TOPIC 3. HABITAT MANAGEMENT PRACTICES

Habitat management practices have been developed and tested over the years to the point where the technological capabilities for manipulating habitat exceeds our understanding of the long range effects of these manipulations. Machines are available for moving earth, changing watercourses, and cutting and handling trees. Fire was used as a management practice by native Americans, and is now staging a comeback as a management practice. Chemicals have been developed which, under certain conditions, can affect large areas of land in very specific ways. Our lack of understanding of long-range effects on habitat is particularly critical with reference to the use of chemicals. These practices are discussed in UNITS 3.1, 3.2, and 3.3.

Good husbandry is good management. Limitations on grazing and browsing is good management. Limitations on grazing and browsing, by controlling animal numbers, and the designation of food production areas are husbandry-type practices discussed in UNITS 3.4 and 3.5.

UNIT 3.1: MECHANICAL

Mechanical practices used in habitat management have changed greatly as a result of technology. The use of manpower and animal power in the early days of logging seems very inefficient to us who are accustomed to powerful tractors and heavy equipment. It is interesting to note that the apparent inefficiency and apparently endless forests resulted in an early but short-lived belief that there was an almost infinite supply of timber available in North America. The effects of settlement and a shift from a hunting society to an agricultural one resulted in much more rapid changes in the habitat than thought to be possible when that shift first began.

Mechanical practices of habitat manipulation have been used for many years. Axes, saws, bulldozers, drag chains . . . all have been used to mechanically alter the habitat. Habitat management practiced now is almost always designed to stimulate regeneration of plants to provide more forage. Cutting practices have been used in Wisconsin to open up the forest, creating openings that provide more summer forage than is found under closed forest canopies (McCaffery and Creed 1969).

Reports of responses of plants to cutting appeared in the Journal of Wildlife Management shortly after its inception in 1937. Cutting is still an effective management practice. Small scale cuttings may be made specifcally for increased browse production. These are often done by volunteer groups, such as hunting clubs, sportsmens groups, boy scouts, etc.

It is more feasible to integrate cutting for browse production with private and commercial timber harvesting. Fuelwood cutting has increased rapidly in the last few years, with openings created in the canopy by the removal of individual trees and openings in the forest by clear-cutting small areas. The extent, distribution, and size of these openings affects their use by deer. McCaffery and Creed (1969) recommend that 3 to 5% of commercial forest land be maintained in openings of about 5 acres, with their locations selected ecologically rather than mechanically.

Large scale commercial forestry cuttings may be designed with wildlife needs in mind. Cutting of larger numbers of smaller but more scattered blocks results in longer perimeters, and that is usually beneficial to wildlife. This may be beneficial to deer, for example, because the habitat offers more variety and choice within smaller areas.

Leopold (1933) formulated the "Law of Interspersion" which emphasized the importance of edges, or borders of different cover types, to game species. Borders, by definition, contain at least two types of habitat, and the more the interspersion of habitat types, the more wildlife expected. Leopold did point out, however, that the benefits of more edges, or more interspersed habitats are most important to game species with low mobility and high type requirements. He specifically cites the buffalo [bison] and antelope [pronghorn] as mobile, one-type game that do not benefit from interspersion.

It is important to realize that the increases in primary production alone may not be beneficial to wild ruminants. The species which invade or increase as a result of mechanical practices are of particular interest, since wild ruminants generally exhibit preferences. Ideally, the most preferred foods should be increased the most, followed by staple foods, with emergency foods and stuffing increased the least (underlined words are terms of Leopold 1933). Such responses by preference category are hard to oc casion; practices should, at least, not result in increased production of the least-preferred foods.

Forage production responses to cutting are described in the serial references listed in this UNIT. A WORKSHEET provides an opportunity to evaluate the increase in perimeter as the number of blocks cut increases and the size of the blocks cut decreases. What is the minimum size of a block cutting in relation to timber-harvesting economics? Another WORKSHEET provides an opportunity to tabulate results and determine costs of mechanical habitat management.

LITERATURE CITED

Leopold, A. 1933. Game Management. Charles Scribner's Sons, N. Y. 481 p. (1961 reprint).

McCaffery, K. R. and W. A. Creed. 1969. Significance of forest openings to deer in northern Wisconsin. Tech. Bull. Number 44, Wisc. Dept. Nat. Res., Madison. 104 p.

REFERENCES, UNIT 3.1

MECHANICAL

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	47--2	125	144	od--	manip chamise,range improv	biswell,hh	1961
CAFGA	49--2	95	118	od--	brush manip, wint de range	gibbens,rp; schul	1963
JWMAA	24--4	401	405	od--	forage incr, thinning pine	blair,rm	1960
JWMAA	36--2	595	605	od--	for manip, habitat, sequoi	lawrence,g; biswe	1972
NAWTA	29---	432	438	odvi	chnges, habitat, brush con	box,tw	1964
WSCBA	20--2	18	22	od--	aspen mgt, solut od problm	harrison,rp	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	68--8	24	26	odvi	dinnerbell for the whiteta	hurd,es	1962
JFUSA	59--8	589	591	odvi	prod white-ced brws, loggi	verme,lj	1961
JFUSA	60--1	40	42	odvi	silvic tech, imprv od habi	krefting,lw	1962
JFUSA	68-11	701	704	odvi	improv hab, cut conif swmp	krefting,lw; phil	1970
JWMAA	2---4	206	214	odvi	cuttng imprv wldl env, for	morton,jn; sedam,	1938
JWMAA	3---3	201	202	odvi	thinning for browse	cook,db	1939
JWMAA	5---1	90	94	odvi	mgt sugges, nor wh-ced typ	aldous,se	1941
JWMAA	5---1	95	102	odvi	meth, incr od browse, minn	krefting,lw	1941
JWMAA	20--4	434	441	odvi	mt maple, herbi, cut, fire	krefting,lw; han/	1956
JWMAA	40--4	639	644	odvi	habitat respns, irrigation	dressler,rl; wood	1976
QBMAA	43--4	722	731	odvi	bulldozing, produce browse	gysel,lw	1961
WCDBA	44---	1	104	odvi	signif, forest openi, wisc	mccaffery,kr; cre	1969
WSCBA	17--3	3	11	odvi	feed 'em - with an axe	deboer,sg	1952
XANEA	33---	1	37	odvi	browsing hrdwds, northeast	shafer,el,jr	1965
XFWLA	320--	1	9	odvi	exper plntg food, covr, od	aldous,se	1949

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	30--4	839	841	odhe	topping stim bttrbrsh twig	ferguson,rb; bas	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JRMGA	28--2	120	125	ceel	odhe, graz,improv qual for	anderson,ew; sche	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				alal			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				rata			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				anam			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				bibi			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	22--1	1	9	ovca	water development, desert	halloran,af; demi	1958

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				ovda			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				obmo			

