Foods Eaten by the Rocky Mountain Elk

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Highlight: *Forty-eight food habits studies were combined to determine what plants are normally eaten by Rocky Mountain elk (*Cervus canadensis nelsoni*), and the relative value of these plants from a manager's viewpoint based on the response elk have exhibited toward them. Plant species are classified as* highly valuable, valuable, *or* least valuable *on the basis of their contribution to the diet in food habits studies where they were recorded. A total of 159 forbs, 59 grasses, and 95 shrubs are listed as elk forage and categorized according to relative value.*

Knowledge of the relative forage value of plants eaten by elk is basic to elk range surveys, and to planning and evaluation of habitat improvement programs. Numerous elk food habits studies have been conducted; however, individual studies are limited to a specific area, and relatively few plant species are found in the diet compared to the number of plants eaten by elk throughout their range. The amount of a particular species consumed in one study may or may not be indicative of its true value as elk forage. The purpose of this inquiry is to combine all food habits work to determine which plants are eaten by elk, and their relative value as reflected by the degree to which they are normally sought.

Methods

With one exception only studies which pertain to food habits of the Rocky Mountain elk (*Cervus canadensis nelsoni*) in the western U. S. and Canada were included. The exception study involving C. *canadensis manitobensis* (Blood, 1966) was incorporated because of its quality and because the plants eaten closely paralleled those consumed on elk ranges in Montana and Idaho. Studies of Rocky Mountain elk transplanted to areas outside their normal range were excluded.

An extensive literature review was made to assemble references concerning elk food habits, and studies meeting the following criteria were incorporated: (1) Data must be original and derived from a specific effort to collect food habits information. References containing statements of what elk eat based on general knowledge, or those which summarized previous food habits studies were excluded. (2) Data must be listed by species eaten, and relative quantity consumed must be expressed in terms which would allow degree of use to be categorized. (3) Season of use must be shown. (4) Data must be listed separately for elk. Studies which referred to combined deer and elk use or "game use" were excluded. (5) Studies with a very limited sample (for example, only two or three stomachs) were excluded. (6) Elk must have had free choice of available forage. This excluded some pen feeding studies. (7) Study animals must not be starving. Forty-eight studies were incorporated in this summary.

Methods of data collection were assigned four categories: stomach analysis, feeding observations on wild animals, apparent use of plants, and pen feeding studies designed to determine preference.

Studies of food habits differ widely in method of data collection and presentation; in number, relative abundance, availability, and relative palatability of plant species encountered; and in number of animals using the study area. Thus, firm guidelines cannot be established for comparing relative forage preference among several food habits studies. In every study, however, some plants were consumed more extensively than others. The procedure used herein involved categorizing plants encountered in each study according to whether they were used (1) lightly (2) moderately or (3) heavily in relation to all species consumed in the particular reference. Plants which contributed less than 1% of the diet or which were reported as trace amounts were excluded. Factors such as relative plant abundance in relation to consumption were considered in assigning plants to use categories when such information was available. An average ranking for each species was then determined on the basis of all studies where it was found to contribute at least 1% of the diet.

The following terminology is used throughout this report. *Highly valuable plant*—One avidly sought by elk and which made up a major part of the diet in food habits studies where encountered, or which was consumed far in excess of its vegetative composition. These had an average ranking of 2.25 to 3.00. *Valuable plants*—One sought and readily eaten but to a lesser extent than highly valuable plants. Such plants made up a moderate part of the diet in food habits studies where encountered. Valuable plants had an average ranking of 1.50 to 2.24. *Least valuable plant*—One eaten by elk but which usually made up a minor part of the diet in studies where encountered, or which was consumed in a much smaller proportion than it occurred on the range. Least valuable plants had an average ranking of 1.00 to 1.49. These terms are used to reflect the relative value of a plant's presence on elk range from a manager's viewpoint because of the response elk have exhibited toward it. Value as used here does not consider nutrient quality or the importance of a species in maintaining a certain desired stage of ecological succession.

Data were separated by the following seasons of use: *Winter*—December, January, February; *Spring*—March, April, May; *Summer*—June, July, August; *Fall*—September, October, November.

