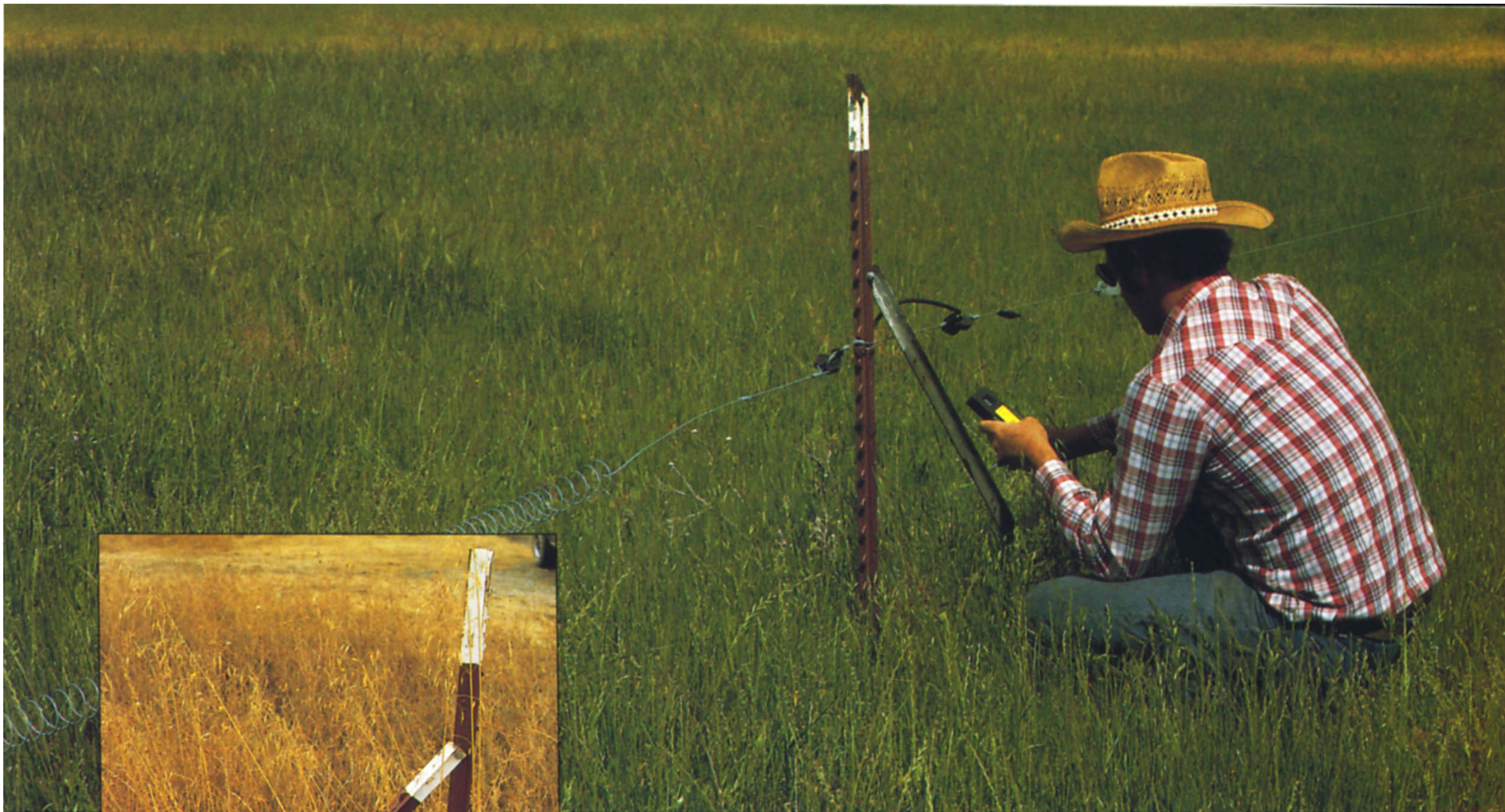

Under intensive grazing, an area is subdivided and cattle are rotated from paddock to paddock every few days to rest pastures between grazings. In this study, single-wire electric fencing was effective as well as providing flexibility and lower cost than barbed-wire fencing.

Intensive grazing increases beef production

Melvin R. George ❑ Ronald S. Knight ❑ Peter B. Sands
Montague W. Demment

Beef production per acre on a foothill range livestock operation increased under an intensive, rotational grazing system. There were management problems, but they were outweighed by the benefits.