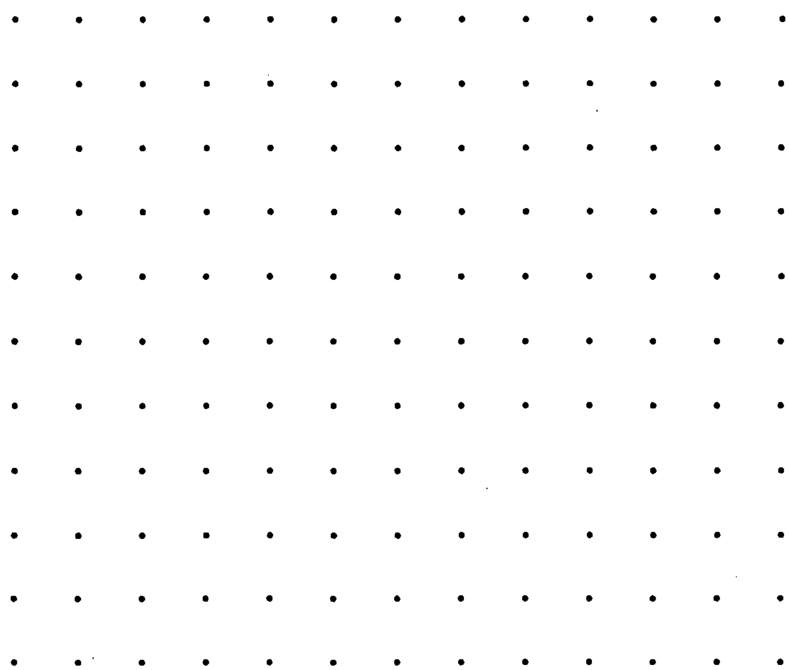
CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				oram			

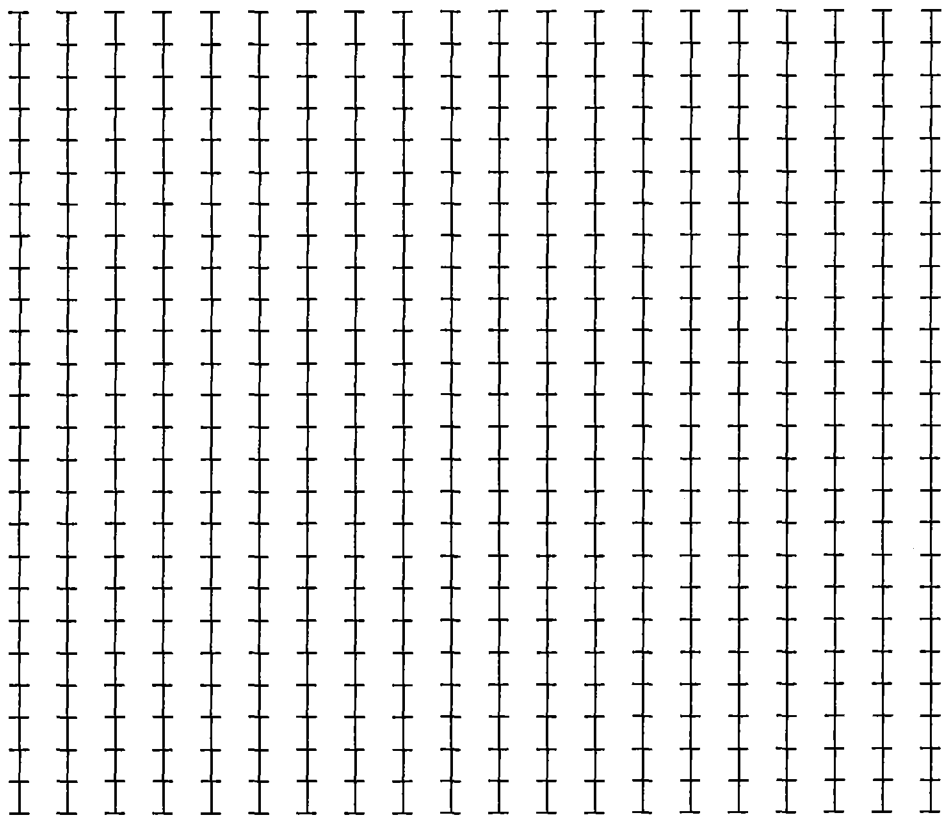
CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ECOLA	44--2	331	343	----	ecol,water-lev manip, mar	harris,sw; marsha	1963
JWMAA	43--3	807	811	----	disking, herb plnts, seeds	buckner,jl; lande	1979

CHAPTER 21, Worksheet 3.1a

Differences in perimeters due to block size

The dot grid below contains 120 units. Remove 10% of the area by cutting (draw lines between dots and x out the block to indicate cuts), using 1 cut of 12 units, 2 cuts of 5 units each, 3 cuts of 4 units each, 4 cuts of 3 units each, 6 cuts of 2 units each, and 1 cut of 12 units each. Determine the sum of the perimeters for each cutting scheme and plot the results in the grid on the next page.





CHAPTER 21, WORKSHEET 3.1b

Estimating production increases and costs per unit increase,
mechanical practices

This WORKSHEET provides a place to tabulate the time spent using mechanical practices to increase forage production, and determine the cost per unit of increase. The questions below are quite general because they apply to a wide range of possible situations described in the literture. Answer them as specifically as possible, and complete the calculations of cost. Note that expected cost rates apply; a projected cost-analysis should include expected costs at the time the work is to be done.

Reference:

Size of area managed?

Forage production prior to managed?

Methods used?

Man-hours required?

Expected rates of pay?

Cost for man-hours?

Machine-hours required?

Expected cost for machine-hours?

Expected total cost?

Forage production after manipulation:

First year?

Second year?

Third year?

Cost per unit weight of forage increase?

Current cost of equivalent amount of cattle feed?

Subjective evaluation of relative cost of wild:domestic ruminant feeding?

(Write a summary on the next page)

UNIT 3.2: FIRE

Fire is a very effective way to manipulate habitat. It has a rapid and drastic effect on the appearance of a plant community, converting it from a living entity to charred ashes, devoid of life, and having the appearance of "ruin." The regularity of wild fires when steam locomotives spewed large volumes of ashes from their mobile smokestacks, along with many other causes of fires, caused considerable concern, resulting in the mobilization of fire prevention forces that have been very effective. One of the greatest impacts such campaigns have had is the psychological impact on people concerning how "bad" fire is.

A plant community that has been burned may look like ruins, but the long-term effect is very different. The burn results in a rapid release of minerals that have been locked up in plant tissue. The canopy opens up, resulting in new quantities of light reaching the soil and becoming available to new growth. The soil is more exposed, with a higher potential for erosion than when the soil was covered with litter and protected by the plant canopy.

Increases in forage production can be dramatic. Diels (1970) reports more than a five-fold increase in the production of green browse per acre two years after a prescribed burning in a mixed pine-hardwood forest in Tennessee, and notes increases in additional studies in Alaska, Minnesota, Virginia, and Isle Royale. The prescribed burns were not intense enough to reduce the ability of the remaining plants to sprout. This is an important characteristic of prescribed burns; they are not enough to damage the plant tissue needed for regeneration.

If undesirable species are to be controlled, then the timing and intensity of the burn is very important. Spring is a good time for burns designed to reduce the vigor of perennial shrubs, after new growth has occurred but before plant reserves have been built up.

Prescribed burns often but not always result in significant increases in forage quality. Protein content of several species were significantly higher after burns at the Patuxent Research Refuge, Maryland (DeWitt and Derby 1955). Other nutrients and chemical constants of the forages were not affected by the controlled fires. The effects now seem to be subject to many variables, and predictions of increases are not always warranted.