Results

Seasonal Use of Major Forage Groups

Winter—Winter use is concentrated on either grasses or shrubs, depending on forage availability. The following authors reported winter grass consumption on Montana's predominately grass ranges as varying from 63 to 100%, and averaging 84%: Casagranda and Janson (1957); Constan (1967); Gordon (1968); Greer (1959); Greer et al. (1970); and Morris and Schwartz (1957). Winter shrub use averaged 9% and forb use 8% in these studies.

DeNio (1938) reported 65% winter use of grasses, 15% shrubs, 2% forbs, and 5% mosses and lichens in Montana, northern Idaho, and northeastern Washington. Winter grass consumption was as high as 97% in Jasper Park, Alta. (Cowan, 1947). Shrubs comprised 95% of the winter diet in New Mexico (Lang, 1958), 62% in Manitoba (Blood, 1966), and 82% in

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Idaho of which 22% were conifers (Trout and Leege, 1971). Boyd (1970) recorded 57% shrub use in Colorado from December through April. In these studies grass consumption averaged 22% and forbs were eaten in only two studies where maximum consumption was 10%.

Spring—Spring grass use on eight Montana studies remained high, averaging 87% (Eustace, 1967; Greer et al., 1970; Gordon, 1968; Kirsch, 1963; Mackie, 1970; Morris and Schwartz, 1957; Rouse, 1957; and Stevens, 1966). Little information outside Montana was available on spring use of major forage classes except for Manitoba, where use of grasses, shrubs, and forbs was 54, 37 and 9%, respectively.

Summer—Forbs became important forage during summer. The summer diet in Montana averaged 64% forbs, 30% grasses, and 6% shrubs (Eustace, 1967; Greer et al., 1970; Kirsch, 1963; Mackie, 1970; Morris and Schwartz, 1957; Rouse, 1958; Stevens, 1966). Rouse (1958) recorded 100% forbs in the summer diet. Summer forage consumption in Colorado, as reported by Nichols (1957), was 58% grasses, 41% forbs, and 1% shrubs. Boyd (1970), also in Colorado, recorded 78% summer use of grasses, 12% forbs, and 10% shrubs. Studies where high summer shrub use were recorded were made by Young and Robinette (1939) in Idaho, where use was 55% shrubs, 25% grasses, and 20% forbs; and by Blood (1966), in Manitoba, who noted 52% use of shrubs, 22% grasses, and 26% forbs.

Fall—Primary use reverts to grasses in the fall in Montana where grass use averaged 73% in nine studies (Greer, 1959; Greer, 1960; Greer et al., 1970; Kirsch, 1963; Mackie, 1970; Morris and Schwartz, 1957; Peek 1963; Rouse, 1957, Rush, 1932). High grass use in fall was also found in Colorado by Boyd (1970), who recorded 92% grass consumed. In New Mexico, Burt and Gates (1959) found that grass comprised 84% of the fall diet; however, Lang (1958), also in New Mexico, recorded 77% use of shrubs, 21% grasses, and 2% forbs. Shrub use was high in Manitoba and Idaho, where Blood (1955) and Young and Robinette (1939) found 55 and 40% use of shrubs, 37 and 40% use of grasses and 8 and 20% forb use, respectively.

Plant Species Value

Plant species eaten by elk and their relative value rankings for each season are listed by forbs in Table 1, grasses in Table 2, and shrubs in Table 3. Validity of these rankings increases with the number of references on which a ranking is based.

Table 1. Relative value of forb species eaten by Rocky Mountain elk.

