Plant Control—Some Possibilities and Limitations
II. Vital Statistics of Range Management

KENNETH B. PLATT

Assistant Area Lands Officer, Bureau of Land Management, Area 2, Salt Lake City, Utah

Among the primary indices of range condition and, concomitantly, of range management success, is the measure of increase or decrease in undesirable plants. Other primary indices are those of forage density and character in relation to usable climax, and of soil fertility and erosion conditions. Together, these indices comprise what we might call the vital statistics of range management. As such they compare in significance with birth, infant mortality, disease incidence and adult death statstics for the human species. In concise summary fashion they tell us how we are progressing. By analysis they can tell us much of what needs to be done, and where it needs to be done, to improve our situation.

A great deal of space in the early literature on range plants was devoted to identification, botanization, habitat studies, ecological relationships, and general distribution of undesirable members of the range plant community, particularly the more dangerously poisonous ones. More recently, much effort has gone into study of life histories and life processes of these plants, and into recording their responses to a wide range of treatments designed to reduce or eliminate them.

Notwithstanding the wealth and diversity of information accumulated through these efforts, there still exists no comprehensive statement of the *economic* distribution of undesirable range plants, upon which concerted plans for further control research and action might be based. In a previous article (Jour. Range Man'gt, 12:64-68. 1959) the author has presented data demonstrating the presence of more than 863,000,000 acres of undesirable plants on major range areas in the United States and Canada. It was also demonstrated that projection of present control programs to cover this entire acreage would mount into many billions of dollars. These figures point to the need for more accurate information upon which to organize what plainly is to be a long and costly battle. The following discussion will examine some of the problems and suggest some steps to be taken in gaining that information.

The previous article discussed in a general way the relationships of various factors affecting success of plant control, with emphasis on the continuing need to follow good range management practices in order to hold the gains made through spray programs, reseeding, and other plant controls. That article brought together, but did not discuss, estimates by representative range authorities in the major range regions of the United States and Canada on the extent of occurrence of the chief undesirable range plants. Space did not permit, however, a showing of distribution by regions, relative importance in particular regions, nor any qualitative evaluation of the various figures. The present article includes further details on the quantitative data (Tables 1 and 2), but is more concerned with their qualitative significance.

Standardization of Terms Needed

The estimates of acreage and of relative importance of different plants in particular regions, presented here, must be recognized as indicative only. Lack of generally accepted and well defined boundaries for the various range regions imposes one obvious limitation on accuracy of these acreage estimates. Thus, while most readers will find the region names used in Table 1 fully familiar, wide variation exists in the boundaries set for these areas in the literature which has dealt with them from the diverse standpoints of climate, vegetation, soils and geology, each of which has its own important bearing on the end problems of how best to manage the resultant range resources.

As a guide to cooperators in this instance, the author specified general boundaries for these regions, as shown in the footnote to Table 2. Indulgence of readers having in mind other or more closely defined boundaries is asked on the ground that the boundaries here used served their intended purpose by reducing overlap of estimates on adjoining regions, and by permitting a broad summary of the total acreages involved. However, as will be discussed, there is need for a standard naming and delineation of range regions for both research and operational applications.

Another recognized limitation on accuracy of the figures here presented is the evident use by some cooperators of a net species acreage concept, as opposed to the concept of acreage requiring treatment for control purposes. For example, Table 1 reveals an estimate by one authority of only 50 acreas of death camas *(Zigadenus spp.)* in the Central Rocky Mountain region, whereas 5,000,000 acreas of this plant is reported by another authority for the Great Basin region. The dif-

TABLE 1

UNDESIRABLE RANGE PLANTS -- PART 1, HERBACEOUS
TEN MOST IMPORTANT SPECIES IN EACH RANGE REGION, AS REPORTED BY LEADING RANGE AUTHORITIES

