The Role of Wet Meadows as Wildlife Habitat in the Southwest[1]

DAVID R. PATTON[2] AND B. IRA JUDD[3]

Wildlife Biologist, Rocky Mountain Forest and Range Experiment Station, and Professor of Agronomy, Arizona State University, Tempe.

Highlight

There are approximately 43,700 acres of wet meadows on National Forests in the Southwest. Three sites (meadow, transition, and dry forest) influence herbage production and plant composition. Average per acre production for a 3-year period was 2,690 lb, 1,330 lb, and 170 lb in the meadow, transition and surrounding dry forest sites, respectively, for two areas studied. Deer and elk spent more time in the adjacent forest edge than in the meadow, but time spent in the meadow may be more important for quantity and quality of forage.

Wet meadows or "cienegas" are relatively flat areas or potholes near the heads or along the courses of mountain streams (Fig. 1). Their drainage is generally slow, and the soil remains wet most of the year because of a high water table. These meadows are found in Arizona and New Mexico in coniferous forests at elevations of 5,500 to 11,000 ft.

Elk, deer, turkey and other wildlife species are often seen in and around cienegas at various seasons, but the importance of wet meadows to wildlife has not been studied intensively.

By primary plant succession, wet meadows in the Southwest are are slowly changing to drier sites. Dry conditions are more favorable for trees, and the meadows are gradually shifting to a forest type. Gully erosion often accelerates succession by lowering the water table, thereby enabling trees to become established faster.

Some knowledge is available on the herbage production of mountain meadows as compared to pine-bunchgrass openings and timber ranges. Arnold (1954) indicates a 1-acre meadow can produce the same amount of herbage as a 4-acre pine-bunchgrass opening or a lightly stocked, 12-acre pine stand. Meadows in the Sierra Nevada mountains in California produce from 835 to 1,435 lb of herbage per acre, with sedges contributing more than grasses (Sanderson, 1967).

No information is available on plant composition in southwestern wet meadows except for a plant list of collections made in the Mt. Baldy Primitive Area, Apache National Forest, Arizona (Buckner, 1967).

Methods

Two meadow study areas on the Apache National Forest were selected to evaluate herbage production, plant composition, and protein content of forage plants. Four meadow locations were used to determine wildlife use. Herbage was estimated by clipping four 9.6-ft^2 plots inside an enclosure that was replicated three times in three different sites (meadow, transition, and dry forest).

Pace transects with 1-ft^2-circular plots were used to record plant species and number. Three transects of approximately 100 plots each were located randomly in the wet, moist, and dry sites. Plants were collected for protein analysis in June, August, and October. Pellet counts were made on four random transects (145 × 12 ft, .04 acre) in each meadow, transition, and adjacent forest area.

Wet meadow acreage on National Forest land in Arizona and New Mexico was determined from estimates provided by district rangers. The estimates were made from topographic maps and aerial photographs.

Results

From aerial photographs and field examinations, three sites of herbage production and plant composition were identified (Fig. 2). These sites, which appear to be related to soil type and depth of water table, represent primary successional stages in meadow development.

Herbage Production

Average herbage production for a 3-year period was 2,690 lb/acre in the meadows, 1,330 lb/acre in the moist transition, and 170 lb/acre in the dry forest (Table 1).

Production varied between years and on all areas. The only consistent pattern was between sites; the wet meadow produced more herbage than the moist transition, and the moist site produced more herbage than the dry forest.

Variation in wet meadows over a 3-year period was 2,000 lb (1,820 to 3,840). In the moist transition, variation was almost 800 lb (980 to 1,760). Variation in the dry forest was approximately 200 lb (100 to 290).

In total, there are approximately 43,700 acres (0.2%) of wet meadows and transition on National Forest land in the Southwest (Arizona 14,900 acres; New Mexico 28,800 acres). The herbage produced by this low acreage is a significant contribution to the National Forest carrying capacity for wildlife and livestock.

Although herbage quantity by itself is a part of carrying capacity, it does not account for the total contribution of meadows to wildlife habitat. Animals apparently seek out plants or parts of plants as food which may not be part of the major forage-producing species. In such instances, plant composition and nutrition are important to the animal.

[1] Received April 17, 1969; accepted for publication June 11, 1969.

[2] Located at Tempe in cooperation with Arizona State University; central headquarters are maintained at Fort Collins in cooperation with Colorado State University.

[3] Work conducted under Engineering Research Center Grant 330-100 in 1966 and Arizona State University Faculty Grant in 1967.

