Wetland site dominated by Veratrum californicum *(western false hellebore) and Salix species (willows).*

wetlands will likely continue to be necessary by law to conserve this critical resource. Approaches to make this evaluation logistically feasible and reasonably accurate will need further attention. Interpretation of infrared aerial photography holds promise as a useful technique.

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Physiographic Factors in Range Management Planning on an Arizona Ranch

Kendall J. Cumming and Duane Thwaits

Editor's Note: The reviewer for the article stated "It was probably in Spokane (SRM Annual Meeting) that someone said we need to find new ways of doing things. This paper does it."

Range management planning for public lands has become more complex in recent years as considerations must be given to the total ecosystems as well as traditional conservation of range and soil resources. Grazing use of riparian areas has become more controversial and necessary predator control is a sore point with certain groups. Measures that address these issues may be unpopular with some ranchers concerned about possible increased costs of grazing operations.

Appreciation is expressed to Dave Lowell and Earl Cumming for their review of physiography section of the paper and to John Bohning and Kenneth Renard for overall review. Reviewer's comments were very helpful. Thanks is also expressed to Jerry Lockwood, U.S.F.S. Nogales District Ranger, for his support of the planning initiatives.

Kendall Cumming has worked as a Range Conservationist with the BIA and, in recent years, done range consulting and participated in management of the Cumming Ranch.

Duane Thwaits is Range Conservationist of the Nogales Ranger District of Coronado National Forest.

Following is an approach to range management planning for an Arizona Ranch that addresses the management needs for riparian areas and upland range sites, while recognizing rancher's goals for forage production and cost efficient management. The controversial issue of mountain lion control is also addressed. This approach, which was developed by U.S. Forest Service personnel and allotment permitees in 1988, places increased emphasis on ranch physiography in the planning process.

Description of Ranch

The ranch is located west of the Santa Cruz River in southeastern Arizona. About 240 head of mature cattle are run year-long under two grazing permits on an allotment (approximately 9,000 acres) of the Coronado National Forest and on adjoining private base land. The ranch includes the eastern slopes of the Tumacacori Mountains and their adjacent rocky ridges and foothills. Elevations generally range from 3,500 to 4,500 feet but reach 5,600 feet. Ranch rainfall ranges from about 14 to 18 inches annually depending on topography and elevation. Over 60% of the annual rainfall comes during the summer

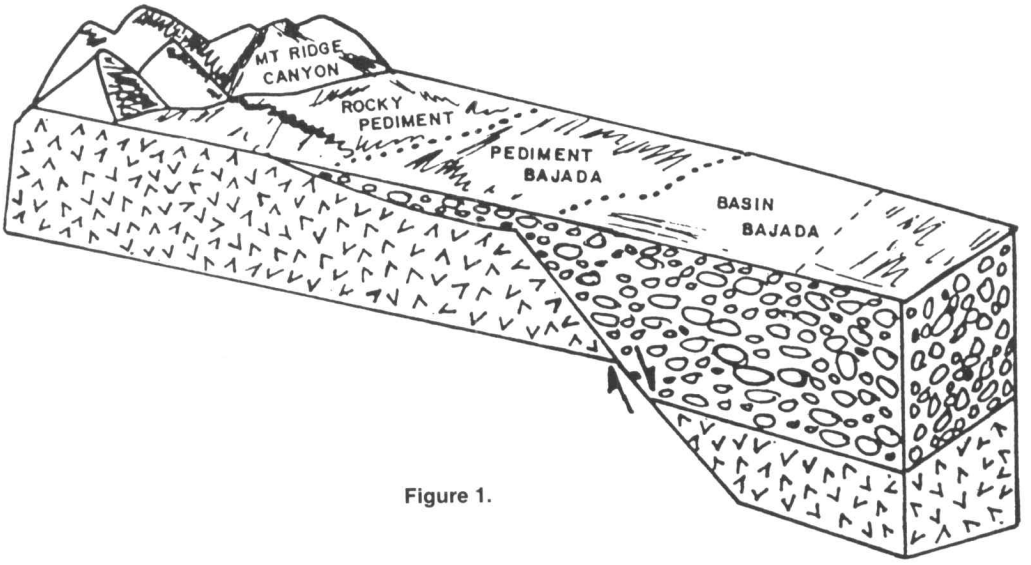

Figure 1.

