

Table 1. Soil fertility parameters based upon Trettin (1986) and Rodham et al. (1996).

Soil Fertility Type		%C			%N			Bulk Density g/cm ³			Litter		
Num- ber	Name	Layer 1	Layer 2	Layer 3	Layer 1	Layer 2	Layer 3	Layer 1	Layer 2	Layer 3	gC/m ²	N/C	Lignin Content
1	moist big sage, Idaho fescue	2.93	0.7	0.37	0.21	0.055	0.032	1.204	1.295	1.35	378	0.0081	0.1
2	silver sage, fescue	2.59	0.92	0.2	0.192	0.091	0.024	1.002	1.269	1.32	864	0.0081	0.1
3	dry sage, fescue	2.63	1	0.34	0.19	0.087	0	1.2	1.3	1		0.0081	0.066
4	Pitchstone Plateau complex	2.13	1.01	0	0.141	0.082	0	1.2	1.3	1.35		0.0081	0.1
5	tufted hairgrass	20.1	7.27	0.64	1.378	0.5	0.034	0.5	0.7	1		0.0081	0.066
6	willow-sedge	2.98	1.22	0.48	0.23	0.093	0.053	1.2	1.3	1.35		0.0081	0.1
7	fescue, hairgrass	1.32	0.19	0	0.097	0.011	0	1.2	1.3	1.35		0.0081	0.066
8	fescue, bearded wheatgrass	4.15	2.81	2.37	0.309	0.223	0.2	1.2	1.3	1.35		0.0081	0.066
9	moist fescue, bearded wheatgrass	3.07	1.09	0	0.179	0.079	0	1.2	1.3	1.35	162	0.0081	0.066
10	hot springs vegetation	1.82	0	0	0.08	0	0	1.2	1.3	1.35		0.0081	0.1
11	subalpine fir, grouse whortleberry	1.48	0.19	0.09	0.07	0.015	0.005	1.237	1.469	1.4	552	0.0045	0.2
12	subalpine fir- meadowrue	1.71	0.49	0.01	0.065	0.026	0.001	1.2	1.35	1.4	2164	0.0045	0.2

Table 1 Continued.

Soil Fertility Class		%C			%N			Bulk Density g/cm ³			Litter		
Num- ber	Name	Layer 1	Layer 2	Layer 3	Layer 1	Layer 2	Layer 3	Layer 1	Layer 2	Layer 3	gC/m ²	N/C	Lignin Content
13	subalpine fir, grouse whortleberry whitebark pine phase	3.92	0.91	0.07	0.154	0.072	0.003	1.265	1.364	1.39	520	0.0045	0.2
14	subalpine fir, grouse whortleberry phase, pinegrass phase	1.32	0.4	0	0.058	0.023	0	1.19	1.35	1.4	433	0.0045	0.2
15	subalpine fir, twinflor, grouse whortleberry phase	3.41	1.91	1.11	0.211	0.141	0.096	1.25	1.5	1.4	-99	0.0045	0.2
16	subalpine fir, globe huckleberry, globe huckleberry phase	2.95	2.25	0	0.156	0.127	0	1.25	1.35	1.4	1300	0.0045	0.2
17	subalpine fir, pinegrass	3.13	1.07	0.73	0.187	0.051	0.033	1.25	1.35	1.4	-99	0.0045	0.2
18	wet forests	1.69	0.28	0.04	0.069	0.013	0.002	1.25	1.35	1.4	-99	0.0045	0.2
19	whitebark pine, elk sedge	2.88	0.04	0	0.09	0.003	0	1.332	1.39	1.4	-99	0.0045	0.2

Table 1. Continued.

Soil Fertility Class		%C			%N			Bulk Density g/cm ³			Litter		
Num- ber	Name	Layer 1	Layer 2	Layer 3	Layer 1	Layer 2	Layer 3	Layer 1	Layer 2	Layer 3	gC/m ²	N/C	Lignin Content
20	lodgepole pine, bitterbrush	0.98	0.08	0.03	0.055	0.012	0.007	1.35	1.35	1.4	-99	0.004 5	0.2
21	Douglas fir, snowberry	1.94	1.05	0.16	0.096	0.05	0.005	1.22	1.27	1.4	2600	0.004 5	0.2
22	Douglas fir, pinegrass	1.29	0.28	0.03	0.058	0.018	0.002	1.25	1.35	1.4	-99	0.004 5	0.2
23	Douglas fir, pinegrass	6.37	5.74	0.17	0.318	0.287	0.008	1.25	1.35	1.4	-99	0.004 5	0.2

Table 2. Percent cover and tree height assigned to cover types. LP-lodgepole pine, SF -spruce/fir, DF-Douglas fir, WB-whitebark pine, NF-non forested, KH-krumholz, mf-mixed forest, li-limber pine, OW-open woodland, ASP-Aspen. 0-regeneration phase, 1-first phase, 2- second phase, 3-mature phase.