Plant Species	Occurrence and Acreages, by Major Range Regions									
	Pacific Northwest	California Sierra	Pacific Southwest	Great Basin	Northern Inter-Mountain	Northern Rocky Mountain	Central Rocky Mountain	Southern Rocky Mountain	Southern Great Plains	Central Great Plains
1 Actinea richardsonii (Pinque)							3 135,000			
2 Amaranthus Spp. (Pigweed)										9 1,000,000
3 Aplepappus tenuisectus (Burroweed)			10 1,000,000					4 9 NE		
4 Astragalus Spp. (Loco)		10 NE	7 5,000,000					10 NE	1 10 38,000,000	1 1,000,000
5 Bromus tectorum (Cheatgrass)				2 5,000,000 1/	10 15,000,000 1/	2 7 50,000				
6 Centauria maculosa (Spotted knapweed)						4 6 50,000				
7 Chenchus pauciflorum (Sandbur)										7 5,000,000
8 Cicuta douglasii & occidentalis (Water hemlock)	8 10 100,000						7 10 NE			
9 Cirsium arvense (Canadian thistle)	4 1,526,000				8 50,000	3 4 10,000	5 200			
10 Delphinium Spp. (Larkspur)	6 6 1,000,000	9 NE		2 8 510,000	4 5 5 5 125,000	3 6 5,000	4 8 9,000			3 2,000,000
11 Elymus caput-medusa (Medusa rye)	3 10 500,000	7 9 80,000	9 NE		1 3 4 5 200,000					
12 Euphorbia Spp. (Leafy spurge)						8 1,000				
13 Halogeton glomeratus (Halogeton)	5 1,300,000	5 45,000		5 5 5,000,000	2 2 2 8 326,000		1 6 3,387,000			
14 Hordeum jubatum (Foxtail)										
15 Hymenoxys odorata (Bitterweed)									8 15,000,000	
16 Hypericum perforatum (Goatweed)	3 5 1,220,000	10 3,500			3 4 200,000	5 5 200,000				
17 Linaria dalmatica & vulgaris (Dalmatian toadflax)					10 NE	9 500				
18 Lupine Spp. (Lupine)	9 30,000,000				5 5 150,000					
19 Madia glomerata (Tarweed)				7 NE	9 NE	8 5,000				
20 Oxytenia acerosa (Copperweed)							3 9 2,000			
21 Oxytropis Sp. (Crazyweed)							2 8,000			2 1,000,000
22 Ranunculus alismaefolius (Buttercup)		6 10,000								
23 Salsola Spp. (Russian thistle)		4 NE								10 100,000,000
24 Salvia aethiopis (Mediterranean sage)	4 9 200,000									
25 Senecio jacobaea (Tansy ragwort)	7 200,000									
26 Suckleya suckleyana (Poison sucklea)										4 5,000,000
27 Taraxacum officianale (Dandelion)										
28 Tribulus terrestris (Puncture vine)										8 1,000,000
29 Triglochin martima (Arrowgrass)										
30 Veratrum californicum (False hellebore)		5 10,000								
31 Wyethia Spp. (Mule's ears)		4 100,000		6 NE	2 3 150,000					
32 Xanthium Spp. (Cocklebur)							10 5,000			5 5,000,000
33 Zigadenus Spp. (Death camas)	7 500,000			8 5,000,000	7 30,000	9 NE	6 50			
Total Acreage Reported, By Range Regions	36,546,000	248,500	6,000,000	15,510,000	16,231,000	321,500	3,546,200	-	53,000,000	121,000,000

NE = No estimate

1/ Author's estimate

NOTE: Underlined figures indicate relative importance among ten most important plants as rated by reporting authority, includi (see Part 2 for woody species). Where two or more authorities reported different acreages of a given species for the sa