Plant name	Forage value[1]				References[2]
	Winter	Spring	Summer	Fall	
Achillea				1.00 – 2	29, 36
Achillea millefolium	1.33 – 3		1.00 – 4	1.00 – 2	9, 14, 17, 18, 30, 31, 37, 44
Actaea spicata			1.00 – 1	2.00 + 1	48
Agastache urticifolia			1.50 + 2		37, 48
Agoseris glauca		1.50 + 4	2.33 * 6		7, 17, 29, 30, 39, 44
Alectoria fremontii	1.00 – 1				13
Allium textile		2.00 + 1			32
Angelica lyallii			1.00 – 1	1.00 – 1	48
Antennaria	1.00 – 3	1.00 – 2	1.00 – 1	1.00 – 2	18, 25, 36, 39
Antennaria parvifolia		1.00 – 1			44
Antennaria rosea	1.00 – 1				18
Aquilegia flavesens		1.00 – 1	1.00 – 1		7
Arenaria			1.00 – 1		10
Arnica		1.50 + 2	2.00 + 1	1.00 – 1	25, 30, 44
Arnica cordifolia			2.00 + 2		17, 29
Arnica latifolia			2.00 + 1	3.00 * 1	48
Arnica sororia		2.00 + 1			32
Artemisia dracunculus	2.00 + 1				42
Artemisia frigida	1.33 – 6	1.00 – 4			14, 20, 24, 25, 29, 30, 42, 44
Artemisia longifolia	1.00 – 1			1.00 – 1	32
Artemisia ludoviciana	1.00 – 1			2.00 + 1	30, 32
Asplenium felix-femina			3.00 * 1	2.00 + 1	48
Aster	2.00 + 2	2.00 + 2	1.75 + 4	1.50 + 8	18, 21, 23, 24, 25, 29, 30, 33, 36, 39, 42, 43
Aster canescens			2.00 + 1	3.00 * 1	48
Aster commutatus				2.00 + 1	32
Aster eatoni			2.00 + 1	3.00 * 1	48
Astragalus	1.50 + 2		3.00 * 1	2.00 + 1	30, 42, 48
Astragalus miser			1.00 – 1		30
Balsamorhiza saggittata	1.75 + 4	2.00 + 2	1.00 – 1		3, 7, 11, 18, 38, 42
Boykinia heucheriformis			3.00 * 1	2.00 + 1	48
Caltha leptosepala			2.50 * 2		6, 35
Castilleja			1.00 – 1		37
Castilleja miniata			1.00 – 1		48
Cerastium arvense		1.00 – 1			44
Chalachortus elegans			1.00 – 1		48
Chamaenerion angustifolium	3.00 * 1		3.00 * 1	2.00 + 1	18, 48
Cirsium	1.00 – 1	1.00 – 2		2.00 + 3	20, 21, 25, 36, 42
Cirsium foliosum		1.00 – 1	1.00 – 1	3.00 * 1	30
Claytonia asarifolia			3.00 * 1	3.00 * 1	48
Claytonia sibirica			3.00 * 1	3.00 * 1	48
Clintonia uniflora			1.00 – 1	1.00 – 1	48
Commandra sp				1.00 – 1	25
Commandra pallida			2.00 + 1		33