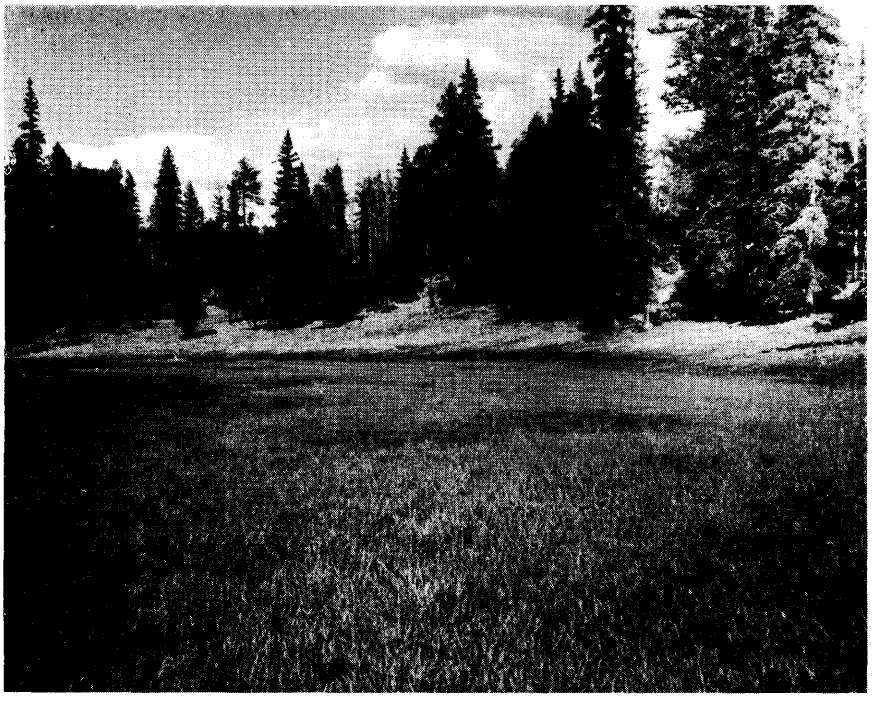

FIG. 1. Wet meadow on the Apache National Forest, Arizona.

Plant Composition

Vegetation in mountain meadows is complex. Twenty-eight genera of grasses and forbs were identified in the dry, 43 in the moist, and 20 in the wet sites. Density and frequency were computed by sites (Table 2). Density refers to number of plants per plot, and frequency is the number of times the plant occurs in 100 plots.

Herbage production in wet meadows was almost entirely from one genus—*Carex*. Production in the moist site, however, was distributed among five or six genera. Plant density was greater in the moist site than in the wet (Table 2) because the wet meadows have a small number of large plants, while the moist transition has a large number of small plants.

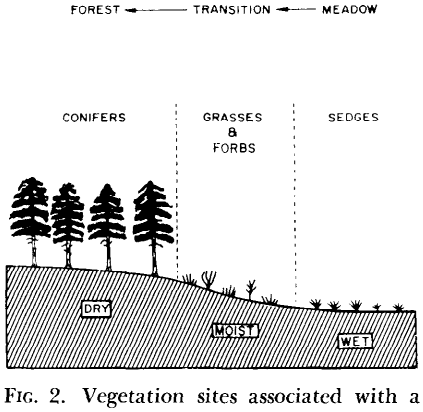

FIG. 2. Vegetation sites associated with a wet meadow.

Protein Analysis

Protein represents the amino acid complex essential for life and is considered the most important nutrient component of plants (Dietz, 1964). Minimum protein requirements for body maintenance in deer have been tentatively established at 7%. Thirteen percent is considered optimum for growth and reproduction (French et al. 1956).

Plant protein content in the different sites was variable. Eleven plants used by livestock and wildlife in and around the meadows were analyzed. Dandelions were highest in protein, averaging 14.2% for the three different collection dates (Table 3). Dandelion, rush, and sedge had their highest frequency and density in the moist and wet sites. Of the eleven plants analyzed from the three different sites, three (dandelion, rush, and sedge) had protein content consistently over the 7% needed for body maintenance for deer. Rumen samples from the White Mountains in Arizona show that rush, sedge, and dandelion are present, from trace amounts to average volumes of over 10%, in the rumen content of deer and elk (Wallmo and McCulloch, 1962). Two of the four plants analyzed from the dry site had protein content at the 7% level.

Wildlife Use

Combined results from four study areas show deer days use (based on pellet counts) in the forest was higher than in the meadow and transition for all three years (Table 4). Elk days use followed the same trend but the difference was not as great. As expected, cattle use was higher in the meadow.