SCHEMATIC DIAGRAM OF RANCH PHYSIOGRAPHY

(NOT TO SCALE)

LEGEND

UNCONSOLIDATED SEDIMENTS

IGNEOUS ROCK

"monsoon" in July, August, and September. Most of the remainder comes in the "winter" rainy season from December through mid March.

The two major vegetative types of the ranch are oak woodland and desert grassland. Principal upland native grasses are sideoats grama, slender grama, sprucetop grama, curly mesquite, cane beardgrass, tanglehead, and plains lovegrass. The most valuable browse is guajilla (false mesquite).

Principal riparian species are Arizona ash, Bonpland willow, Gooding willow, Arizona black walnut, Fremont cottonwood, seep willow, and Arizona grape. The relative abundance of these species may relate to the seral stage of the riparian community. Elements of several riparian communities described by Szaro (1989) are found on the ranch. Velvet mesquite and canyon hackberry are present in some riparian areas but also occur along with desert willow in areas without a shallow water table but subject to summer flooding.

Physiography and Its Implication to Range Management

The ranch includes the major features of the Basin and Range Physiographic (land form) Province. An upthrown "mountain" block composed mostly of acidic volcanic extrusives is separated by an old fault from a sediment filled basin. Tertiary erosion has cut into the mountain fronts forming a sloping area of rocky low ridges and canyons called a "pediment." Unconsolidated coarse and poorly sorted gravel and rock sediments from erosion of the mountains cover part of the pediment and grade into the basin deposits. This formation is called a "bajada." (Fig. 1 is a schematic diagram of these features.) The sediments were cut to an erosion surface in early Quaternary time; remnants of these surfaces (locally called mesas) are still present today. Most areas of the bajada have been dissected by erosion and now form a rolling topography of ridges and canyons. Bajada soils are generally deep rocky clays or clay loams that grade into the underlying sediments. They are derived principally from andesitic parent materials.

For purposes of this paper, the four major areas of the ranch (Figure No. 2) are classified as:

(1) The Basin Bajada
(2) The Pediment Bajada
(3) The Rocky Pediment
(4) The Mountain Ridge-Canyon

Each of these areas may include several range sites.

Following is a description of the areas as they occur on the ranch:

Basin Bajada

This area comprises that part of the bajada below the fault. Since canyons here do not cut down to bedrock, a perched water table is not present. Much of the flow of the major drainages, upon passing the fault line, percolates downward through the coarse sedimentary fill to a fluctuating water table that sometimes is over 100 feet below the canyon bottom and deeper below the upland surfaces. The major drainages widen in this area and narrow strips of silty or sandy alluvium may be present. Because of the depth to ground water, these canyon sites do not contain phreatophytic riparian species (which do not extend past the fault line) but do support some species partially dependent on flood or runoff water.