Prescribed burns are relatively inexpensive compared to mechanical or chemical methods of reducing above-ground vegetation. The costs are in preparation of fire lanes and fire protection rather than in the technique itself. A WORKSHEET is included for evaluation of the costs of prescribed burning, and the estimates should be compared to those of mechanical practices in WORKSHEET 3.1b.

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DeWitt, J. B. and J. V. Derby, Jr. 1955. Changes in nutritive value of browse plants following forest fires. J. Wildl. Manage. 19(1):65-70.

Dills, G. G. 1970. Effects of prescribed burning on deer browse. J. Wildl. Manage. 34(3):540-545.

REFERENCES, UNIT 3.2

FIRE

BOOKS

TYPE	PUBL	CITY	PGES	ANIM	KEY WORDS------------------	AUTHORS/EDITORS--	YEAR
aubo	mhbc	nyny	584	----	forest fire: control & use	davis,kp	1959
edbo	pnfr	poor	275	----	fire in northern env; symp	slaughter,cw,ed;/	1971

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
CAFGA	47--2	125	144	od--	manip chamise, range impro	biswell,hh	1961
CAFGA	47--4	357	389	od--	brush man,fire,winter rang	biswell,hh; gilma	1961
CAFGA	49--2	95	118	od--	brush manip on winter rang	gibbens,rp; schul	1963
JWMAA	36--2	595	605	od--	for manip, habitat, sequio	lawrence,g; biswe	1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
ECOLA	41--3	431	445	odvi	effct fire,growth,repr veg	ahlgren,ce	1960
JFUSA	54--9	582	584	odvi	eff pres burn,for prod,pin	lay,dw	1956
JWMAA	5---1	95	102	odvi	meth, increas browse, minn	krefting,lw	1941
JWMAA	19--1	65	70	odvi	chan,nutr value,brows,fire	dewitt,jb; derby,	1955
JWMAA	20--4	435	441	odvi	mt maple, herbi, cut, fire	krefting,lw; han/	1956
JWMMA	34--3	540	545	odvi	effec prescr burn, de brws	dills,gg	1970
WLSBA	4---2	69	73	odvi	odhe, prescrib burn,s dako	lovaas,al	1976
XANEA	33---	1	37	odvi	browsing hardwds, northeas	shafer,el,jr	1965

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JWMAA	7---1	119	122	odhe	chapparal sprouts and deer	reynolds,hg; samp	1943
JWMAA	10--1	54	59	odhe	management of black-tailed	einarson,as	1946
JWMAA	41--4	785	789	odhe	ceel, resp cl cut, fire,wy	davis,pr	1977
WLSBA	4---2	69	73	odhe	odvi, prescrib burn, s dak	lovaas,al	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JBRGA	26--4	247	250	ceel	burning veg,grazng,scotlnd	miles,j	1971
JWMAA	36--4	1332	1336	ceel	aerial ignitn, idaho range	leege,ta; fultz,m	1972
NOSCA	53--2	107	113	ceel	eff repeat prscr burn,idah	leege,ta	1979
XARRA	226--	1	4	ceel	od, eff wildfire, ponderos	kruse,wh	1972

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	11---	296	308	alal	status moos on isle royale	aldous,se; krefti	1946
NAWTA	18---	539	552	alal	prog,mgmt,south cent alask	spencer,dl; chate	1953
TTFPB	3----	10	33	alal	moose & fire, kenai penins	spencer,dl; hakal	1964

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
ABSZA	30--4	1	44	rata	lichen stands, newfo, rata	ahti,t	1959
JWMAA	18--4	521	526	rata	fire,declin mt car herd,bc	edwards,ry	1954
NAWTA	32---	246	259	rata	effect on, bg car, habitat	scotter,gw	1967

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFNA	91--3	282	285	anam	prair fire, prongh, cactus	stelfox,jg; vrien	1977

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				bibi			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				ovca			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				ovda			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				obmo			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JFUSA	33--3	338	341	doca	relatn grass fire,graz,lon	greene,sw	1935
XATBA	683--	1	52	doca	fire, doca graz, lnglf pne	wahlenberg,wg; g/	1939

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BOREA	9---9	617	654	----	eff fire,vegetatn,southeas	garren,kh	
ECOLA	13--4	315	327	wldl	factors influnc wldl, cali	stover,ti	1932
ECOLA	30--2	135	145	----	successnl resp herbs, pine	lemon,pc	1949
ECOLA	30--2	223	233	----	ecol role, pne-oak for, nj	little,s; moore,e	1949
ECOLA	34--3	520	528	----	eff on groun covr, pne reg	buell,mf; cantlon	1953
ECOLA	39--1	36	46	----	undergrwth veg, south pine	hodgkins,ej	1958
ECOLA	41--3	431	445	both	effs on repr & grow, minne	ahlgren,ce	1960
JAGRA	50...	809	822	----	eff annual grass fire,long	greene,sw	1935
JFUSA	30--4	419	420	----	burni stimul aspen suckers	shirley,hl	1932
JFUSA	40--2	129	131	----	place of fire, southrn for	conarro,rm	1942
JFUSA	54--9	582	584	----	eff on forage & mast produ	lay,dw	1956
JRMGA	18--4	202	205	----	eff yld, prair brush-savan	vogl,rj	1965
JRMGA	29--1	13	18	----	shrub, herb, 20 yr prescri	lewis,ce; harshba	1976
JWMAA	19--1	65	70	----	change, nutrit valu browse	dewitt,jb; derby,	1955
JWMAA	35--3	508	515	----	sprouting of shrubs, idaho	leege,ta; hickey,	1971
JWMAA	40--3	507	516	----	scrub oak habitat, pennsyl	hallisey,dm; wood	1976
JWMAA	43--3	807	811	----	fire,disk,herb plants,seed	buckner,jl; lande	1979

---- continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NAWTA	3----	376	380	wldl	wildlife forest relationsh	horne,ee	1938
PCGFA	9----	55	60	----	eff burn forag & mast prod	lay,dw	1955
SCIEA	215--	661	663	----	fire eff water,for nutr cy	richter,dd; ralst	1982
SWNAA	23--2	279	288	wldl	eff fire, lodgpol pine for	roppe,ja; hein,d	1978
TTFPB	13---	39	64	hrbv	effs, prscib fire, scotlnd	miller,gr; watson	1973
VILTA	9---3	45	192	wiru	prscb fire,win hbt,lnd use	ahlen,i	1975
XASRA	118..	1	2	----	herb yield, burn flatwo ra	rummell,rs	1958

OTHER PUBLICATIONS

Ralston, C. W. and G. E. Hatchell. 1971. Prescribed Burning Symposium. U.S. Department of Agriculture Southeastern Forest Experiment Station, Asheville, N.C.

Shantz, H. L. 1947. The use of fire as a tool in the management of the brush ranges of California. State Board of Forestry. 156 p.

CHAPTER 21, WORKSHEET 3.2a

Estimating production increases and costs per unit increase, fire

This WORKSHEET provides a place to tabulate the time spent using fire to increase forage production, and determine the cost per unit of increase. The questions below are quite general because they apply to a wide range of possible situations described in the literature. Answer them s specifically as possible, and complete the calculations of cost. Note that expected costs are used; a projected cost-analysis should include expected costs at the time the work is to be done.

Reference:

Size of area burned?

Forage production prior to burning?

Burn methods used?

Man-hours required?

Expected rates of pay?