TABLE 1

UNDESIRABLE RANGE PLANTS -- PART 2. WOODY

TEN MOST IMPORTANT SPECIES IN EACH RANGE REGION, AS REPORTED BY LEADING RANGE AUTHORITIES

Plant Species	Occurrence And Acreage, By Major Range Regions												Total Acr. Reported By Species
	Pacific Northwest	California Sierra	Pacific Southwest	Great Basin	Northern Inter-Mountain	Northern Rocky Mountain	Central Rocky Mountain	Southern Rocky Mountain	Southern Great Plains	Central Great Plains	Northern Great Plains	Canadian Plains	
1 Acacia stricta (Whitethorn)								7 NE					NE
2 Adenostema fasciculatum (Chamise)		1 2,500,000	1 6,000,000										8,500,000
3 Alhagi camelorum (Camel thorn)		8 500	10 1,000										1,500
4 Arctostaphylos Spp. (Manzanita)			6 4,000,000										4,000,000
5 Artemisia Californica (California sage)		8 500,000											500,000
6 Artemisia cana & arbuscula (Black sage)		3 200,000											200,000
7 A. cana, frigida & tridentata (Mixed sagebrush)											1 4 3,000,000	2,500,000 2/	5,500,000
8 Artemisia filifolia (Sand sage)									2 6 12,000,000				12,000,000
9 Artemisia tridentata (Big Sage)	1 1 20,000,000	2 2 2,000,000	2 3 5 9 4,370,000	1 1 28,000,000	1 1 1 6 15,000,000	1 1 500,000							69,870,000
10 Chrysothamnus Spp. (Rabbitbrush)	2 2 3,000,000	3 NE	4 300,000	3 4 NE	3 4 7 1,500,000		5 125,000						4,925,000
11 Coleogyne ramosissima (Northern blackbrush)			3 6 500,000										500,000
12 Cytisus scoparius (Scotch broom)		6 NE											NE
13 Eleagnus comutata (Wolf willow)												4 250,000	250,000
14 Flourensia cernua (Southern blackbrush or tarbrush)			8 250,000					6 8 NE	5 13,000,000				13,250,000
15 Gutierrezia Spp. (Snakeweed or broomweed)			9 10 2,000,000		5 NE		4 125,000	3 4 NE	7 7 140,000,000			9 NE	142,125,000
16 Juniperus Spp. (Juniper)		7 500,000	1 2 12,383,000	4 3,500,000 1/	7 8 2,000,000 1/		2 500,000	1 5 NE	2 5 45,000,000				63,883,000
17 Larrea Spp. (Creosote bush)			5 7 7 8 17,000,000					2 7 12,000,000	11 17,500,000				46,500,000
18 Opuntia Spp. (Cactus)			3 3 6 2,000,000					5 8 NE	4 4 65,000,000	1 6 5,000,000	2 3 6,500,000	3 100,000	78,600,000
19 Pinus edulis & P. monophylla (Pinyon pine)			4 NE										NE
20 Pinus ponderosa (Yellow pine)			5 8 8 4,000,000										4,000,000
21 Populus tremuloides (Aspen)												2 2 2,000,000	2,000,000
22 Potentilla fruticosa (Shrubby cinquefoil)						10 NE						1 750,000	750,000
23 Prosopis Spp. (Mesquite)			1 2 2 9,000,000					1 6 14,000,000	1 70,000,000				93,000,000
24 Prunus Spp. (Chokecherry)			9 10,000										10,000
25 Quercus Spp. (Scrub Oak)			4 4 5,000,000				11 250,000		3 3 35,000,000				40,250,000
26 Rhus trilobata (Skunkbrush)									8 500,000				500,000
27 Rosa Spp. (Wild rose)												7 1,000,000	1,000,000
28 Salix Spp. (Willow)				6 10,000								4 2,000,000	2,010,000
29 Sarcobatus vermiculatus (Greasewood)							7 100,000						100,000
30 Symphoricarpos Spp. (Snowberry)												2 9 3,000,000	3,000,000
31 Tamarix Sp. (Salt cedar)								9 NE					NE
32 Tetradymia Spp. (Horsebrush)				3 100,000	9 50,000								150,000
33 Yucca glauca (Yucca)									6 2,000,000				2,000,000
Total Acreage Reported, By Range Regions	23,000,000	5,700,500	66,814,000	31,610,000	18,550,000	500,000	1,100,000	26,000,000	400,000,000	5,000,000	9,500,000	11,600,000	599,374,500

NE = No estimate

1/ Author's estimate

2/ A. frigida only

NOTE: Underlined figures indicate relative importance among ten most important plants as rated by reporting authority, including both woody and herbaceous species (see Part 1 for herbaceous species). Where two or more authorities reported different acreages of a given species for the same region, the largest estimate has been used. Where the estimate offered was in terms of a range of [illegible]

ficulty of forming meaningful area estimates for species which commonly occur either as infrequent dense populations in limited habitat, such as water hemlock (*Cicuta* spp.), or as thinly scattered occupants of a wide habitat, such death camas, or loco (*Astragalus* spp.), is reflected in the frequent "no estimate" reports on such plants by cooperators.