Pellet transects in the forest were located approximately 50 yards from the edge of the moist transition. Indications are that high pellet counts at that distance could result from an edge effect. Studies in ponderosa pine show deer and elk pellet groups start to decline about 200 ft from the forest border (Reynolds, 1966).

Table 1. Herbage production (lb/acre) estimates for two study areas on the Apache National Forest.

Area	Year	Wet (meadow)	Moist (transition)	Dry (forest)
Meadow No. 1	1966	1820	1760	200
	1967	2210	1080	100
	1968	3840	1010	100
Meadow No. 2	1966	3380	1680	210
	1967	2310	1490	290
	1968	2600	980	130
Three-year average		2690	1330	170

Table 2. Square-foot density and percent frequency of grasses and forbs by site. Includes only plants with frequency over 4 percent.

Species	Common name	Forest Den.	Forest Freq.	Transition Den.	Transition Freq.	Meadow Den.	Meadow Freq.
Lathyrus arizonicus Britt.	Arizona peavine	0.9	22	—	—	—	—
Aristida fendleriana Steud.	Fendler three-awn	4.2	19	—	—	—	—
Muhlenbergia montana (Nutt.) Hitchc.	Mountain muhly	4.0	19	—	—	—	—
Vicia americana Muhl.	American vetch	0.6	18	—	—	—	—
Cirsium undulatum (Nutt.) Spring	Wavyleaf thistle	0.3	11	—	—	—	—
Deschampsia caespitosa (L.) Beauv.	Tufted hairgrass	2.1	22	4.3	34	—	—
Erigeron spp.	Fleabane	3.4	31	1.3	30	—	—
Festuca arizonica Vasey	Arizona fescue	6.7	36	0.9	10	—	—
Trifolium spp.	Clover	1.8	11	0.4	6	—	—
Scirpus microcarpus Presl.	Panicled bulrush	—	—	8.9	26	—	—
Tridens pilosus (Buckl.) Hitchc.	Hairy tridens	—	—	2.2	21	—	—
Muhlenbergia wrightii Vasey	Spike muhly	—	—	1.3	18	—	—
Rumex hymenosepalus Torr.	Canaigre	—	—	0.5	16	—	—
Agrostis scabra Wild.	Winter bent	—	—	2.2	16	—	—
Iris missouriensis Nutt.	Rocky Mt. iris	—	—	0.6	13	—	—
Hypericum formosum H.B.K.	St. Johnswort	—	—	0.4	13	—	—
Umbellifera spp.	Carrot	—	—	0.3	12	—	—
Blepharoneuron tricholepis (Torr.) Nash.	Pine dropseed	—	—	0.4	8	—	—
Bromus anomalus Rupr.	Nodding brome	—	—	0.3	8	—	—
Evolvulus sericeus Swartz	Evolvulus	—	—	0.2	7	—	—
Mentha spp.	Mint	—	—	0.3	5	—	—
Juncus spp.	Rush	—	—	6.4	42	1.6	10
Poa fendleriana (Steud.) Vasey	Mutton bluegrass	—	—	0.6	9	0.4	7
Poa ampla Merr.	Big bluegrass	—	—	0.4	11	0.1	5
Carex spp.	Sedge	1.3	15	7.9	68	23.1	100
Achillea lanulosa Nutt.	Western yarrow	1.3	21	2.5	29	0.6	6
Potentilla hippiana Lehm.	Horse cinquefoil	0.4	13	5.4	42	0.1	6
Taraxacum officinale Weber	Dandelion	3.2	43	6.6	60	0.2	5
No. genera with frequency over 4%			13		22		6
Plant density/ft²			31		54		29

Use of the meadows and transition sites by other wildlife species was noted during the study period. Turkey sign was abundant in the spring and early summer (June and July). Adults and poults apparently use meadows as "bugging" areas, since insects are plentiful in

Table 3. Protein (%) in plants by site. Three-year averages.

Species	Protein** June	Protein** Aug.	Protein** Oct.	Avg. protein	Site of highest freq.
Dandelion	13.8	16.2	13.4	14.2	Moist transition
Rush	12.0	12.0	13.6	12.5	Moist transition
Sedge	13.2	10.0	9.1	9.6	Wet meadow
Mutton bluegrass	8.8	5.0	3.5	7.0	Moist transition
Spike muhly	4.5	8.5	5.5	6.5	Moist transition
Tufted hairgrass	*	7.3	4.7	5.9	Moist transition
Pine dropseed	2.0	7.0	5.3	4.3	Moist transition
Arizona fescue	8.6	7.5	5.4	6.9	Dry forest
Junegrass	*	6.5	5.0	5.0	Dry forest
Mt. muhly	3.5	7.0	4.0	4.9	Dry forest
Bottlebrush squirreltail	*	4.0	6.0	5.0	Dry forest

* No data.