Expected cost for man-hours?

Machine-hours required?

Expected cost for machine-hours?

Total expected cost?

Forage production after burning:

First year?

Second year?

Third year?

Cost per unit weight of forage increase?

Cost of an equivalent amount of cattle feed?

Subjective evaluation of relative cost of wild:domestic ruminant feeding?

(Write up summary on the next page)

UNIT 3.3: CHEMICAL PRACTICES

Chemicals may be used to stimulate forage production by either direct or indirect means. Ranges with low fertility and depressed total production benefit from the application of chemical fertilizers. Ranges with ample total production but of species not palatable to foraging animals benefit from the application of selective herbicides.

Fertilizers. Experimental application of fertilizers, chemical responses by plants, and selection of browse has indicated that some chemical characteristics of plants are altered in response to fertilizers, and that ruminants show preference for fertilized plants. Nitrogen fertilization resulted in significantly higher crude protein levels in several browse species treated in Maine (Abell and Gilbert 1974). Vegetable yields and crude protein content in Japanese honeysuckle (*Lonicera japonica*) increased, but fruit yields decreased in response to nitrogen fertilization in Arkansas (Segelquist and Rogers 1975). Neither of these two papers report on deer responses to fertilized compared to unfertilized plots, however. The crude protein content of *Quercus undulata* (wavyleaf oak) was not altered by nitrogen fertilizing in a study in New Mexico, but fertilized range showed greater use by mule deer than unfertilized range (Anderson *et al*. 1974).

Herbicides. Growth hormone herbicides were developed rapidly after World War II. They function by stimulating growth to the point where plants "grow to death." One of the early studies on the use of herbicides is reported by Krefting *et al*. (1956) who used 2,4-D and 2,4,5-T to kill the aerial stems of *Acer spicatum* (mountain maple) in order to stimulate regrowth. They cite another study by Roe (1953) which indicated that spraying at the time of bud burst resulted in greater regrowth than spraying during the dormant season. A later study by Krefting and Hansen (1969) showed increased production of better browse plants for white-tailed deer up to six years after spraying with 2,4-D, and deer used the sprayed areas more than control areas when the study was terminated eight years after treatment. The effectiveness of herbicides in selectively controlling and promoting plant growth and forage production is clear enough when short-term effects are evaluated. The important questions about long-term effects, and effects on species other than target species, including non-game species, are major ecological considerations.

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Abell, D. H. and F. F. Gilbert. 1974. Nutrient content of fertilized deer browse in Maine. J. Wildl. Manage. 38(3):517-524.

Anderson, B. L., R. D. Pieper, and V. W. Howard, Jr. 1974. Growth response and deer utilization of fertilized deer browse. J. Wildl. Manage. 38(3):525-530.

Krefting, L. W. and H. W. Hansen. 1969. Increasing browse for deer by aerial application of 2,4-D. J. Wildl. Manage. 33(4):784-790.

Krefting, L. W., H. L. Hansen, and M. H. Stenlund. 1956. Stimulating regrowth of mountain maple for deer browse by herbicides, cutting, and fire. J. Wildl. Manage. 20(4):434-441.

Roe, E. I. 1953. Resprouting of mountain maple after basal spraying with 2,4,5-T. Rec. Rept. Tenth Ann. N. Cent. Weed Cont. Conf.: 73-74.

Segelquist, C. A. and M. J. Rogers. 1975. Response of Japanese honeysuckle to fertilization. J. Wildl. Manage. 39(4):769-775.

REFERENCES, UNIT 3.3

CHEMICAL PRACTICES

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
AGJOA	56--2	223	226	od--	eff fertil grass, deer use	thomas,jr; cospe/	1964
FOSCA	16--1	21	27	od--	brows, ferm doug fir, fert	oh,jh; jones,mb;/	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
FOSCA	16--1	113	120	odvi	uplnd oak resp,fert,n,p,ca	ward,ww; bowersox	1970
JFUSA	60-10	718	719	odvi	dogwood resp nitrogen fert	curlin,jw	1962
JWMAA	5---1	95	102	odvi	meth, increas browse, minn	krefting,lw	1941
JWMAA	20--4	434	441	odvi	mt maple, herbi, cut, fire	krefting,lw; han/	1956
JWMAA	33--4	784	790	odvi	incr brws aer applic 2,4-d	krefting,lw; hans	1969
JWMAA	38--3	517	524	odvi	nutr cont, fertilized brws	abell,dh; gilbert	1974
JWMAA	39--3	259	250	odvi	brows, herbage, intns mngt	wolters,gl; schmi	1975
JWMAA	39--4	769	775	odvi	resp jap honeysckl, fertil	segelquist,ca; ro	1975
NFGJA	15--2	155	164	odvi	fertil, protein, witchhobb	bailey,ja	1968
NCANA	94--	335	346	odvi	eff for fert,prot,ca,p,oak	wood,gw; lindsey,	1967
PSAFA	1960-	103	106	odvi	aer appli 2,4-d, impr brws	krefting,lw; hans	1960
XANEA	33---	1	37	odvi	browsing hardwds, northeas	shafer,el,jr	1965

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JRMGA	30--1	53	57	odhe	ceel, improv rang, sprayng	kufeld,rc	1977
JWMAA	38--3	525	530	odhe	growth, utiliz frtlz brows	anderson,bl; pie/	1974

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JRMGA	16--2	74	78	ceel	chem sgebrsh control distr	wilbert,de	1963
JRMGA	30--1	53	57	ceel	odhe, improv rang, sprayng	kufeld,rc	1977
XARRA	240--	1	4	ceel	sagbrsh cont,herb,calv beh	ward,al	1973