Even where uniform estimation is achieved and accurate acreages of occurrence established, these acreages may not be uniformly significant from the management standpoint. At one extreme are highly poisonous plants such as hemlock and tall larkspur (*Delphinium* spp.), a few scattered patches of which may make several thousand acres of range unusable. At the opposite extreme are many plants not harmful in themselves, or not present in sufficient density to dominate the plant cover, yet whose space we would prefer to have taken by valuable forage. In this group we may list the pigweed (*Amaranthus* spp.), sandbur (*Cenchrus pauciflorum*) and Russian thistle (*Salsola* spp.) of the Central Great Plains.

Finally, it should be noted that the inquiry on which the figures in this article are based called for estimates only on the ten most important undesirables in each region. This explains the absence of many familiar poisonous plants, as well as other undesirables. A complete listing of undesirables doubtless would swell the total acreage significantly.

With the foregoing limitations in mind, the acreages listed in Table 1 may be viewed as showing, in a general way, the relative importance of the listed plants in the different regions. This table also shows the range of distribution, in economically significant quantity, of each listed plant by range regions. Table 2 lists the controls recommended for those plants for which control is considered practical, and the costs experienced in applying those controls.

Chemical Controls Dominate

In Table 2 it will be noted that for 12 of the 23 herbaceous plants listed, chemicals are the only controls recommended, and that chemicals are recommended for either alternative use or use in combination with other controls on an additional 9 plants, leaving only two plants on which chem-

Table 2. Undesirable range plants: Part 1, Herbaceous. Recommended control methods and estimated control costs.

Plant Species	Recommended Control, By Range Region[1]	Estimated Control Cost Per Acre
Actinea richardsonii (Pingue)	Chemical (CRM)	$ 4.50
	Chemical (NIM)	2.50 - 6.00
Astragalus spp. (Loco)	Chemical (CGP)	2.00
	Chemical (SGP)	2.50 - 4.00
Centauria maculosa (Spotted knapweed)	Chemical (NRM)	10.00
Cicuta spp. (Water hemlock)	Chemical (PNw)	8.00 - 10.00
	Chemical (CRM)	4.00
Cirsium arvense (Canadian thistle)	Chemical (PNw)	20.00 plus
	Chemical (NRM)	10.00
Delphinium spp. (Tall larkspur)	Chemical (PNw)	8.00 - 10.00
	Chemical (C-S)	6.00 - 10.00
	Chemical & Biological (NIM)	5.00
	Chemical (NIM)	2.50 - 6.00
	Chemical (CRM)	4.00 - 4.50
(Low larkspur)	Chemical (CGP)	3.00
Elymus caput-medusae (Medusa rye)	Cultural (PNw)	10.00 - 15.00
	Management & cultural (C-S)	8.00
	Management & cultural (NIM)	12.00
	Cultural (NIM)	8.00 - 10.00
Halogeton glomeratus (Halogeton)	Chemical (C-S)	6.75
	Cultural (NIM)	8.00 - 10.00
	Chemical & Cultural (NIM)	1.50 - 4.00
	Management & chemical (CRM)	7.50
Hypericum perforatum (Goatweed)	Biological & management (PNw)	5.00
	Chemical & cultural (NIM)	5.00 - 10.00
	Biological & chemical (NRM)	2.00 - 3.00
Lupinus spp. (Lupine)	Chemical (PNw)	3.00
	Chemical (NIM)	3.50
Madia glomerata (Tarweed)	Burning & cultural (NIM)	0.50 - 10.00
	Chemical (NRM)	10.00
Oxytenia acerosa (Copperweed)	Chemical (CRM)	7.00
Oxytropis spp. (Crazyweed)	Chemical (CRM)	3.00
	Chemical (CGP)	2.00
Ranunculus alismaefolius (Buttercup)	Cultural (C-S)	7.00 - 8.00
	Cultural & chemical (C-S)	12.00
Salvia aethiopis (Mediterranean sage)	Chemical (PNw)	10.00 plus
Senecio jacobaea (Tansy ragwort)	Chemical & management (PNw)	10.00 plus
Suckleya suckleyana (Poison suckleya)	Cultural (CGP)	1.00
Taraxacum officinale (Dandelion)	Chemical (CP)	2.25
Tribulus terrestris (Puncture vine)	Chemical (CGP)	2.00
Veratrum californicum (False hellebore)	Cultural & chemical (C-S)	15.00
Wyethia spp. (Mule's ears)	Cultural (C-S)	8.00 - 10.00
	Cultural & chemical (C-S)	15.00
	Chemical (NIM)	2.50 - 5.00
	Chemical (NRM)	2.00 - 3.50
Xanthium spp. (Cocklebur)	Chemical (CRM)	4.00
	Chemical (CRM)	6.00
Zigadenus spp. (Death camas)	Chemical (CRM)	4.00
	Management & chemical (CP)	3.50