* * Composite sample: includes leaves stems & flowers.

Table 4. Use (days/acre) by deer, elk, and cattle in wet meadow and transition, and adjacent forest from June to October, Apache National Forest, Arizona.

Species	Use[1] For.	Use[1] Edge	Use[1] Meadow & Trans.
	1966		
Deer	1.9		1.0
Elk	2.4		0.5
Cattle	6.0		25.0
	1967		
Deer	1.0		0.0
Elk	0.5		0.4
Cattle	1.3		8.2
	1968		
Deer	1.9		0.4
Elk	1.0		0.8
Cattle	3.4		31.0

[1]Based on defecation rate of 13 for deer and elk, 12 for cattle (U.S. Forest Service, 1963).

the moist and wet sites. In years of good rainfall, ducks use meadows as resting and in some cases as nesting sites.

Discussion

Vegetation in the wet meadow-forest mosaic is complex. Moist transition sites have 43 plant genera compared to 20 genera in the dry forest and 28 in the wet meadow sites. The combined wet and moist sites offer abundant forage produced by a variety of plants unmatched by the adjacent dry forest.

Protein content of plants in the moist and wet sites is high. Three species—sedge, rush, and dandelion—furnish protein in the amount needed by deer for growth and reproduction.

Deer and elk days use was higher in the forest edge but the time spent in the wet meadow and transition may be more important because of the quantity and quality of forage available. Use of meadows by deer and elk is difficult to evaluate because suitable techniques to determine the time element are lacking. It seems reasonable to assume that deer and elk feed in the meadow and transition for short periods, then move back into the forest edge for cover. A deer or elk would have to spend more hours searching for and consuming a day's ration of forage in the forest (170 lb/acre) than in the moist transition site (1,330 lb/acre) or wet meadow (2,690 lb/acre).

Wet meadows and moist transitions must be considered for their total contribution to wildlife habitat, not just individual attributes of herbage production, plant composition, or protein content. Habitat diversity is important to wildlife and the fact a meadow exists in a natural state in a monotonous forest is reason enough to afford it protection and maintenance.

The following guidelines are suggested for the protection, maintenance, or restoration of wet meadows.

1. All roads and trails should be kept out of the moist and wet sites. Preferably they should be located back into the adjacent, dry forest.
2. Succession should be controlled by removing trees that invade the moist and wet sites.
3. Keep livestock and game numbers at a level that will improve or maintain desirable plant composition and not induce erosion from trampling.
4. Wet meadows that have been reduced to dry sites by gully erosion can be restored by remedial measures to raise the water table.

Literature Cited

ARNOLD, J. F. 1954. Plant life form, a basis for evaluating the ecological condition and trend of range communities within the ponderosa pine zone of Arizona. Unpublished. 108 p. On file: Forest Hydrology Lab., Arizona State Univ., Tempe, Arizona.

BUCKNER, E. L. 1967. List of plants collected in Mt. Baldy Primitive Area, Apache National Forest. U.S. Forest Serv. Unpublished. 13 p. Typewritten. On file: Springerville Ranger District, Springerville, Arizona.

DIETZ, D. R. 1964. Techniques and usefulness of nutrition measurements in wildlife habitat research. Rocky Mountain Forest and Range Exp. Sta., Range and Wildlife Habitat Workshop, Tempe, Arizona. 42 p.

FRENCH, C. E., L. C. MCEWEN, W. D. MAGRUDER, R. H. INGRAM, AND R. W. SWIFT. 1955. Nutritional requirements of white-tailed deer for growth and antler development. Pennsylvania Agr. Exp. Sta. Bull. No. 600. 50 p.

REYNOLDS, H. G. 1966. Use of a ponderosa pine forest in Arizona by deer, elk, and cattle. U.S. Forest Serv. Res. Note RM-63. Rocky Mountain Forest and Range Exp. Sta., Fort Collins, Colo. 7 p.

SANDERSON, H. R. 1967. Herbage production on high Sierra Nevada meadows. J. Range Manage. 20: 255–256.

U.S. FOREST SERVICE. 1963. Wildlife management handbook, Region 3, Albuquerque, New Mexico. 118 p.

WALLMO, O. C., AND C. M. MCCULLOCH. 1962. Influence on carrying capacity of experimental water conservation measures. Ariz. Game and Fish Dept. P-R Completion Report W-78-R-7.