The uplands of the basin bajada area support typical

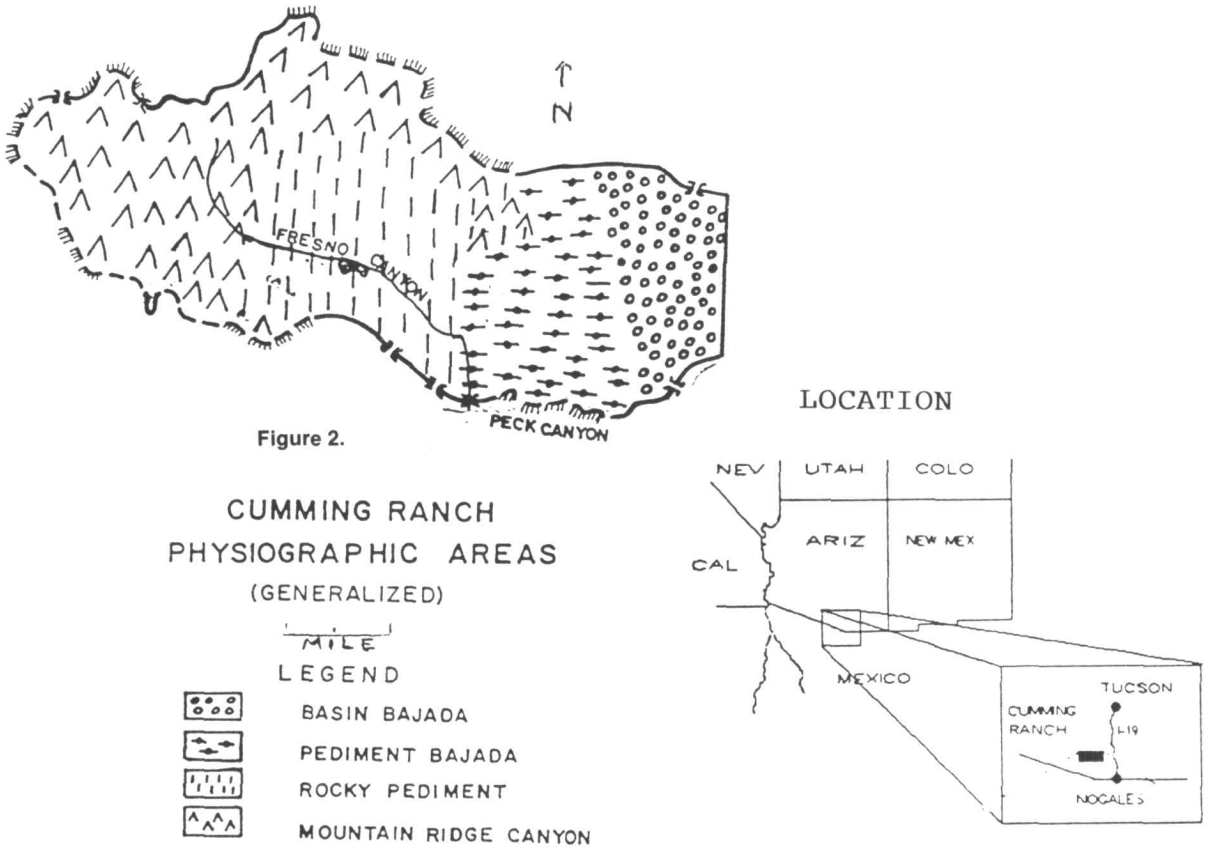

Figure 2.

upland forage species. Mesquite invasion is a problem. The geologic formations of this area consist of coarse unconsolidated sediments, and consequently, there are no exposed rock surfaces to concentrate surface runoff nor tenajas (rock tanks) to hold water. For this reason, there is seldom temporary water available here except at two man-made reservoirs. The moderate ridge canyon topography of this area allows cattle use throughout the area although concentration of use may occur on "mesa" sites and alluvial areas of the canyons.

Pediment Bajada

This area comprises that part of the pediment covered with a veneer of coarse unconsolidated sediments that grade into the bajada sediments below the fault. The upper "veneer" sediment sites are similar in most characteristics to those of the uplands of the basin bajada area while the rocky canyon bottoms are similar hydrologically and floristically to those of the rocky pediment area, (described later). Because of limited drainage, most canyons of the pediment bajada do not have permanent water or the more phreatophytic riparian species. A major exception is Peck Canyon, which traverses a part of this area. Some temporary water is present during rainy seasons where drainages have cut to rock, but little is retained on the sediment surfaces. One earthern reservoir in this area usually holds water for several months.