Coptis occidentalis			1.00 – 1	2.00 + 1	48
Corydalis scouleri			2.00 + 1		48
Delphinium sp			2.00 + 1		3
Delphinium bicolor		1.00 – 1	2.00 + 1		17, 20
Delphinium scopulorum		2.00 + 1	2.00 + 2		7, 48
Dodecatheon conjugens			3.00 * 1	3.00 * 1	48
Dodechatheon pauciflorum		1.00 – 1			20
Dodocathelon conjugens			3.00 * 1	3.00 * 1	48
Epilobium angustifolium			2.00 + 2		4, 29
Equisetum	1.00 – 1		1.00 – 1	1.00 – 1	23, 25
Erigeron		2.00 + 1	1.50 + 2	2.00 + 1	17, 30
Eriogonum	2.00 + 1			1.50 + 2	18, 24, 25
Eriogonum heracleoides				1.00 – 1	37
Eriogonum umbellatum				1.00 – 1	44
Fragaria	1.50 + 2	2.00 + 1	1.00 – 3	1.00 – 2	18, 25, 30, 48
Fragaria virginiana			1.00 – 1		44
Fraseria sp.			2.00 + 1		3
Gaillardia sp.			1.00 – 1		48
Galium boreale	1.00 – 1				42
Geranium		2.00 + 1	1.50 + 2	1.00 – 1	3, 25, 29, 30
Geranium richardsonii		3.00 * 1			30
Geranium viscossissimum		2.00 + 2	2.43 * 7	2.00 + 2	17, 29, 30, 39, 40, 44, 48
Geum			2.00 + 1		6
Geum triflorum		1.00 – 1	2.00 + 1		17, 20
Geum turbinatum		1.00 – 1			10
Glycyrrhiza lepidota			3.00 * 1	3.00 * 1	32
Hedysarum sulphurescens			2.00 * 1		29
Helianthus maximilliana				2.00 + 1	32
Heracleum lanatum		1.00 – 1	1.00 – 2		7, 48
Hieracium sp.			2.00 + 1		3
Hieracium albiflorum			2.00 + 1	1.00 – 1	48
Hieracium chapacanum			2.00 + 1		37
Hieracium cynoglossoides		1.00 – 1	1.00 – 1		44
Hieracium scouleri			1.00 – 1		48
Heuchera glabella			2.00 + 1	2.00 + 1	48
Hydrophyllum capitatum			3.00 * 1		48
Iris missouriensis				1.00 – 1	9
Lactuca pulchella		2.00 + 1			32
Lactuca serriola			2.00 + 1		32
Lathyrus	1.00 – 1	2.00 + 2	2.00 + 1		4, 6
Lathyrus laetivirens			2.00 + 1		5
Ledum groenlandicum	2.00 + 1				4
Liatris punctata	1.00 – 1			3.00 * 1	30, 42
Ligusticum grayi			1.00 – 1		37
Ligusticum scopulorum			2.00 + 1	1.00 – 1	48
Ligisticum tenufolium			2.00 + 1	1.00 – 1	48
Lithospermum ruderale	1.00 – 2				18, 42
Lupinus	1.50 + 2	2.00 + 1	1.00 – 7	2.40 * 5	14, 17, 23, 24, 25, 29, 36, 37, 39, 42, 44, 48
Lupinus leucophyllus			3.00 * 1		33
Lupinus ornatus	2.00 + 1				18
Lupinus sericeus	2.67 * 3	2.00 * 2	2.00 + 1		7, 20, 30, 42
Medicago sativa			3.00 * 1	3.00 * 1	2, 33
Melilotus officinalis	1.00 – 1	1.00 – 1	2.50 * 2	3.00 * 1	32, 33
Mertensia ciliata			3.00 * 1	3.00 * 1	48
Microseris		1.00 – 1	1.00 – 2		30, 44
Mitella stauropetala			1.00 – 1	2.00 + 1	48
Myosotis alpestris			3.00 * 1	3.00 * 1	39
Oenothera flava				2.00 + 1	39
Opuntia sp.		3.00 * 1			46
Oreoxis alpina			3.00 * 1		10
Osmorhiza occidentalis			3.00 * 2		37, 48
Oxytropis			1.00 – 1		25
Oxytropis splendens		1.00 – 1			29
Oxytropis viscida		3.00 * 1			30
Pedicularis cystopteridifolia			2.00 + 1		17
Pedicularis groenlandica			2.00 + 1		48
Pedicularis racemosa			2.00 + 1	1.00 – 1	48
Penstemon	1.00 – 1				18
Penstemon confertus				1.00 – 1	48
Penstemon pinetorum			3.00 * 1	3.00 * 1	48
Penstemon procerus			1.00 – 1		37
Petasites saggittatus		2.00 + 1			4
Phacelia heterophylla			1.00 – 1	2.00 + 1	48
Phlox	1.00 – 1			1.00 – 1	25, 36
Phlox hoodii	1.00 – 1				39
Polemonium delicatum			2.00 + 1	1.00 – 1	48
Polygonum phytolaccaefolium			2.50 * 2		37, 48