CODEN VO-NU BEPA ENPA ANIM KEY WORDS----------------- AUTHORS---------- YEAR

alal

CODEN VO-NU BEPA ENPA ANIM KEY WORDS----------------- AUTHORS---------- YEAR

rata

CODEN VO-NU BEPA ENPA ANIM KEY WORDS----------------- AUTHORS---------- YEAR

anam

CODEN VO-NU BEPA ENPA ANIM KEY WORDS----------------- AUTHORS---------- YEAR

bibi

CODEN VO-NU BEPA ENPA ANIM KEY WORDS----------------- AUTHORS---------- YEAR

ovca

CODEN VO-NU BEPA ENPA ANIM KEY WORDS----------------- AUTHORS---------- YEAR

ovda

CODEN VO-NU BEPA ENPA ANIM KEY WORDS----------------- AUTHORS---------- YEAR

obmo

CODEN VO-NU BEPA ENPA ANIM KEY WORDS----------------- AUTHORS---------- YEAR

oram

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	44--4	335	348	biga	resp brush seedlings, fert	schultz,am; bisw/	1958
CAFGA	48--4	268	281	biga	resp browse plants fertili	gibbens,rp; piepe	1962
CGFPA	28---	1	25	biga	miner fertil, range improv	carpenter,lh; wil	1972
JFUSA	41-12	915	916	----	better acrns fr fertlz oak	detweiler,sb	1943
JFUSA	55-11	803	809	----	silvc prac, wldlf food,cov	gysel,lw	1957
JFUSA	60--1	33	35	biga	fertil, contrl distrb anim	brown,er; mandery	1962
JRMGA	14--3	126	130	----	hrbc eff,nativ forag plnts	mccaleb,je; hodg/	1961
JRMGA	18--6	338	340	----	hrbc veg resp, ozrk woodln	halls,lk; crawfor	1965
JRMGA	25--6	452	456	----	resp prair grass to fertil	rehm,gw; moline,/	1972
JWMAA	30--1	141	151	biga	herbicid trtmt brwse, idah	mueggler,wf	1965
JWMAA	32--3	538	541	biga	herbicd trtmt brwse, 6 yrs	lyon,lj; mueggler	1965
MFNOA	42...	1	2	----	herbici, regrowth mt maple	krefting,lw; hans	1955
MFNOA	66...	1	2	----	wint, spr appl 2,4-d, regr	krefting,lw; hans	1958
MFNOA	95...	1	2	----	imprv brws, aer appl 2,4-d	krefting,lw; hans	1960
NAWTA	21---	127	141	----	herbic, hardwd, brsh contr	goodrum,pd; reid,	1956
NAWTA	27---	384	393	wldl	hrbc appl, south, mangment	chamberlain,eb,j/	1962
PCGFA	30---	656	659	----	fetil oak stimul mast prod	colvin,tr	1976
VILTA	9---3	45	192	wiru	winter habitat, land use	ahlen,i	1975
WLSBA	6---4	259	260	----	frtz eff, bear oak browse	wolgast,lf	1978

OTHER PUBLICATIONS

Stanton, F. W. 1962. Relationship of sagebrush spraying to antelope welfare. Inter. Antelope Confer. Trans. 13: 71-81.

CHAPTER 21, WORKSHEET 3.3a

Estimating production increases and costs per unit increase, herbicides

This WORKSHEET provides a place to tabulate the time spent using herbicides to increase forage production, and determine the cost per unit of increase. The questions below are quite general because they apply to a wide range of possible situations described in the literature. Answer them as specifically as possible, and calculate the expected cost. Note that expected rates apply; a projected cost analysis should include expected costs at the time the work is to be done.

Reference:

Size of area managed?

Forage production prior to application?

Herbicides used?

Cost of herbicides?

Man-hours required?

Expected rates of pay?

Cost for man-hours?

Machine-hours involved?

Cost for machine-hours?

Total expected cost?

Forage production after application?

First year?

Second year?

Third year?

Cost per unit weight of forage increase?

Cost of equivalent amount of cattle feed?

Subjective evaluation of relative cost of wild:domestic ruminant feeding?

(Write summary on the next page)

CHAPTER 21, WORKSHEET 3.3b

Determination of cost of increased quality of forage due to fertilization

Fertilizing of forest stands may be a costly practice. Fertilied areas often produce higher-quality forages. Nitrogen fertilizer increases crude protein content, for example. The actual cost of the protein increase, expressed on a par unit weight basis lmay be compared to the cost of cattle feed to give an estimate of the cost of management. Answer the following questions to determine the cost.

1. What is the forage production per acre, in pounds or kg per hectare before treatment?

2. What is the protein content, in percent, before treatment?

3. What is the total cost per acre for fertilization?

4. What is the forage production per acre or hectare after treatment?

5. What is the protein content in percent after treatment?

6. What is the difference in percent?

7. To determine the actual cost of the protein from fertilization:

   a. subtract answers in #2 from #5.

   b. multiply the gain (presumably) by the answer to #1.

   c. subtract #1 from #4.

   d. multiply #5 times the answer to c above.

   e. add the answer in d above to b above to get the protein increase.

   f. relate the answer in e above to #3.

   g. compare the cost of cattle feed by calling a local feed store and comparing prices for equivalent units of protein.

UNIT 3.4: LIMITATIONS ON GRAZING AND BROWSING

One way to increase forage production is by preventing excessive grazing or browsing. It is a form of "passive" management, one that recognizes that a proper amount of grazing results in increased forage production, and excessive grazing results in a decline in plant productivity. Grazed plants maintain active growth rather than becoming mature and dormant, resulting in greater actual production than ungrazed plants.

There are optimum foraging intensities and times for different forage species. These have been determined for many of the western range species, but not for the hundreds of different species eaten by white-tailed deer in the eastern United States.

Overgrazing or overbrowsing results in plant reduced vigor and forage production. Complete protection sometimes results in dramatic differences between plant communities outside and inside of exclosures. A small exclosure in the Canadian Rockies, Saskatchewan, protected from elk, was filled with young aspen trees (personal observation, A. N. Moen), while the surrounding area was a grass and sedge meadow.

Exclosures have been set up in many areas, and they demonstrate the impacts that large herbivores have on plant growth and stand composition. Quantitative measurements are not always made in the exclosures available, though they would be very useful to have for comparisons of growth and forage production inside and outside. Also, many small exclosures would be better than few large ones, with the exclosures located in different habitat types. Measurements of production inside and outside the exclosures should be made regularly and analyzed in relation to weather and growing conditions and to herbivore population densities.

REFERENCES, UNIT 3.4

LIMITATIONS ON GRAZING AND BROWSING

BOOKS

TYPE PUBL CITY PGES ANIM KEY WORDS------------------ AUTHORS/EDITORS--YEAR

edbo acpr nyny 718 hrbv herbiv: interac w/plnt met rosenthal,ga,ed;/ 1979

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	40--3	215	234	od--	deer-fora rel lassen-washo	dasmann,w; blaisd	1954
ECOLA	51--6	1088	1093	od--	long term exclusn, pne for	ross,ba; bray,jr/	1970
JFUSA	47-11	909	913	od--	effect conifer repro, mont	adams,l	1949
JFUSA	48-10	675	678	od--	deer in reln plnt successn	leopold,as	1950
JFUSA	56--2	116	121	od--	stand dens, od brws, adiro	curtis,ro; rushmo	1958
JFUSA	64--5	322	326	od--	eff sim od brows, doug-fir	crouch,gl	1966
NAWTA	15---	571	578	od--	deer in reln plnt successn	leopold,as	1950
NAWTA	23---	478	490	od--	deer exclosure exper, mich	graham,sa	1958
NYCOA	5---3	6	8	od--	what's happen to deer rang	darrow,rw	1950
PCGFA	2....	1	6	od--	evaluation of deer browsin	goodrum,p	1948
PZESA	8----	52	54	od--	effect,subalpn for & scrub	wardle,p	1961
TAGPA	3....	10	12	od--	react, popul, grazng prac	merrill,lb; teer/	1957
XANEA	33---	1	37	od--	brwsng hardwoods, north es	shafer,el,jr	1965

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JAPEA	16--3	855	861	odvi	influ on struc & comp for	anderson,rc; louc	1979
JFUSA	54--6	391	398	odvi	effct matur n hrdwd forest	webb,wl; king,rt/	1956
JFUSA	64-12	801	805	odvi	influ logged n hrdw forest	tierson,wc; patr/	1966
JWMAA	5---1	90	94	odvi	mgt sugges, nor wh-ced typ	aldous,se	1941
JWMAA	10--1	60	63	odvi	summr browse, cut-ovr hrdw	cook,db	1946
JWMAA	16--4	401	409	odvi	brows study, lake sta	aldous,se	1952
JWMAA	21--1	75	80	odvi	effct repro, heml-hardwood	stoeckeler,jh; s/	1957
JWMAA	24--1	68	80	odvi	influence on vege, wiscons	beals,ew; cottam,	1960
JWMAA	24--4	387	395	odvi	deer-fore habita reln, ark	halls,lk; crawfor	1960
RWLBA	7---1	1	61	odvi	eff, adirndack forest typs	pearce,j	1937
XANEA	308--	1	8	odvi	impact on hardwood regen	marquis,da	1974
XFNNA	87---	1	4	odvi	hickory run deer exclosure	grizez,tj	1959