Rocky Pediment

This area lies entirely on igneous rock except for a few places where unconsolidated stream gravels are present

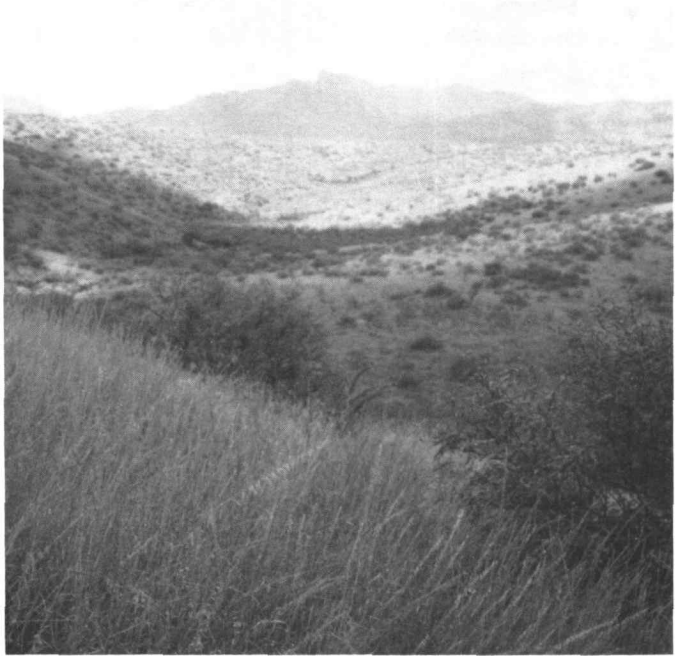

Fig. 1. *A view of the bajada pediment area (beyond the cloud shadow) from basin bajada site (under the cloud shadow).*

or remnant veneer capping of hills remains. Soils are generally shallow with the degree of development dependent on slope, exposure, and parent material. Plant species composition in this area is more diverse than in the bajada areas because rock surfaces may concentrate

water allowing more mesic species to grow in localized areas.

Permanent water is found in two locations in the streambed of Fresno Canyon and an adjoining tributary, and apparently occurs in several other places where it is perched on bedrock under several feet of stream gravels. During the rainy seasons, clear water may run for several weeks and in a few areas may remain for several months. Because of these characteristics, riparian species may occur in many locations of canyon bottoms, but the more typically phreatophytic species such as willow and cottonwood are generally confined to areas where more permanent ground water is at or near the surface.

A major management characteristic of this area is the abundance of temporary water in the uplands, during the rainy seasons, resulting from the many rock surfaces. Even the minor drainages of the uplands run water at these times. In many places, tenajas (rock tanks) may hold water for weeks or months. Two reservoirs (one masonry and the other earthen) may hold water for several months. Since the canyon gradients and watershed slopes are relatively steep, water velocities are high and scouring sometimes occurs, exposing bedrock. Where sediments are present, they are generally deposited as narrow strips of coarse sand, rock, and boulders in the streambeds.

Because the canyon bottoms are mostly rocky and narrow, there is usually not a "soft ground" incentive for cattle to concentrate on these sites. Only one significant area (about 15 acres) of relatively level, rock free alluvium occurs in this area.

Mountain Ridge-Canyon

This area is comprised of the slopes of the Tumacacori Mountains and their associated steep ridges and deep canyons. The canyons share some characteristics of the canyons of the rocky pediment, but steeper gradients usually result in more scouring of streambeds rather than deposition. Permanent water (developed springs) occurs at two sites in canyons of the area, and in one location, an intermittent stream runs much of the year. Two small masonry dams have been constructed in high headwater drainages.

The higher steep, rocky slopes of some localities can inhibit grazing use, especially by some types of cattle, but because of differences in slope, explosure, and altitude, the area presents myriads of microclimates which may influence plant phenology and species composition. As a result, cattle will often climb these slopes (especially in winter) in search of green forage or different forage species. Management measures have also been effective in obtaining moderate use of the steeper and more rocky slopes. A major livestock management problem of this area is mountain lion predation since the area is a preferred habitat for this animal.

Grazing History

Cattle were introduced by Jesuit Father Kino to nearby Pima Indian Villages on the Santa Cruz River in the 1690's.