Few comparative studies of grazing systems on annual rangeland have been conducted, partly because they are expensive, require large acreages, and must continue for several years to produce meaningful results. Those that have been reported suggest that continuous grazing and rotational grazing result in similar animal production. In this article, we present a case study of a beef stocker operation on annual range that has documented several benefits and some problems from controlled grazing. Controlled grazing is the use of pasture subdivision and rotation to rest pastures between successive grazings and to control forage levels and animal performance.

Ranch description

The O'Connell Ranch, 20 miles southwest of Red Bluff, California, is approximately 4,500 acres of rolling annual grassland with scattered oak trees. The ranch includes the soil series Newville-Dibble, Nacimiento-Newville, Sehorn-Millsholm, Myers, and Zamora. Average annual precipitation at the nearby Paskenta Ranger Station is 24 inches, varying from 12 to 40 inches over a 20-year period.

The annual grassland vegetation consists of soft chess (*Bromus mollis*), annual fescue (*Festuca megalura*), foxtail (*Hordeum* spp.), medusahead (*Taeneatherum asperum*), annual ryegrass (*Lolium multiflorum*), wild oats (*Avena fatua*), filaree (*Erodium* spp.), rose clover (*Trifolium hirtum*), subterranean clover (*T. subterranean*), crimson clover (*T. incarnatum*), vetch (*Vicia* spp.), lupine (*Lupinus* spp.) and miscellaneous other grasses and forbs. Medusahead is widespread but is especially dense on the clay bottomland soils. Perennials include *Stipa pulcra*, *Aristida oligantha*, *A. hamulosa*, and the seeded hardinggrass (*Phalaris tuberosa* var. *stenoptera*) and perlagrass (*P. tuberosa* var. *hirtiglumis*).

The range has been seeded several times over the decades that the ranch has been in the family. Hardinggrass pastures seeded many years ago are still in use. Seedings of rose and subterranean clover and of perlagrass have also been conducted for many years before and after initiation of controlled grazing.

Pasture subdivision

In 1983, the O'Connells subdivided 1,060 acres of annual rangeland using a 30-inch-high single-wire electric fence radiating from a central point to produce a grazing cell of 16 pie-shaped paddocks of approximately 66 acres each (fig. 1). In 1984, they developed an additional cell using existing fencing subdivided with single-strand elec-

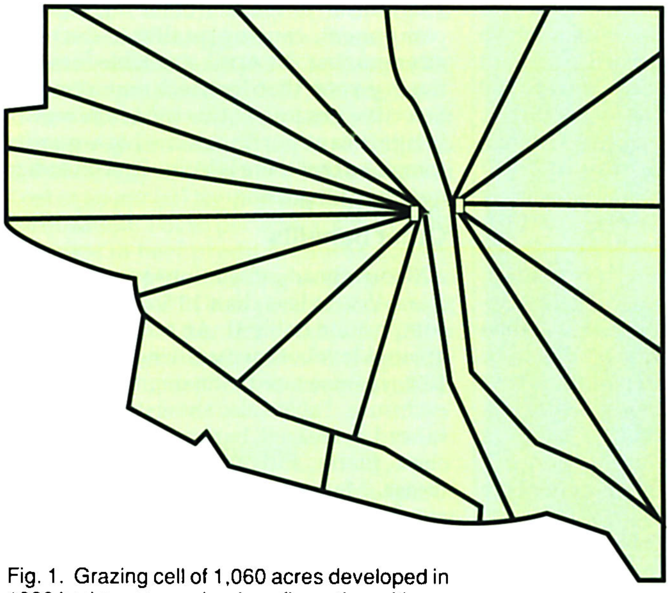

Fig. 1. Grazing cell of 1,060 acres developed in 1983 had a wagon-wheel configuration with stock water at center.