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
NOSCA	52--3	233	235	odhe	deer & forest reprod, wash	amaral,m	1978

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
JRMGA	18--4	218	220	ceel	doca, respns plnt spec, wy	jones,wb	1965
JWMAA	5---4	427	453	ceel	effect wintr brwsng, monta	gaffney,ws	1941
NOSCA	34--1	25	36	ceel	response, graz, gras & shr	smith,dr	1960
PASCC	22---	23	24	ceel	influ elk dist, graz, vege	ashby,kr	1971

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
AMNAA	95--1	79	92	alal	impct of browsng borea for	snyder,jd; janke,	1976
JWMAA	32--4	729	746	alal	damage, fir-wh bir, newfnd	bergerud,at; manu	1968
LESOA	3....	67	73	alal	effect forest regen, ussr	baleishis,rm; pad	1975
LESOA	3....	74	79	alal	effect undrgro, bush woo	yanushko,ad; duni	1975

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
ABSZA	30--4	1	44	rata	lichen stands, newfoundlnd	ahti,t	1959
JWMAA	32--2	348	367	rata	introduc, increase & crash	klein,dr	1968

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
				anam			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS------------------	AUTHORS----------	YEAR
				bibi			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
tdbca	10---	71	77	ovca	mult use coord, san gorgon	graham,h	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				ovda			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				obmo			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JAPEA	12--1	25	29	doca	nutr remov, doca, sh gr pr	dean,r, ellis,je/	1975
XATBA	683--	1	52	doca	fire, doca graz, lnglf pne	wahlenberg,wg; g/	1939

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
BRYOA	81--2	294	306	graz	lichens, tundr transit are	kershaw,ka	1978
BSETB	41--1	85	94	brws	effs grazng, browsg on veg	nicholson,ia	1970
CPLSA	41--3	615	622	graz	comp light gr, ungr grassl	johnston,a	1961
ECOLA	21--3	381	397	graz	effe overgr & erosn, prair	smith,cc	1940
ECOLA	35--2	200	207	graz	eff compos & prod, prairie	keating,rw	1954
FOSCA	1....	61	67	brws	eff brws, qual hardw, mich	switzenberg,df	1955
FRCRA	34--1	21	24	brws	infl brwsng anims, regener	de vos,a	1958
JFUSA	48--2	118	126	graz	chng pond pne bnchgras rng	arnold,jf	1950
JFUSA	67-12	870	874	brws	grwt, dev brwsd mapl seedl	jacobs,rd	1969
JFUSA	68--5	298	300	brws	brwsng, hrdwd regen, appal	harlow,rf; downin	1970

continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JRMGA	11--4	186	190	biga	exclosures, manageme, utah	young,s	1958
JRMGA	23--2	95	97	graz	effec tramplng, graz, lich	pegau,re	1970
JRMGA	25--6	426	429	graz	clippng effects utah range	drawe,dl; grumbl/	1972
JWMAA	3---1	1	13	----	electric fence in wldl man	mcatee,wl	1939
JWMAA	3---4	295	306	brws	yellowst wint rnge studies	grimm,rl	1939
JWMAA	17--4	487	494	brws	eff sim od damag, conifers	krefting,lw; stoe	1953
JWMAA	30--3	481	488	brws	eff simul & naturl, mt map	krefting,lw; ste/	1966
JWMAA	32--4	769	772	brws	surv, grwt brwsd bittrbrus	ferguson,rb	1968
NAWTA	19---	526	533	brws	chang n mich frsts, brwsng	graham,sa	1954
UASPA	32---	65	69	biga	exclosures, manageme, utah	young,s	1955
WSCBA	18--1	3	10	brws	and the browse came back	deboer,sg	1953
XFNNA	33---	1	3	brws	wh-cedar eliminatd by, n j	little,s; somes,h	1965
ZORVA	32...	67	70	brws	browsing shrub vegetation	stalfelt,f	1970

OTHER PUBLICATIONS

ZoBell, R. S. 1963. Background of the Wyoming antelope fencing study. Inter. Antelope Confer. Trans. 14: 61-66.

Rouse, C. H. 1962. Antelope and sheep fences. Inter. Antelope Confer. Trans. 13: 45-47.

Interstate Antelope Conference. 1962. Recommended specifications for barbed wire fences (for benefit of livestock and wildlife). Inter. Antelope Confer. Trans. 13: 100-101.

UNIT 3.5: FOOD PRODUCTION AND WATERING AREAS

Food production areas are established when the primary management objective is production of more forage. Such an objective is valid when forage is an important limiting factor.

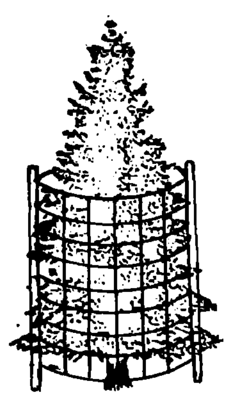
Food production may be increased by increasing the number of food-producing plants and by increasing the production of existing plants. Both can be accomplished at the same time in some areas, and in others, one of the two is used alone.

Reseeding is a commonly-used management practice for increasing forage production. This practice is used on large areas in the Western States, with "chaining" used to prepare the soil surface and destroy shrubby vegetation, followed by seeding of grasses using airplanes to broadcast the seed, and then "back-chaining," or chaining again to cover the seed and further clear the land.

Reseeding is used on a smaller scale in the Lake States and in the Northeast, where small (an acre or so) log-landings are often seeded to hasten the recovery of vegetation. Research at the Arnot Forest, Cornell University, has shown that the recovery rate by natural succession is very site-related; if soil conditions are good for growth, natural revegetation is rapid and seeding is not necessary. If particular species are desired in the early stages of succession, then reseeding will be necessary, of course.

Production by existing plants can be stimulated by cutting of those species that produce suckers, and by opening up closed canopies to allow more light to reach species in the understory that are light-limited. Clear-cutting or selective cutting are both effective ways to set back succession and stimulate forage production.

A rather intensive method of increasing food production by white cedar has been demonstrated by Severinghaus and Sharick (1980). Wire netting (4-inch mesh) cylinders 34 inches in diameter and 60 inches high are placed around 2 to 4-foot high white cedars that have been planted, supported by two steel posts. As the trees grow, their leaves reach the wire mesh and pass through. The deer can also reach into the cylinders, but not far enough to browse too heavily on the cedar.



Production per cylinder averaged between 1.28 and 2.88 pounds of fresh-weight forage per year, which, with 300 cylinders per acre, results in 384 to 864 pounds of forage per acre per year. This is considerably more than the forage production in many forest stands. Further, white cedar is high quality forage. Additional forage is produced between the cylinders too, of course.

Food production areas become rather expensive, and every effort should be made to establish them only where necessary, where plant growth is assured, and where they will be protected from the effects of overuse. They should not be counted on to support large populations of wild ruminants; natural production of forage is necessary for productive free-ranging populations.