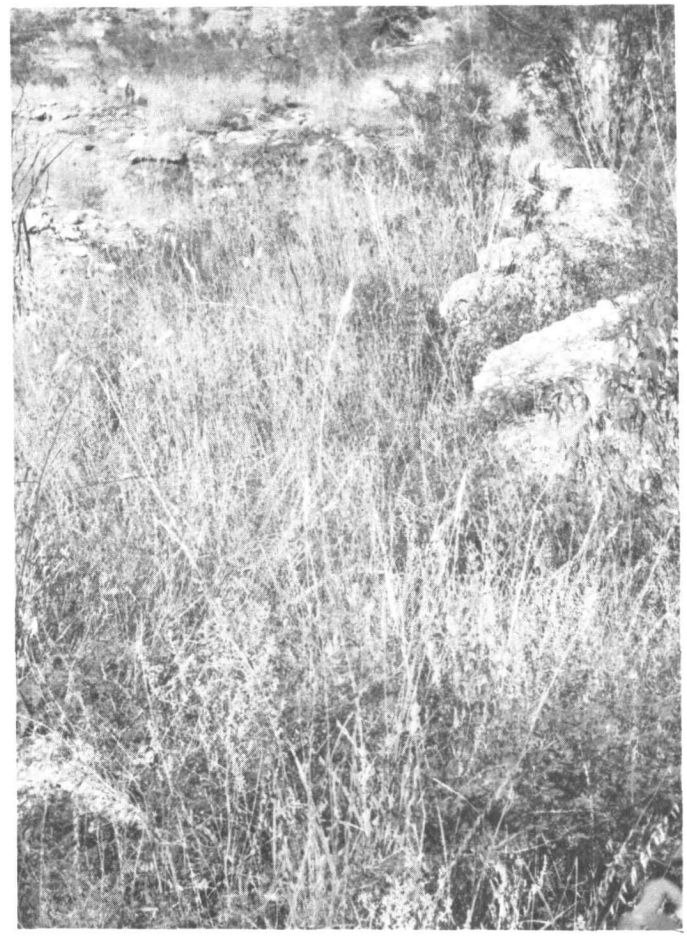

Fig. 2. *A sideoats grama, canebeard grass, purple grama association in the rocky pediment area September 1990. When forage like this is present in uplands with ample water nearby, there is little reason for cattle to concentrate in riparian areas.*

Spanish, and later, Mexican cattle probably grazed the area of the present ranch periodically from the latter part of the 18th century into the fourth decade of the 19th century when Apache depredations temporarily disrupted cattle operations. A period of heavy open range grazing by the cattle of several ranches occurred from the 1870's until Forest Service allotments were fenced in the early 1920's. The Cumming family was among the range users in the latter part of this period. Douglas Cumming has managed the ranch for most of the past half century and is one of the two allotment permittees.

Historically, except for wild (feral) cattle, livestock preferred the more level areas of the bajada when water was available in nearby canyons. During the dry period of April through early July, cattle concentrated at the more permanent waters located in the canyon bottoms of the rocky pediment and bajada pediment areas (which were also riparian areas). This occurred at a time when perennial grass of the uplands was generally dry. In the riparian areas, however, the green shoots and leaves of the young plants were succulent and highly palatable. The resultant heavy selective grazing use probably reduced the younger age classes of some palatable riparian species. After the

onset of the yearly monsoon rains, and water and green forage were available in the uplands, the cattle scattered, and overuse of riparian species was no longer a problem.

Grazing use of the mountain ridge-canyon area was mostly by wild cattle until the early 1920's. Later, most use was by "located cattle" that were retained because of their habitual use of this area.

Even after the boundaries of Forest Service allotments were fenced and stocking limits set, it was difficult to control distribution until the early 1950's when the first pastures were fenced. By the early 1970's several fenced pastures made rest rotation grazing systems possible and improved cattle distribution. Distribution was also enhanced by the construction of additional stockwaters, salting, drifting of cattle, and by running young Barzona and Brangus cattle which adapt well to rough country. Other management measures that increased forage production were: flexible stocking rates, mesquite control, soil ripping, and reseeding with Lehmann lovegrass on several hundred acres of the "Mesa Area." (Cumming 1989).

