterson, past Agricultural Extension Agent, Klamath County.

14. Depending upon specific conditions, local wintering would increase the unit area per head requirement by a factor of about 2.5.
15. Personal correspondence with the Agricultural Extension Agents of Tehama, Glenn, Colusa, Shasta, Placer, Nevada, Sacramento and Yolo counties, California, 1974.
16. Ibid.
17. The Monfort animals are trucked to Caldwell, Idaho, and then transported by rail to Ft. Collins. Other movements of feeder cattle, brood stock and calves are handled entirely by truck.
18. Trucks have so dominated livestock transportation that the Southern Pacific Railroad recently discontinued all livestock hauling services.
19. Commonly referred to as "shipping fever".
20. Cooperative Extension Service, Klamath County Reviews Plans for the Future, (Klamath Falls, 1968), p. 24.
21. Personal correspondence with Ron Hathaway, Cooperative Extension Service, Klamath Falls.
22. The costs per A.U.M., (Animal Unit Month), is about the same for the Klamath and Sacramento pastures.
23. Increases in land rental costs also boost the cost of hay production, partially offsetting the direct effect on grazing costs.

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