LITERATURE CITED

Severinghaus, C. W. and W. N. Sharick. 1980. Winter deer feeders. The Conservationist 35(3):10-13.

REFERENCES, UNIT 3.5

FOOD PRODUCTION AND WATERING AREAS

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	47--2	125	144	od--	manip chamise, rang improv	biswell,hh	1961
CAFGA	49--2	95	118	od--	brush manip on winter rang	gibbens,rp; schul	1963
CAGRA	7....	4	....	od--	planting to reduce damage	longhurst,wm	1953
IGWBA	3....	1	61	od--	improv winter rang, revege	holmgren,rc; basi	1959
JFUSA	67-11	803	805	od--	improv habitat, s w forest	reynolds,hg	1969
JWMAA	2---1	1	2	od--	preventing deer concentrat	cox,wt	1938
JWMAA	24--4	401	405	od--	forage incr, thinning pine	blair,rm	1960
MOCOA	12...	4,5	13	od--	food planted with an axe	dunkeson,r	1951
NAWTA	3----	403	410	od--	experimental feeding of de	nichol,aa	1938
NAWTA	13---	431	441	od--	meth, measr deer range use	mccain,r	1948
WSCBA	20--2	18	22	od--	aspn mgt,solut deer problm	harrison,rp	1955

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	68--8	24	26	odvi	dinnerbell for the whiteta	hurd,es	1962
JFUSA	59--8	589	591	odvi	prod white-ced brws, loggi	verme,lj	1961
JFUSA	60--1	40	42	odvi	silvicult tech, improv hab	krefting,lw	1962
JRMGA	23--3	213	214	odvi	growng food admist s timbr	halls,lk	1970
JWMAA	5---1	90	94	odvi	man sugg, north white ceda	aldous,se	1941
JWMAA	5---1	95	102	odvi	methods of increasng brows	krefting,lw	1941
JWMAA	18--4	531	533	odvi	result ccc plantings, mich	dobie,jg; marshal	1954
JWMAA	20--4	434	441	odvi	stim regrow mt map, herbic	krefting,lw; han/	1956
JWMAA	33--4	784	790	odvi	incr brws aer applic 2,4-d	krefting,lw; hans	1969
JWMAA	40--4	639	644	odvi	habitat respons,irrigation	dressler,rl; wood	1976
NAWTA	9----	144	149	odvi	determ carr cap deer yards	davenport,la; sh/	1944
NAWTA	18---	581	596	odvi	deer yard carr cap, browse	davenport,la; sw/	1953
NAWTA	22---	501	519	odvi	exprm deer yrd mgt, n hamp	laramie,ha,jr; do	1957
NFGJA	8---1	19	30	odvi	seeding herbaceous perreni	webb,wl; patric,e	1961

odvi continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
NYCOA	Dec-J	8	9	odvi	winter feedng, good or bad	hesselton,wt	1964
PCGFA	13---	21	34	odvi	range anal, mgt implicatns	adams,wh,jr	1959
PSAFA	1947-	210	214	odvi	cedar swamp mgmnt and deer	bartlett,ih	1947
PSAFA	1965-	229	233	odvi	sustaind yield, woody brws	shaw, sp; ripley,	1965
QBMAA	43--4	722	731	odvi	bulldozing, produce browse	gysel,lw	1961
WLSBA	4---4	186	188	odvi	greenbrier, silvicult trtm	maxey,wr	1976
WLSBA	6---4	212	216	odvi	mgmt bur oak, winter range	severson,ke; kran	1978
WSCBA	20--2	18	22	odvi	aspen mgt,solutn deer prob	harrison,rp	1955
XFWLA	320--	1	9	odvi	exper planting food, cover	aldous,se	1949

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	8---4	317	338	odhe	supplem winter feedg, utah	doman,er; rasmuss	1944
JWMAA	30--4	839	841	odhe	toppng stim bittrbrsh twig	ferguson,rb; bas	1966

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JRMGA	28--2	120	125	ceel	odhe,graz, improv qual for	anderson,ew; sche	1975
JRMGA	30--1	53	57	ceel	odhe, improv rang, sprayng	kufeld,rc	1977

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				alal			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				rata			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				anam			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				bibi			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	22--1	1	9	ovca	water development, desert	halloran,af; demi	1958
tdbca	2----	28	31	ovca	watr dev,kofa & cabeza ran	kennedy,ce	1958
tdbca	6----	41	48	ovca	range improv meth and prac	yoakum,j	1962
tdbca	7----	185	192	ovca	summr waterhole study, cal	knudsen,mf	1963
tdbca	9----	53	54	ovca	a habitat management plan	schneegas,er	1965
tdbca	10---	53	55	ovca	proposed rang devl project	call,mw	1966
tdbca	13---	14	21	ovca	desert habitat mangmt plan	warburton,jl	1969
tdbca	13---	103	107	ovca	stubbe sprng guzzler,water	baker,jk	1969

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				ovda			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				obmo			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CAFGA	38--4	453	484	----	mgt chamise brshlnds,calif	biswell,hh; tabe/	1952
CAFGA	48--1	49	64	game	manip shrb form, brws prod	gibbens,rp; schul	1962
ECOLA	44--2	331	343	----	ecol,water-levl manip, mar	harris,sw; marsha	1963
JFUSA	30--4	129	131	----	burni stimul aspen suckers	shirley,hl	1932
JFUSA	41-12	915	916	----	better acrns fr fertlz oak	detweiler,sb	1943
JFUSA	55-11	803	809	----	silvc prac, wldlf food,cov	gysel,lw	1957
JFUSA	60--1	33	35	biga	plant,fert,control distrib	brown,er; mandery	1962

---- continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	2....	79	81	game	use salt, control distribu	case,gw	1938
JWMAA	43--3	807	811	----	fire,disk,herb plants,seed	buckner,jl; lande	1979
MFNOA	79...	1	2	wldl	survivl, grwth, cover plnt	krefting,lw	1959
NAWTA	30---	285	296	----	brush mgt tech, forag, tex	box,tw; powell,j	1965
NAWTA	33---	217	222	----	game food plntngs, s fores	____; stransky,jj	1968
PCGFA	30---	656	659	----	fertilz oak stim mast prod	colvin,tr	1976

CHAPTER 21, WORKSHEET 3.5a

Forage production cylinders and metabolic energy produced

The forage production cylinders described by Severinghaus and Sharick (1980) represents an intensive management practice that might be used in local areas. Revise the cost estimate based on current prices, and then convert the total cost from a "per pound of forage" basis to a "per megacalorie metabolizable energy" basis. Refer to PART IV, CHAPTER 11, TOPIC 3 for digestibility and metabolizable energy coefficients for white cedar or the species of your choice. Answer the following questions pertaining to costs per cylinder:

Netting cost?

Steel posts?

Labor?

Cost per tree?

Total cost per cylinder?

Expected forage production in kg per cylinder?

Digestible energy per kg of forage?

Metabolizable energy per kg of forage?

Cost per megacalorie of metabolizable energy?

Number of cylinders per acre?

Megacalories per acre?

Equivalent deer-days of metabolism for a 60 kg deer at 1.75 MBLM?

LITERATURE CITED

Severinghaus, C.W. and W.N Sharick. 1980. Winter deer feeders. The Conservationist 35(3):10-13.