Fig. 3. *Rock water is extremely abundant in the rocky pediment during the monsoon season.*

These management measures resulted in significant upward trends in upland range condition in the period from the 1960's to the late 1980's. The condition at a number of transect clusters changed from "fair" to "good" during this time. (USFS File Data) Some riparian areas showed improvement, but others appeared to remain static.

Management for the 1990's

In 1988 Duane Thwaits, U.S.F.S Range Conservationist, and Douglas and Kendall Cumming held several discussions concerning the effectiveness of past management and the changes necessary to meet the management challenges of the 1990's. It was agreed that the currently successful management practices should continue but more emphasis should be placed on improvement of riparian areas, and measures should be taken to limit mountain lion predation of calves to both minimize adverse economic effects of calf losses and to reduce the need to remove killer lions. It was also agreed to emphasize physiographic factors in range planning.

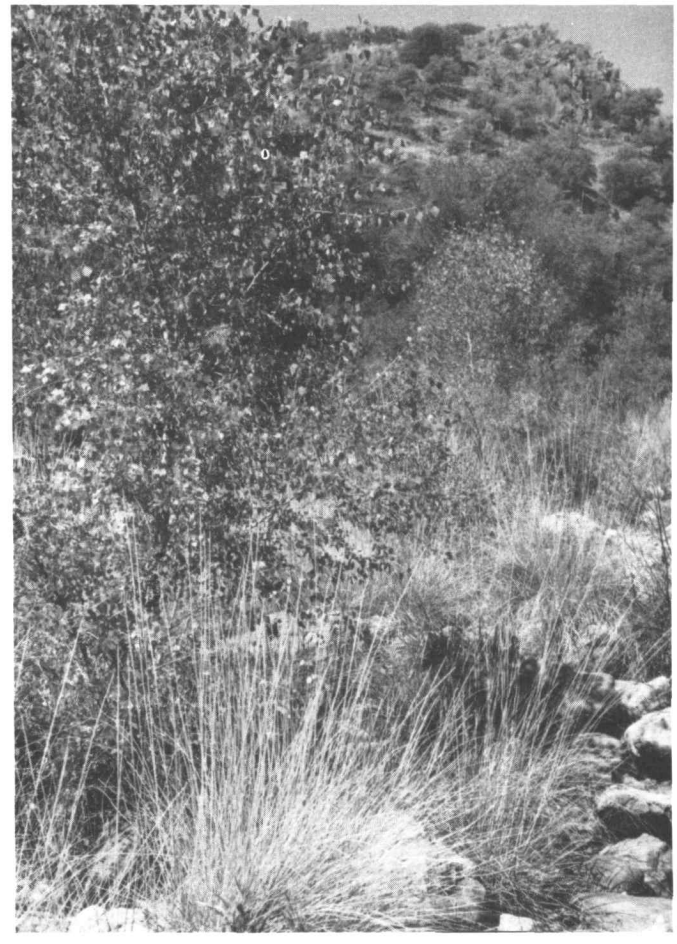

Fig. 4. *Riparian area in canyon of rocky pediment. Trees include Arizona ash, Bonpland willow, and Fremont cottonwood. Note younger age classes.*

Goals and Objectives

General goals were formalized to include objectives for both range management and livestock management.

Following are listed ranch goals and objectives for the 1990's:

(1) *Goal.* Continued upward trends in range condition of the uplands with emphasis on increased plant diversity.

Specific Objective. A 20% improvement in average composition score at each cluster site from 1988 to transect re-measurement in 1998.

(2) *Goal.* Improvement of riparian areas.

Specific Objective. A 50% increase in number of desirable riparian shrub and tree seedlings and saplings of age class under 10 years by the year 2000.