Potentilla		1.00 – 2	1.29 – 7	1.50 + 2	10, 17, 25, 29, 30, 39, 44
Potentilla glandulosa			1.50 + 2	2.00 + 1	37, 48
Potentilla gracilis			1.00 – 1		29
Pteris aquilina			1.00 – 1		48
Ranunculus			2.00 + 1		30
Ranunculus glaberrimus		1.00 – 1	1.00 – 1		7
Rumex paucifolius		2.00 + 1	2.00 + 1		7
Sanguisorba sitchensis			2.00 + 1		37
Selaginella densa		1.00 – 1			44
Senecio	1.50 + 2		1.00 – 2		4, 18, 35, 39
Senecio columbianum			3.00 * 1		48
Senecio triangularis			2.50 * 2	3.00 * 1	37, 48
Smilacina racemosa				2.00 + 1	48
Smilacina stellata				2.00 + 1	48
Solidago	1.00 – 1				18
Sonchus arvensis			2.00 + 1		4
Sphaeralcea rivularis			3.00 * 1	3.00 * 1	48
Stellaria	1.00 – 1				30
Taraxacum		1.00 – 2	3.00 * 3		17, 29, 44
Taraxacum officinale		1.00 – 2	2.00 + 3	3.00 * 1	4, 7, 30
Thermopsis montana			1.00 – 1		39
Thermopsis pinetorum				1.00 – 1	9
Tragopogon				1.00 – 1	21
Tragopogon dubius	2.00 + 1	2.00 + 1	2.00 + 1		20, 32, 42
Trifolium		1.00 – 1	2.00 + 3		17, 30, 40
Trifolium dasyphyllum			3.00 * 1		10
Trifolium haydeni		2.00 + 1	2.00 + 1		7
Trifolium repens			3.00 * 1		44
Trifolium rydbergi		2.00 + 1	2.00 + 1		7
Typha				1.00 – 1	25
Valeriana sitchensis			3.00 * 1	3.00 * 1	48
Veratrum eschscholtzii			1.00 – 1		48
Vicia americana		2.00 + 1	2.00 + 1		4, 32
Viola nuttallii		1.00 – 1	1.00 – 1		7
Wyethia			2.50 * 2	2.50 * 2	36, 39, 40
Xanthium strumarium	3.00 * 1				32
Xerophyllum tenax	1.00 – 1		2.00 + 1		18, 48
Zizia aptera		3.00 * 1	3.00 * 1		30

[1]Each entry consists of 3 parts. The first number is the computed value ranking. The second part is the value ranking symbol: – = least valuable; + = valuable; * = highly valuable. The third part is the number of references upon which the ranking is based.
[2]Numbers indicate references in literature cited section on which value rankings were based.

Table 2. Relative value of grass species eaten by Rocky Mountain elk.

Plant name	Forage value[1]				References[2]
	Winter	Spring	Summer	Fall	
Agropyron cristatum		2.00 + 1			29
Agropyron dasystachyum		1.00 – 1			29
Agropyron pauciflorum	3.00 * 1				18
Agropyron scribneri			2.00 + 1		10
Agropyron smithii	3.00 * 1	3.00 * 1	2.00 + 1	3.00 * 1	32
Agropyron spicatum	3.00 * 8	2.00 + 8	1.50 + 2	2.00 + 1	8, 11, 14, 17, 18, 20, 29, 30, 33, 38, 42, 43, 44
Agropyron subsecundum			1.00 – 1	3.00 * 1	17, 39
Agropyron trachycaulum			1.00 – 1	2.00 + 1	39
Agrostis exarata			3.00 * 1	2.00 + 1	48
Agrostis idahoensis			1.00 – 1		35
Bromus	1.00 – 1		1.67 + 3		17, 30, 44
Bromus carinatus			3.00 * 1	3.00 1	48
Bromus inermis			2.00 + 2	2.00 + 1	29, 33
Bromus marginatus	3.00 * 1				18
Bromus tectorum	2.00 + 2				8, 13
Calamagrostis canadensis	2.50 * 2				18, 30
Calamagrostis rubescens	2.00 + 2	3.00 * 1	3.00 * 1	1.50 + 2	18, 30, 48
Camassia quamash		2.00 + 1	1.00 – 1		30
Carex	2.00 + 3	1.00 – 1	1.67 + 6	2.33 * 3	2, 17, 18, 25, 30, 35, 37, 38, 39, 44
Carex filifolia	3.00 * 1				18
Carex geyeri	2.33 * 3	3.00 * 1	2.33 * 3	2.50 * 2	13, 18, 29, 30, 37, 48
Carex nubicola		2.00 + 1	2.00 + 1		7
Carex raynoldsii		2.00 + 1	2.00 + 1		7
Danthonia	2.00 + 1	1.00 – 1	2.00 + 1		30
Danthonia intermedia	3.00 * 1				18
Danthonia parryi	2.00 + 1				30
Danthonia unispicata	2.00 + 1				11
Deschampsia caespitosa			3.00 * 1		35
Distichlis stricta	2.00 + 1				32