UNIT 3.6: SUPPLEMENTAL FEEDING

The feeding of deer and other wild ruminants in the winter has been a controversial practice. Controversies have focused on whether deer will eat hay and grain fed to domestic ruminants (they will), whether they can digest such foods or not (they can), whether it is too expensive for the returns (it can be very expensive), and whether or not it is ecologically desirable. The last "whether" is best answered by more than a parenthetical expression.

The feeding of wild ruminants is not ecologically "natural" in the sense that populations thrived without supplemental feeding for centuries before settlement. The feeding of bison in Custer State Park, South Dakota prevents them from wandering "naturally" during the winter, seeking areas with less snow cover, but it is necessary to keep the herd of over a thousand animals in a fairly restricted area, relative to bison psychology. The feeding of white-tailed deer in New York State is different; the animals are distributed throughout the state, and the deer populations are very high in some areas. So high, in fact, that winter mortality from starvation occurrs almost annually in some areas. Should such deer be fed?

The answer to the last question is not simple, unless one looks at only one framework for answers. Ecologically, the answer is no. Ecological alternatives to the high population include increased hunting pressure and removal of more females from the population to reduce population growth.

Socially, the answer is yes to some people. They like to see deer, and they like to feed them. Further, snow depths sometimes limit movement so much that deer are concentrated much more than usual, which results in starvation even if good management practices have been carried out. The problem with making decisions on such bases is that such decisions can hardly be reversed the next year when conditions might be much improved for the deer. People do not reverse their thinking very fast.

Hunting clubs and private parks are going to feed deer regardless of the arguments for or against this practice (Statement by Paul Smiths Fish and Game Club, 1970, mimeo). Given that premise, how should feeding be carried out?

The supplemental feed should be provided before nutritional problems appear. The animals need time to become accustomed to the new feed; microorganism populations will shift as new substrates become available in the rumen.

Corn, pelleted grains, and leafy hay will be consumed by deer, and they will derive nutritional benefits from such foods.

The food should be supplied in areas where cover is also available, and it should be spread out over larger areas to avoid concentration of animals and to provide subdominant animals more opportunity to access the food.

Feeding must continue once it has started. The high cost of the feeds and the man-hours needed to provide it regularly will make the total cost of a supplemental feeding program rather high.

If supplemental feeding is not accompanied by herd control or, better yet, herd reduction, the need for supplemental feeding will likely increase, with escalating costs and potentially more biological problems as a result of concentrating the animals.

Having worked with deer for about 20 years, I feel an obligation to present my best professional judgement concerning supplemental feeding of deer. I do not recommend it, preferring rather to see efforts directed toward controlling herds to levels that are within the carrying capacity of the range.

What is the carrying capacity of a particular range? Calculations in PART VI call attention to the parameters necessary in order to evaluate carrying capacity using known biological knowledge. I also prefer to use a safety margin on the side of the range, keeping deer populations to less than rather than more than what the range could support under average conditions. I think that carrying capacity should be based on expected conditions in at least 19 out of 20 years. In other words, accept the effects of a 1 in 20 winter, but be conservative enough to hold deer populations down so problems will not appear, on the average, every 19 years. Further, if I were asked to reconsider my recommendation, it would be even more conservative (1 in 30 or more).

I do recognize that local situations surrounding particular species may need special attention. The recommendation above is for well-established populations subjected to regulated hunting.

It is also important to realize that weight loss during the winter is normal for wild, free-ranging ruminants. The annual weight cycle (See PART I, CHAPTER 1, UNIT 1.4) includes weight losses as a result of the mobilization of fat reserves. Further, the metabolic depression, an adaptation for survival in the winter, reaches a minimum in February (See PART III, CHAPTER 7, TOPIC 6), so if winter ends in March and early April, ecological metabolism has not yet risen so high that it cannot be met under normal early spring range conditions. Since the timing of the arrival of spring cannot be predicted in early winter when feeding must start, the duration of supplemental feeding is unknown, and the worst case should be expected.

Separate the biological from the social issues when confronting questions of supplemental feeding, and allow the emotions to have some input only into the social ones. There is sufficient knowledge available to evaluate biological considerations, and they should be presented as the framework within which social issues may be argued.

REFERENCES, UNIT 3.6

SUPPLEMENTAL FEEDING

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
AMFOA	51--1	13	15	od--	killing deer by kindness	carhart,ah	1945
JWMAA	39--4	813	813	od--	wntr fld test, suppl blcks	anderson,rh; you/	1975
NAWLA	7---1	46	47	od--	feeding deer to death	giles,rh,jr; mcki	1968
NAWTA	8----	333	337	od--	fallacies in winter feedng	carhart,ah	1943

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
CNSVA	19...	8	9	odvi	winter deer feeding	hesselton,wt	1964
JWMAA	39--4	813	814	odvi	wint field test,food block	anderson,rh; you/	1975
NAWTA	4----	268	274	odvi	results, feeding exp, mich	davenport,la	1939
NYCOA	2---4	21	21	odvi	winter deer feeding	darrow,rw	1948
WSCBA	14---	18	19	odvi	deer starv at feedng statn	stollberg,bp	1949

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JWMAA	8---4	317	338	odhe	supplmntl wint feedng, uta	doman,er; rasmuss	1944

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
JRMGA	4---4	279	280	ceel	elk mngmnt problms,montana	cooney,rf	1951
JRMGA	5---1	3	7	ceel	elk problems in montana	cooney,rf	1952
NEJZA	26--3	448	448	ceel	ecolo, wint feedng, sctlnd	wiersema,gj	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				alal			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				rata			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				anam			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				bibi			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				ovca			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				ovda			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				obmo			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS-----------------	AUTHORS----------	YEAR
				oram			

CHAPTER 21, WORKSHEET 3.6a

The cost of supplying feed to wild ruminants

The cost of supplying feed to wild ruminants may be calculated quite easily by determine the cost of each component of the feeding operation and summing them up. A list of questions is given below which will aid in cost determination.

The next WORKSHEET includes questions on population changes as a result of supplying feed, with the cost represented on a "per animal increase" basis. Both of these WORKSHEETS should be completed in order to arrive at the true cost of supplemental feeding.

Amount of feed provided?

Cost of feed provided?

Man-hours required to feed?

Cost per man-hour?

Machine-hours required to feed?

Cost per machine-hour?

Feeding station equipment needed?

Cost of feeding station equipment?

Complete the calculations and write a summary statement of the total cost in the space below.

CHAPTER 21, WORKSHEET 3.6b

The cost "per animal increase" of feeding wild ruminants

The total cost of providing feed, calculated in the previous WORKSHEET, should now be divided by the population increase that can be attributed to supplemental feeding to determine the cost "per animal increase." The best way to determine the increase is to go back to PART VI, CHAPTER 19 and review the factors affecting population changes and predictions. Then, use the appropriate WORKSHEETS in CHAPTER 19 to make the calculations necessary for predicting population changes as a result of this particular managment practice. Predict the number of animals present in the fall population with no supplemental feeding, and with supplemental feeding. The difference is the net increase in the population. Divide that number into the total cost of feeding to determine the cost per animal increase. Summarize your results below.

The cost per animal increase in the population is one thing, and the cost per animal harvested as a result of supplemental feeding is another. Suppose that the annual harvest equals one-third of the population. The cost per animal harvested is then three times the cost per animal increase. Redo your calculations of cost in relation to the harvest rate and summarize your results below.