(3) *Goal.* More consideration of animal species in the ecosystem.

Specific Objective. Reduce the need to remove mountain lions (that have killed calves) by 50% for the decade of the 1990's as compared to the 1980's.

(4) *Goal.* Increase pounds of beef produced in decade of 1990's by 20% over that produced in 1980's.

Specific Objective. (To achieve Goal No. 4.)

(a) Increase marketable calf crop to 90%.

(b) Increase average steer calf weight at fall sale to 510 pounds.

(c) Increase percentage of calves born between March 10 and May 10 to 90%. [This also affects objectives (a) and (b)]

Planning Strategies

Long-range planning and annual plans are based on the following strategies and projected actions:

(1) *Seasonal Use of Range Areas.*

(a) Exclude cattle from pastures which include riparian areas from about April 1 until after the monsoon rains have put out rock water and "greened" the perennial grass of the uplands. During this time, utilize the bajada pastures.

(b) Use the rocky pediment pastures both during the summer monsoon season, the early fall, and early spring (before riparian species begin to bud and develop leaves).

(c) Use the mountain ridge-canyon pastures as part of the rest-rotation system but emphasize winter and early spring use when cattle naturally climb in these areas.

(2) *Grazing Systems*

Rest rotation and time control grazing will be used to minimize possible adverse effects of concentrated seasonal grazing. It might be assumed that concentrated spring and early summer grazing would result in the spread of mesquite (by cattle) in bajada areas. This should not present a problem because mesquite beans are immature during this period so any ingested beans will not sprout in cow manure. Further, use of mesquite blossoms and immature beans will reduce the total production of ripe beans which might reproduce naturally at a later date.

(3) *Calving.*

Most calving will occur in the basin bajada and pediment bajada pastures in the period between April 1 and May 10. Having the cows here at calving facilitates assistance in problem births and reduces killing of calves by mountain lions since calves are most vulnerable to predation in their first two months, and the bajada pastures are not normal mountain lion territory.

(4) *Breeding*

Bulls are concentrated with cows in the bajada pastures where most breeding occurs between May 20 and July 18. Bulls may also be concentrated with cows for short periods in the Lehmann lovegrass pastures on a time-control basis later in July. This is to assure breeding of cows that might not have conceived earlier. Protein-vitamin mineral supplements may be used in some years during the breeding period to enhance fertility. Placement of such supplements will be used as a range management tool.

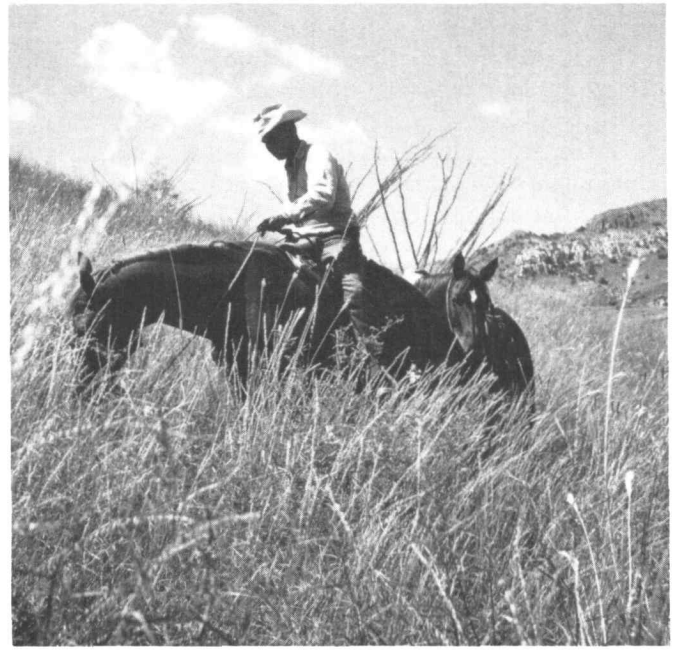

Fig. 5. *Many sites of the mountain ridge-canyon area can be highly productive—species visible include sideoats grama, cane beard grass, and plains lovegrass.*

(5) *Shrub Control.*

Initiate mesquite control on selected bajada areas when such control is not precluded by Federal environmental restrictions.