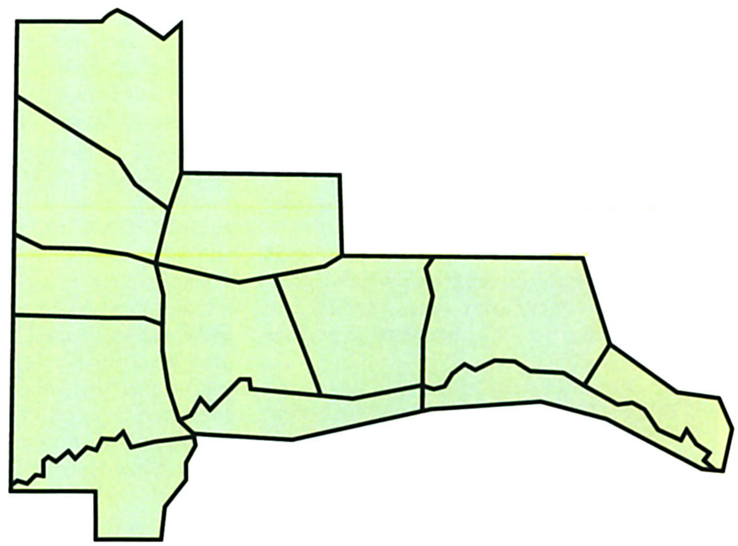

Fig. 2. Block pasture cell of 1,110 acres was developed in 1984 from existing fencing subdivided with electric fences.

tric fences (fig. 2). This cell consists of 1,110 acres divided into 12 paddocks ranging from 50 to 135 acres.

Cattle were rotated from paddock to paddock every few days according to a predetermined but flexible grazing plan. Each paddock received a maximum of 60 to 120 days' rest during the winter and a minimum of 25 to 30 days' rest during rapid spring forage growth. Movement from paddock to paddock was determined by visual appraisal of paddocks that had adequate rest.

Methods

Long-term ranch production records, livestock and pasture monitoring, and photographic records were used to document changes due to controlled grazing. We used long-term production records to compare livestock carrying capacity (acres per head) and beef production (pounds per acre), after installing the grazing cells, with productivity for 8 years before implementing intensive grazing.

Seasonal rates of gain were monitored by weighing 50 yearling steers four times during the 1984-85 growing season and six times in 1985-86. Calves were shrunk overnight before weighing. The grazing season began in November or December, depending on stocker cattle purchase dates, and continued until the dry season (May 11 in 1985 and June 6 in 1986).

In 1984-85, seasonal forage levels (pounds per acre) were determined in two paddocks before and after grazing so that seasonal forage productivity, utilization, and quality could be estimated. Forage quality was estimated by determining acid detergent fiber (ADF), in-vitro dry matter digestibility (IVDMD) and protein content of dried forage samples. Acid detergent fiber is a measure of the cellulose and lignin concentration of forage. In-vitro dry matter digestibility is a measure of the amount of dry matter digested by rumen microbes in 48 hours.

Each spring, plant species composition was determined along permanent transects to detect changes due to intensive grazing. Photographs were also used to document rangeland conditions and changes due to controlled grazing.

Beef production increased

Beef production (pounds per acre) increased, because stocking-rate increased (table 1). Before controlled grazing, beef production averaged 50 pounds per acre for the grazing season and carrying capacity was 5 acres per head. With controlled grazing, beef production fluctuated between 76 and 120 pounds per acre because of weather conditions, with a stocking rate of 2.5 to 3 acres per head.

The O'Connells were able to monitor progress toward preestablished gain targets by the periodic weighing of cattle during the season. Seasonal conditions clearly limited productivity (table 2). Cattle gains during the forage growing season varied from losses or poor gains in December and January, followed by a period of slow gain in February. During rapid spring forage growth, average daily gains of 2 pounds per head per day or more were recorded. Gain

TABLE 1. Beef productivity and stocking rate before and after intensive grazing management

Year	Beef productivity	Stocking rate
	lb/acre	*acres/head*
Before subdivision		
1973-74	57	5
1975-76	50	5
1976-77	56	5
1977-78	58	5
1978-79	45	5
1979-80	53	5
1980-81	45	5
1981-82	62	5
1973-82 (avg.)	53	5
After subdivision		
1982-83	95	2.5
1983-84	112	2.5
1984-85	76	2.5
1985-86	120	3
1982-86 (avg.)	101	2.6

TABLE 2. Seasonal average daily gain (ADG) of stocker cattle in grazing cells, 1984-85 and 1985-86

Weigh date	Weight	Weigh period ADG	Growing season ADG
	.... *lb*		
1984-85			
12/20	576		
2/26	621	.66	
4/11	709	2.00	
5/11	801	3.07	1.58
1985-86			
12/19	450		
1/21	449	-.03	
3/5	485	.84	
4/1	560	2.78	
5/3	642	2.56	
6/5	687	1.36	1.41

on drying mature forage in May and early June declined to 1.36 pounds per head per day.