[1] Range region designations used here are: *Pacific Northwest* (PNw), Washington, northern and western Oregon, northern Idaho; *California-Sierra* (C-S), California portions of Sierra Nevada watershed; *Pacific Southwest* (PSw), southern and western Arizona, southern California; *Great Basin* (GB), Nevada and western Utah; *Northern Inter-Mountain* (NIM), southern Idaho, southeastern Oregon; *Northern Rocky Mountain* (NRM); western Montana and western Wyoming; *Central Rocky Mountain* (CRM), eastern Utah, western Colorado; *Southern Rocky Mountain* (SRM), northeastern Arizona, southern and western New Mexico; *Southern Great Plains* (SGP), western Texas, northeastern New Mexico, Oklahoma; *Central Great Plains* (CGP), Kansas, Nebraska, eastern Colorado; *Northern Great Plains* (NGP), Dakotas, eastern Wyoming and eastern Montana; *Canadian Plains* (CP), Saskatchewan and Alberta.

ical controls are not recommended at all. Likewise, chemical control is recommended by one or more authorities for 18 of the 25 woody plants listed. By contrast, management alone is not recommended for control of any of the listed undesirables, and even in combination with other treatments it is recommended for only 5 herbaceous and none of the woody plants.

This comparison must not be taken to justify the conclusion that management no longer is important as a factor in control of undesirable range plants. As pointed out in the previous article, without accompanying good management no other form of control of undesirable plants can be expected to succeed more than temporarily, since bad management will insure the destruction of any gains made by means other than management. We may properly conclude, however, that chemical and other means now available are effective in enabling us to establish higher levels of range productivity by reducing or eliminating the undesirables, and in this respect are a powerful tool in aid of management. The questions of (1) how lasting, or (2) how profitable these controls may be are not answered by the data here considered.

Uniform Comparative Cost Basis Recommended

The control costs shown in Table 2 vary widely in many instances. Some of these variations reflect differences in density of stand dealt with and differences in difficulty of terrain. Some reflect an element of chance in the success of the method, often present in burning projects. Another source of variation is the lack of uniformity in treatment of costs chargeable to the control project. For example, one suspects that where the cost of control by burning is reported as low as 50¢ an acre, no allowance has been made for the costs

Table 2. Undesirable range plants. Part 2, Woody. Recommended control methods and estimated control costs.