(6) *Other.*

Branding and spraying for insects will be done at facilities on private land in the bajada pastures.

All moves of cattle will be planned so as to minimize distance of drives over rocky terrain in order to prevent potential problems of sore feet since this condition can interfere with utilization of rough terrain.

Preliminary Results of New Planning Approach

The plan has been in effect since the late spring of 1988. The addition of two new range watering points by piping water from new water sources on adjoining private land made the early initiation of the plan possible.

Although plan implementation was disrupted by a drouth of record severity in 1989 (necessitating a 40% voluntary stocking rate reduction through 1990), it appears that four years under the new planning process had by mid 1991 resulted in the following:

(1) Continuing improvement of upland range condition.

(2) Seedlings and young age classes (under 5 years) of riparian species appear to be increasing in number.

(3) Mountain lion predation has decreased from an average of four calf kills a year in the 1970's to two kills in the 1990–1991 period; no kills occurred in the bajada pastures.
(4) Weights of steer calves averaged 480 pounds (after a severe drouth) in 1989 and about 513 pounds in 1990.
(5) About 90% of the calves born in 1990 and 1991 were dropped in the period of March 15 through May 10.
(6) Approximately 90% of cows pregnancy tested in 1989, 1990, and 1991 (excluding yearling heifers and purchased pregnant two-year olds) were pregnant. Effective calf crop (as calves sold) in 1990 and 1991 averaged about 85%.

Conclusion

Szaro (1989) expressed a need for new and innovative ideas in grazing use of riparian areas. The concept of non-use of these areas shortly before and after riparian species put out new leaves is not new. It was recommended by Martin (1979) and has been included in many United States Forest Service range plans for many years. The Cumming range range-planning approach may, however, incorporate new elements including the deferment of pastures with riparian areas until the monsoon season, and increased consideration of physiographic factors and historic cattle use in riparian use planning. It is too early to draw final conclusions regarding the effectiveness of the new planning approach, but it appears that it is helping meet some environmental goals of the U.S. Forest Service and economic goals of the ranchers. Preliminary data indicate that the plan which was implemented in 1988 has resulted in improvement of both riparian areas and upland ranges while increasing total beef production. It has also reduced mountain lion predation of calves and diminished the need to remove problem lions.

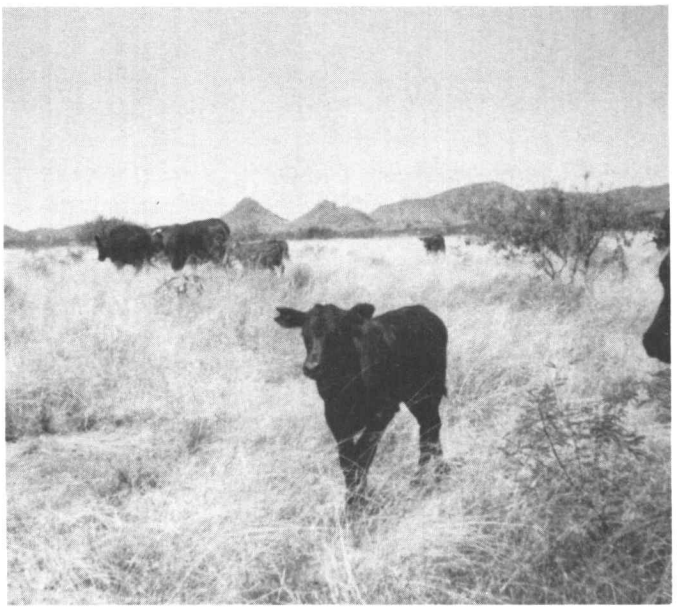

Fig. 6. *Most calving now occurs in bajada pastures where mountain lion predation is not a serious problem.*

Further observations and measurement data will be required to determine long term results of the plan.

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