Forage

The 1984-85 growing season began on about November 1, 1984, following mid-October rains. On January 3, 1985, forage yield was 888 pounds per acre (table 3). Approximately 1,000 pounds per acre of dry residual forage from the previous growing season was also present. During the January grazing, 211 pounds per acre of forage dry matter were utilized. Forage productivity was low in the winter, which was characterized by long dry periods and cold temperatures. In early March, 200 pounds per acre of dry matter were utilized. Rapid spring growth began in mid-March, reaching peak standing crop of 1,917 pounds per acre in late April. The grazing rotation was accelerated as forage productivity increased. In late April, 241 pounds per acre of forage dry matter were utilized.

In January, ADF of the forage before grazing was higher and IVDMD was lower than after grazing. Crude protein tended to be higher after grazing but not significantly. In March, ADF tended to increase after grazing but not significantly, and IVDMD and protein decreased significantly. In April, ADF, IVDMD, and crude protein were unchanged after grazing.

These results are consistent with expected seasonal changes in forage quality on annual range. At the beginning of the green season, the previous season's dry residue lowers the quality of the available forage. Grazing reduces the proportion of low-quality residue so that forage quality increases in January following grazing.

In March, there is more available forage. Livestock can be more selective and remove a significant proportion of the high-quality component, causing quality to decrease after grazing. In April, available forage is much greater than livestock requirements. Selective grazing at this time removes an insignificant portion of the high-quality forage, so that there is little effect on forage quality after grazing.

TABLE 3. Quality and production of forage harvested before and after grazing for each rotation of the controlled grazing system

Period	Before grazing*	After grazing*	Average*
Acid detergent fiber (ADF)		%	
Jan	40.09 a	25.88 c	32.99 b
Mar	26.83 c	31.87 c	29.35 c
Apr	33.09 b	33.43 b	33.26 b
June°	—	—	40.54 a
Average	35.14	32.93	
In-vitro dry matter digestibility (IVDMD)		%	
Jan	80.07 b	90.45 d	85.41 b
Mar	91.79 d	85.88 c	88.83 c
Apr	85.54 c	84.34 c	84.94 b
June	—	—	74.40 a
Average	83.03	83.77	
Crude protein		%	
Jan	9.6 b	12.0 ab	10.8 ab
Mar	14.7 a	10.9 b	12.8 a
Apr	10.2 b	9.4 b	9.8 b
June	—	—	5.9 c
Average	10.1	9.6	
Forage level		*lb/acre*	
Jan	888 b	677 bc	783 b
Mar	734 bc	534 c	634 b
Apr	1917 a	1676 a	1797 a
June	—	—	—
Average	1180	962	

* Data followed by the same letter in the before- and after-grazing columns or the average column are not significantly different at p<0.01.
° There was no June grazing, but remaining dry forage was sampled and analyzed for comparative purposes.

Other benefits

Medusahead infestations were reduced from 45% to less than 10% of the species composition (table 4). An acceptable background level of medusahead of less than 10% was measured in an ungrazed wildlife exclosure. Table 4 also shows that as medusahead decreased, bare ground, litter, soft chess, filaree, and other forbs tended to increase. Medusahead depends on development of a thatch that excludes associated competitors. Intensive grazing over a 2-year period reduced additions to the thatch layer and allowed existing thatch to decay, thus opening medusahead-occupied sites to other species. Other UC researchers have shown that seeding annual legumes in conjunction with medusahead reductions give the manager partial control over the resulting species composition.

The photographic records suggest that wildlife cover and streambank stability may improve when pasture subdivision is used to achieve controlled access to riparian areas. Wildlife cover adjacent to riparian areas increased, because pasture subdivision allowed for reduced grazing in the riparian paddock and facilitated cover development. In 1986, wild turkeys were observed in the area. Controlling the grazing pattern also reduced livestock impacts in the streambed, allowing sustained development of plant cover that increases streambank stability.