Plant Species	Recommended Control, By Range Region	Estimated Control Cost Per Acre
Adenostoma fasciculatum (Chamise)	Chemical, burning, and cultural (C-S)	$ 9.00 - 10.00
	Chemical, burning, and cultural (C-S)	25.00 - 30.00[1]
Alhagi camelorum (Camel thorn)	Chemical (C-S)	100.00
	Unspecified (PSw)	5.00 - 25.00
Arctostaphylos spp. (Manzanita)	Burning (PSw)	1.00
	Chemical (PSw)	9.00
Artemisia californica (California sage)	Cultural (C-S)	8.00 - 10.00
	Cultural & Chemical (C-S)	15.00
Artemisia cana, frigida & tridentata (Mixed sagebrush)	Chemical (NGP)	3.00
	Cultural (CP)	7.50
Artemisia filifolia (Sand sage)	Chemical (SGP)	2.50 - 3.50
	Mowing (SGP)	4.00
Artemisia tridentata (Big sagebrush)	Burning (PNw)	0.50
	Chemical (PNw)	2.75
	Cultural & Chemical (PNw)	2.50 - 5.00
	Cultural (C-S)	4.00 - 6.00
	Chemical (C-S)	8.00 - 10.00
	Cultural & chemical (C-S)	15.00
	Burning (PSw)	1.00
	Railing or chaining (PSw)	1.50 - 2.00
	Chemical (PSw)	4.00
	Cultural (GB)	7.00 - 10.00[1]
	Burning (NIM)	0.50
	Chemical (NIM)	2.50
	Cultural (NIM)	5.50
	Chemical (NRM)	3.50
	Chemical & other (NRM)	2.00 - 10.00
	Cultural & chemical (CRM)	4.50
	Chemical & cultural (NGP)	1.00 - 3.00
Chrysothamnus spp. (Rabbitbrush)	Chemical (PNw)	3.00
	Cultural (PNw)	12.00
	Chemical (C-S)	4.00 - 6.00
	Chemical (NIM)	3.50
	Cultural & chemical (NIM)	4.00 - 5.00
Coleogyne ramosissima (Northern blackbrush)	Burning (PSw)	0.10 - 1.00
Eleagnus comutata (Wolf willow)	Chemical & cultural (CP)	4.00 - 8.00
Flourensia cernua (Southern blackbrush or tarbrush)	Chaining (PSw)	0.90 - 1.50
	Mowing (SGP)	3.00 - 10.00
Gutierrezia spp. (Snakeweed or broomweed)	Chemical (CRM)	4.50
	Chemical (SGP)	2.50 - 4.00
Juniperus spp. (Juniper)	Cabling, chaining or dozing (PSw)	1.00 - 5.75
	Cabling or chaining (CRM)	1.00 plus
	Cabling or chaining (SGP)	2.00 - 6.00
	Cabling or chaining (SGP)	5.00 - 15.00
Larrea spp. (Creosote bush)	Cabling or chaining (PSw)	0.75 - 1.50
Opuntia spp. (Cactus)	Burning (PSw)	0.50 - 3.00
	Cabling & grubbing (PSw)	1.00
	Burning & grubbing (SGP)	2.00
	Chemical (CGP)	5.00
	Chemical (NGP)	2.00 - 3.00
Pinus ponderosa (Yellow pine)	Burning (PSw)	1.00 - 3.00
Populus tremuloides (Aspen)	Removal & cultural (CP)	20.00 - 50.00
	Removal & chemical (CP)	7.50
Potentilla fruticosa (Shrubby cinquefoil)	Cultural (CP)	7.50
Prosopis spp. (Mesquite)	Chemical (PSw)	3.00 - 7.00
	Chemical (SRM)	0.65 - 1.75
	Chemical (SGP)	2.50 - 3.20
	Chaining (SGP)	1.50 - 4.50
	Root plowing (SGP)	10.00
	Cultural (SGP)	10.00
Quercus spp. (Scrub oak)	Chemical (CRM)	6.00
	Chemical (SGP)	10.00 - 11.00
Rhus trilobata (Skunkbrush)	Chemical (SGP)	2.50
Rosa spp. (Wild rose)	Cultural (CP)	7.50
Salix spp. (Willow)	Removal & chemical (CP)	7.50
Sarcobatus vermiculatus (Greasewood)	Chemical & cultural (CRM)	4.50
Symphoricarpos spp. (Snowberry)	Chemical (CP)	5.00
	Chemical & cultural (CP)	4.00 - 8.00

[1] Author's estimate.

of one or more year's deferred grazing and possibly some fencing, and that reported cultural control costs of $5.00 or less an acre have not included fencing, water development, rodent control, and other provisions so often necessary to the success of cultural methods. Thus, while the cost figures in Table 2 provide useful references in general range of control costs by different methods in different range regions, they do not provide sufficiently precise information as to the cost elements included to serve as a basis for accurately judging the relative desirability of different control methods.

An additional variant not systematically reported in control projects, but having important bearing on cost comparisons, is the degree of control achieved by the method. Even where percentages of kill are reported along with control costs there is need for a common denominator to express the combined significance of the two measures. A convenient device for this purpose would be a cost per "control acre", that is, the theoretical cost of 100 percent control as derived from the actual cost of partial control.