Elymus flavescens	3.00 * 1	3.00 * 1			46
Elymus glaucus	2.00 + 1	2.00 + 1	3.00 * 1	3.00 * 1	39, 48
Elymus innovatus				1.00 – 1	39
Festuca idahoensis	2.56 * 9	2.83 * 6	1.50 + 2	3.00 * 2	7, 8, 11, 14, 17, 18, 20, 29, 30, 38, 39, 42, 43,44
Festuca ovina		2.00 + 1	2.00 + 1		7
Festuca scabrella	2.40 * 5	2.75 * 4	1.00 – 2	2.00 + 1	11, 17, 18, 20, 29, 30, 42, 44
Juncoides parviflorum			3.00 * 1	3.00 * 1	48
Juncus balticus			3.00 * 1		35
Juncus parryi			3.00 * 1		37
Koeleria cristata	1.60 + 5	1.50 + 4	2.00 + 1	2.00 + 2	11, 17, 18, 20, 32, 38, 44
Melica spectabilis			1.00 – 1		39
Muhlenbergia	1.50 + 2				11, 38
Muhlenbergia cuspidata	1.00 – 1			2.00 + 1	32
Orzyopsis hymenoides				3.00 * 1	46
Phleum		2.00 + 1	1.50 + 2		7, 44
Phleum alpinum		2.00 + 1	2.00 + 2		7, 35
Phleum pratense	2.50 * 2	2.00 + 1	1.00 – 1	3.00 * 1	18, 30
Poa	2.00 + 5	2.67 * 6	2.00 + 5	2.50 * 2	13, 14, 17, 20, 29, 30, 33, 42, 44
Poa alpina			2.00 + 1		30
Poa canadensis	3.00 * 1				18
Poa compressa	3.00 * 1	2.00 + 1		2.00 + 1	18, 32
Poa epilis		2.00 + 1	2.00 + 2		7, 35
Poa secunda	2.00 + 1	2.50 * 2	1.50 + 2	3.00 * 1	7, 32
Sitanion hystrix			1.00 – 1		37
Stipa	2.33 * 3	2.00 + 1	2.00 + 1	3.00 * 1	11, 30 38
Stipa columbiana	3.00 * 1		1.00 – 1		18, 37
Stipa comata				3.00 * 1	46
Stipa viridula	1.00 – 1	2.00 + 1			32
Trisetum spicatum			2.00 + 1	2.00 + 1	17, 29
Trisetum wolfii			2.00 + 1		35

[1]Each entry consists of 3 parts. The first number is the computed value ranking. The second part is the value ranking symbol: – = least valuable; + = valuable; * = highly valuable. The third part is the number of references upon which the ranking is based.
[2]Numbers indicate references in literature cited section on which value rankings were based.

Table 3. Relative value of shrub species eaten by Rocky Mountain elk.

Plant name	Forage value[1]				References[2]
	Winter	Spring	Summer	Fall	
Abies grandis	1.00 – 2				18, 45
Acer glabrum	2.25 * 4	1.00 – 1	3.00 * 1	3.00 * 1	18, 19, 27, 30, 48
Acer spicatum			2.00 + 1		4
Alnus tenuifolia	1.00 – 1		1.50 + 2	2.00 + 1	5, 18, 48
Amelanchier alnifolia	2.50 * 6	2.00 + 2	2.50 * 2	2.33 * 3	1, 4, 5, 18, 19, 26, 27, 30, 42, 48
Arctostaphylos uva-ursi	1.00 – 2	1.00 – 1		1.50 + 2	4, 29, 42
Artemisia cana	2.00 + 1				32
Artemisia tridentata	1.50 + 8	1.25 – 4	1.00 – 2	1.67 + 3	5, 6, 13, 19, 21, 22, 25, 27, 32, 37, 39, 43, 46
Artemisia tripartita	3.00 * 1	2.00 + 1			39
Berberis repens	2.00 + 2	1.25 – 4	1.00 – 1	1.80 + 10	1, 2, 6, 21, 23, 24, 25, 28, 29, 30, 36, 39, 45
Betula glandulosa	2.00 + 2		3.00 * 1		18, 30
Betula fontinalis	1.00 – 1				18
Ceanothus velutinus	2.40 * 5		3.00 * 1	2.00 + 2	13, 18, 19, 30, 33, 47, 48
Ceanothus sanguineus	3.00 * 3		3.00 * 1	3.00 * 1	18, 45, 47, 48
Cercocarpusmontanus	3.00 * 2				27, 31
Cercocarpus ledifolius	2.00 + 1			3.00 * 1	1, 13
Chrysothamus nauseosus	2.00 + 3	1.00 – 1			12, 13, 43, 46
Chrysothamus viscidiflorus	1.25 – 4	3.00 * 1		2.00 + 2	12, 20, 32, 43, 46
Cornus stolonifera	2.20 + 5		3.00 * 1	2.00 + 1	4, 18, 19, 27, 45, 48
Dasiphora fruticosa	1.00 – 1				18
Elaeagnus commutata	2.50 * 2				18, 30
Fraxinus	2.00 + 1				26
Garrya wrightii	3.00 * 1				31
Juniperus	1.50 + 2			1.00 – 1	24, 31
Juniperus communis	1.00 – 3			1.00 – 1	18, 29, 42
Juniperus horizontalis	1.00 – 3				11, 30, 42
Juniperus occidentalis	2.00 + 1				13
Juniperus scopulorum	1.50 + 2	1.00 – 1		1.00 – 1	18, 32
Ledum groenlandicum	2.00 + 1				4
Linnaea		1.00 1		1.00 1	29
Linnaea borealis	1.00 – 1				18
Lonicera involucrata	2.00 + 1		2.00 + 1		18, 48
Lonicera utahensis			3.00 * 1	1.00 – 1	48
Menziesia ferruginea			3.00 * 1		48
Odostemon sp.	1.00 – 1				13
Odostemon aquifolium	1.00 – 1				18