TABLE 4. Change in species composition, 1984 to 1986, for four transects in medusahead infestations and one transect in a small ungrazed exclosure

Composition	Medusahead 1984	Medusahead 1986	Exclosure 1984	Exclosure 1986
		%		
Bare ground	1	8	0	0
Litter	16	25	16	18
Medusahead	45	10 **	8	10
Soft chess	17	23	16	
Wild oats	4	0	34	22
Annual ryegrass	2	5		
Annual fescue	1	2		
Ripgut brome	0	0	22	44
Annual legumes	4	4		
Filaree	10	13		
Other forbs	2	6 *	4	6
Sample size (n)	4	4	1	1

* Significantly different at p<0.05
** Significantly different at p<0.01

Fencing costs

New Zealand-type electric fencing is a useful tool for improving ranch productivity and management flexibility. Pasture subdivision has been considered expensive, because it requires increased fencing. New Zealand fencing materials and techniques have substantially reduced fencing costs so

TABLE 5. Actual fencing material costs for two grazing cells and estimated cost for traditional barbed wire

Grazing cell	Area	Distance	Cost: Per mile	Cost: Total/acre
	acres	*miles*	*$*	*$*
Single-strand electric high-tensile wire				
Wagon-wheel	1060	12.5	400	4.72
Block	1110	9	400	3.24
Four-strand barbed wire				
Wagon-wheel	1060	12.5	2,000	23.58
Block	1110	9	2,000	16.22

NOTE: Costs based on 1983-84 prices; 1989 costs were approximately 50% higher.

TABLE 6. Comparison of pasture subdivision with other common range improvements

Practice	Life	Cost	Amortized cost	Production increase	Beef production
	yr	*$*	*$*	*%*	*lb/a*
None	—	—	—	—	50
Subdivision	10	10	0.92	50 - 100	75
Legume seeding	20	50	7.12	50 - 100	75
Nitrogen fertilization	2	25	14.99	50 - 100	75

NOTES: Comparison uses conservative estimates of improvement life, costs, and production increases.
Interest rate = 13%

that pasture subdivision can be one of the least expensive range improvements.

Fence material costs in 1983-84 were $400 per mile compared with $2,000 for traditional barbed wire fences (table 5). That converts to less than $5 per acre, which is substantially less than the establishment cost of an annual legume seeding or range fertilization. For $5 per acre, a 50% to 100% increase in beef production was accomplished. A legume seeding yielding 50% to 100% increases in beef production would cost about $50 per acre (table 6). Fifty pounds per acre of nitrogen will frequently double production for 1 to 2 years at about $15 to $30 per acre.

Management problems

Controlled grazing is not without problems. More labor was needed because of the frequent rotation of stocker cattle to new paddocks. The large pasture size and short time the cattle were on the ranch may have affected labor requirements. On other ranches using smaller paddocks for controlled grazing, stockers have been moved very quickly. Ease of movement from paddock to paddock contributes to ranch operational efficiency, as indicated by reduced labor and lower animal stress. Ranch landscape, layout, accessibility, and stock-water availability are important factors affecting the efficiency of cattle movement from paddock to paddock.

Trampling reduced plant cover during the wet season on heavy clay soils. It's amazing how much damage 720 head of 700-pound steers can cause just by being moved. The narrow portions of the pie-shaped paddocks were heavily affected by the concentrated trampling that occurred each year. This problem may be difficult to avoid in cell arrangements with a central watering facility. The second cell on the O'Connell Ranch did not have the same problem, because of its block arrangement with water in each paddock. Placement of stock water in each paddock is preferable, if sufficient water is available and facilities can be developed economically. Pie-shaped paddocks with a single central watering facility should not be overlooked, however, because they remain a powerful tool for achieving pasture rest between successive grazings.

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Treated tomato transplants (right) were significantly shorter than untreated plants.

Growth regulator controls tomato transplant height

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Richard Smith

A new plant growth regulator, uniconazole, controlled height of greenhouse-grown fresh market tomato transplants in a 1-year trial. Field results showed no effect on final yields and quality.

Delays in planting can result in overgrown, difficult-to-handle transplants. As is true of ornamental plants grown in greenhouses, increased shelf life for vegetable transplants is an important goal for producers, particularly when plants must be held in the greenhouse for a longer than optimal period.

A growth regulator, uniconazole (Sumagic) has been shown in a study by the senior author to be an effective plant height inhibitor for many species of greenhouse-grown ornamental plants (*Flower & Nursery Report*, Spring 1988). Another potential use for this chemical is in vegetable transplants grown in the greenhouse. We conducted trials to evaluate uniconazole on fresh market field tomato transplants. Our purpose was to determine effective application rates for height control in the greenhouse and to study any effects on yield.

Methods

Greenhouse flats of 144 plants each were seeded May 20 with Royal Flush, a fresh market field tomato variety. Using four flats for each treatment replication, we established six treatments: 0.25, 0.5, 1, 2, and 5 parts per million (ppm) active ingredient uniconazole applied on June 8, as well as an untreated control. Treated flats were sprayed with a hand-held applicator, at a