To illustrate, assume two plant control projects, one of which achieves 95 percent control at a cost of $7.60 an acre, and the second of which costs $6.00 an acre to achieve 60 percent control. Ratios of cost to accomplishment then are:

1) $\$7.60 : 95\% = x : 100\%$

and

2) $\$6.00 : 60\% = x : 100\%$

Solving these equations for values of x, we have:

1) $95x = \$760$

$$x = \frac{760}{95} = \$8.00 \text{ per acre}$$

fully controlled (control acre)

2) $60x = \$600$

$$x = \frac{600}{60} = \$10.00 \text{ per acre}$$

fully controlled (control acre)

Most readers will recognize this method as identical with that commonly used for calculating the cost per pound of viable seed where various lots of seed having different percentages of viability and different selling prices are being compared. Such a measure admittedly is not the whole answer to comparing plant control costs. It does not cover such variables as probable speed of reinvasion, residual density which safely may be tolerated, supplemental treatments necessary to gain full benefit of the control, etc. For example, a treatment giving 50 percent kill of big sagebrush (*Artemisia tridentata*) at 25 percent of the cost of another method giving 98 percent kill, might actually be an almost total waste of money because of the high rate of reinvasion to be expected from the 50 percent residual sagebrush stand. On the other hand, if a spray treatment can reduce low larkspur to nondangerous density at a fraction of the cost of cultural treatments which reduce this plant much further, the cheaper treatment clearly has the advantage.

Notwithstanding such additional considerations as these, it is felt that the standardization of plant control costs to a uniform comparative basis as here suggested would greatly facilitate evaluation of the multitudinous control trials now being reported in range management literature.

ASRM Should Sponsor Improved Plant Control Data

Further collection and refinement of acreage and distribution data on *economic* occurrence of undesirable plants likewise could be of immense benefit in, first, gaining more reliable information on the over-all size of the plant control job and, second, directing research and action programs against those fronts most likely to yield economic gains. With these points in mind the author suggests that the American Society of Range Management take the lead in sponsoring action to bring into being an inter-regional body qualified to name and define major range regions for standard adoption in literature dealing with ranges of the United States and Canada, and possibly Mexico. The appropriate functioning of such a body is visualized along the following lines:

1. Agree on standard major range regions, and their names.
2. Define boundaries of each region in terms of state and county lines most nearly conforming to natural division lines, to facilitate acreage statistics. (In the United States, public land statistics embracing much of the total range land area are compiled by states and counties. Similar organization of information in Can- and Mexico is assumed).
3. Obtain county-by-county reports covering:
   a. Lists of undesirable plants considered important enough in that county to warrant control, if control may be had at costs commensurate with value of the range resource.
   b. Acreage estimates of occurrence, in economic quantity, in terms of acres requiring treatment in order to effect control. (Two or more counties could be combined where separate estimates are difficult, except where they lie in different regions).
4. Consolidate county statistics into state and regional summaries for distribution to State Departments of Agriculture, legislators, research and teaching agencies, extension agents, public land administrators, chemical and equipment manufacturers, and others instrumental in furthering

needed plant control work.

Once the first two steps are accomplished, or perhaps concurrently with them, steps 3 and 4 could be carried out by other persons working under a coordinated scheme laid down by the central body. Here the utilization of master's degree or possibly doctorate assignments in one or more higher educational institutions in each state or province suggests itself as a logical means for an orderly attack under competent direction. Needed coordination would be mostly in terms of format for compilation, and standards for segregation of cultivated pastures and other areas not properly classifiable as range lands.

The possible benefits to chemical and equipment companies of having reliable information upon which to plan and direct their sales campaigns would seem to recommend this field as one rewarding for the financing of scholarships. State and Provincial legislatures also might see here ultimate tax savings to be had from more effective weed control campaigns, as well as tax gains from increased range production. In the United States, planning and budgeting of Federal plant control programs would be greatly facilitated.

In conclusion the author wishes to state his own conviction that accurate statistics on occurrence of undesirable plants in economic quantity are urgently needed as basic information for future range management planning and action. The determination of what per acre control costs are recoverable on any given range should not be neglected in defining economic quantity of undesirables.