Opulaster malvaceus	1.00 – 1		2.00 + 1	1.00 – 1	48
Pachistima myrsinites	1.50 + 2			2.33 * 3	2, 13, 18, 28, 31
Philadelphus lewisii	3.00 * 1				18
Pinus	1.00 – 3			1.00 – 1	6, 24, 39, 45
Pinus conterta	1.33 – 3			1.50 + 2	18, 21, 25, 30, 42
Pinus flexis				1.00 – 1	36
Pinus ponderosa	1.00 2				13, 18
Populus balsamifera	2.00 + 1				4
Populus tremuloides	2.50 * 8	2.25 * 4	1.74 + 4	2.50 * 8	2, 4, 5, 6, 9, 18, 25, 27, 30, 31, 36, 42, 48
Populus trichocarpa	3.00 * 1				18
Potentilla sp.				1.00 – 1	9
Potentilla fruticosa	1.00 – 1				30
Prunus virginiana	2.38 * 8	2.00 + 3	2.00 + 2	1.50 + 2	4, 12, 18, 21, 26, 27, 30, 32, 39, 42, 46, 48
Prunus emarginata			3.00 * 1	3.00 * 1	48
Prunus pensylvanica	2.00 + 1				4
Pseudotsuga menziesii var.*glauca*	1.27 – 11	1.00 – 3		2.00 + 1	5, 6, 13, 15, 18, 21, 24, 25, 29, 32, 42, 45
Purshia tridentata	3.00 * 4			3.00 * 1	2, 12, 13, 27, 46
Quercus gambellii	3.00 * 3	2.00 + 1			5, 26, 27
Rhamnus purshiana			1.00 – 1		48
Ribes	1.00 – 1				18
Ribes cereum			1.00 – 1		5
Ribes cognatum			3.00 * 1	2.00 + 1	48
Ribes montigenum			3.00 * 1		37
Ribes petiolare			1.00 – 1	1.00 – 1	48
Ribes viscosissimum			3.00 * 1	2.00 + 1	48
Rosa	1.50 + 2		3.00 * 1	2.00 * 1	18, 42, 48
Rosa acicularis	1.00 – 2		3.00 * 1	3.00 * 1	4, 38
Rubus				1.00 – 1	25
Rubus idaeus			2.00 + 1		4
Rubus parviflorus			3.00 * 1	2.00 + 1	48
Salix	2.11 + 9	2.00 + 1	1.71 + 7	2.29 * 7	4,6,13,19,21,22,25,29,30,33,36 39,42,44,47,48
Salix bebbiana	3.00 * 1				18
Salix exigua	2.00 + 1				18
Salix geyeriana	2.00 + 1				18
Salix lutea	3.00 * 1				18
Salix melanopsis	2.00 + 1				18
Salix scouleriana	1.50 + 2				18, 45
Salix subcoerulea	3.00 * 1				18
Sambucus sp.			3.00 * 1		3
Sambucus caerulea			3.00 * 1	3.00 * 1	48
Sambucus melanocarpa	3.00 * 1		3.00 * 1	3.00 * 1	18, 48
Sericotheca discolor	1.00 – 1		2.00 + 1	1.00 – 1	47, 48
Shepherdia canadensis	2.00 + 1		1.00 – 1	2.00 + 1	25, 33, 42
Sorbus americana			3.00 * 1	3.00 * 1	48
Sorbus occidentalis	2.00 + 1				18
Spirea	1.00 – 1		1.00 – 1	1.00 – 1	18, 29
Spirea betulifolia	2.00 + 1				42
Spirea lucida			2.00 + 1	2.00 + 1	48
Spirea menziesii			2.00 + 1	2.00 + 1	48
Symphoricarpos	1.40 – 5		1.50 + 2	1.83 + 6	13, 23, 25, 27, 29, 32, 33, 36, 42, 47
Symphoricarpos albus	3.00 * 1		3.00 * 1	2.00 + 2	4, 18, 48
Symphoricarpos occidentalis	1.00 – 1				39
Symphoricarpos utahensis		1.00 – 1	1.00 – 1		5
Tetradymia canescens	1.50 + 2			1.50 + 2	46, 39
Thuja plicata	2.00 + 1				45
Vaccinium	2.00 + 2		1.00 – 3	1.00 – 2	6, 13, 25, 30, 36, 44
Vaccinium membranaceum	1.00 – 1		3.00 * 1	1.33 – 3	18, 29, 33, 48
Vaccinium scoparium	1.00 – 1		1.00 – 1	1.00 – 3	9, 18, 29, 31, 48

[1]Each entry consists of 3 parts. The first number is the computed value ranking. The second part is the value ranking symbol: – = least valuable; + = valuable; * = highly valuable. The third part is the number of references upon which the ranking is based.
[2]Numbers indicate references in literature cited section on which value rankings were based.

Forbs having the best documented highly valuable rankings as summer forage were *Agoseris glauca* and *Geranium viscossimum. Lupinus* spp. was rated as highly valuable fall forage on the basis of five studies. *Aster* spp. was frequently mentioned and was considered a valuable plant throughout the year.

Highly valuable grasses or grasslikes having the best documented rankings were *Agropyron spicatum, Carex* sp., *Carex geyeri, Festuca idahoensis, Festuca scabrella,* and *Poa* sp. Highly valuable ratings were seasonal for most of these species. Only *Carex geyeri* was rated highly valuable throughout the year. *Koeleria cristata* was well documented as a valuable species on an annual basis.

Among shrubs, the highly valuable species with rankings based on a relatively large number of references were *Amelanchier alnifolia, Ceanothus sanguineus, Ceanothus velutinus, Populus tremuloides, Prunus virginiana, Purshia tridentata, Quercus gambellii* and *Salix* spp. Like forbs and grasses, these shrubs were highly valuable during only certain portions of the year. Most were highly valuable during the fall or winter.

Discussion

The validity of some value rankings could be influenced by the fact that

various strains of the same species can differ in palatability. Palatability may also vary with differences in climate, soil conditions, and topography. However, the impact of these factors on rankings cannot be assessed until their effects on palatability of all elk forage species have been researched extensively.

Relative abundance and availability are two other factors which may have influenced value rankings. Some species may have received least valuable rankings because they were not abundant or because they were relatively unavailable due to some factor such as snow cover. Thus, they were only minor contributors to the diet. They may be highly valuable when they are more abundant or available. However, unless the normal abundance or availability of such species can be increased through management, their assigned rankings must stand as indications of their value as elk forage under natural conditions.

It must be remembered that rankings contained herein are averages for all studies where the species were eaten. Thus, some elk managers working where food habits have been studied extensively may feel that certain ratings are too high or low for their particular area. In such instances, questionable rankings may be adjusted up or down to fit the circumstances. However, the real benefits from these rankings should be realized by managers who lack sufficient data to determine the relative forage value of plants in their area and by managers who want to revegetate their ranges with plant species known to be good elk forage.

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