Cover Type Numeric Code	Cover Type	% Cover	Height m	Cover Type Numeric Code	Cover Type	% Cover	Height m
1	LP1/LP	89	15	30	LP1/LP2	53	14
2	WB0	16	1	31	LP2/DF	81	24
3	DF0	29	1	32	LP2/NF	43	13
4	LP0/NF	24	1	33	LP/LP2	84	23
5	LP0	26	1	34	KH	21	3
6	LP	68	25	35	LP2	59	20
7	NF	0	0	36	KH/NF	32	2
8	LP3	53	25	37	ASP/NF	50	9
9	SF/NF	26	20	38	WB2	60	20
10	SF	50	30	39	LPP	27	3
11	WB	41	25	40	DF1	43	10
12	WB/NF	28	16	41	DF2	79	20
13	WB/DF	51	27	42	DF3	77	30
14	WB/SF	53	27	43	SF0	21	1
15	WB/WB0	13	17	44	SF1	60	10
16	DF/NF	42	20	45	SF2	67	20
17	DF	58	30	46	WB3	49	25
18	LP/LP3	87	25	47	ASP0	58	3
19	LPP/SF	34	2	48	ASP1	62	10
20	LP3/NF	30	16	49	ASP2	65	12
21	LPP/LP3	25	11	50	ASP3	58	14
22	LP2/LP3	29	22	51	LI3	80	25
23	ASP	34	14	52	LI	80	25
24	DF1	37	10	53	OW	87	30
25	WB1/NF	32	7	54	MF0	12	1
26	WB1	53	10	55	MF1	32	10
27	LP1/DF	41	17	56	MF2	27	20
28	LP1/NF	41	7	57	MF	48	30
29	LP1	59	10	58	misc	58	20

Table 3. A synthesis of herbaceous biomass data from a variety of non-forested habitat types in Yellowstone National Park. Values are means for each of the studies and indicated plot types. All data are from inside exclosures or grazing cages unless noted. Habitat codes and descriptions can be found in Appendix 2.

Habitat	Descriptors	Elev- ation m	Un-grazed g m ⁻²	Grazed g m ⁻²	Reference
DRY HABITATS- LOW ELEVATION					
Mudflow Mosaic- Idaho Fescue, Bluebunch Wheatgrass, Needlegrass					
mfm	current growth	1650	53	49	Coughenour 1991
mfm	low elevation winter range	1650		52	Coughenour and Singer 1996
mfm	S1,S2 alluvial outwash	1650	41	41	Frank and Groffman 1998
<i>Mean</i>			47	47	
DRY HABITATS-					
UPPER NORTHERN WINTER RANGE					
Idaho Fescue/Bluebunch Wheatgrass					
fa	B,L2	2050	74	57	Frank and Groffman 1998
fa	ridgetop	2020		75	Frank et al 1994
fa	upperbench	2020		69	Frank et al 1994
fa	lowerbench	2020		65	Frank et al 1994
fa	mid elevation	2290		92	Merrill et al. 1993 and Boyce 1988
<i>Mean</i>			74	72	
Idaho Fescue					
fd	mid-high elevation, transition range	2690		119	Merrill et al. 1993
Big sagebrush/Bluebunch Wheatgrass					
ta	slope	2020		138	Frank et al 1994
ta		2460		68	Merrill et al. 1993
<i>Mean</i>				85	

Table 3. Continued.

Habitat	Descriptors	Elev- ation m	Un-grazed g m ⁻²	Grazed g m ⁻²	Reference
Big Sagebrush/Idaho Fescue - Sticky Geranium Phase					
tf/tfg	current growth	2050	47		Singer 1995
tf/tfg	current growth	2050	92	70	Coughenour 1991
tf/tfg	upper winter range	2050		67	Coughenour and Singer 1996
tf/tfg	unburned,current growth	2050	78	78	Singer and Harter 1996
tf/tfg	Blacktail,grid plots	2147		59	Wallace et al. 1995
Mean			72	68	
Agropyron cristatum					
	Dry grasslands, landscape samples			65	Wallace et al. 1995
Big Sagebrush/Idaho Fescue					
tf	M2, upper winter range	1950	41	75	Frank and Groffman 1998
tf		1990		49	Merrill et al. 1993
Mean			41	63	
HAYDEN VALLEY					
fds	Feld Dry	2450	83	68 ^B	Olenicki and Irby 2003
fds	Ridge	2450	91	75 ^B	Olenicki and Irby 2003
Mean			87	72	
WEST SIDE					
Bluebunch Wheatgrass					
(tf on habitat map)	4MS moveable cage	2070	81	28	Dawes 1998
(tf on habitat map)	4MS fixed cage	2070	70	24	Dawes 1998
Mean			76	26	
Big Sagebrush/Idaho Fescue					
Sagebrush	Gallatin	2100		91	Hansen et al 2000

Table 3. Continued.

Habitat	Descriptors	Elev- ation m	Un- grazed g m ⁻²	Grazed g m ⁻²	Reference
MOIST HABITATS					
UPPER NORTHERN WINTER RANGE					
Idaho Fescue/Bearded Wheatgrass					
fn	mid elevation	2470		116	Merrill et al. 1993
Idaho Fescue/Bearded Wheatgrass Sticky Geranium Phase					
fng	Hellroaring	2000	130	110 ^A	Tracy 1996
fng	Hellroaring, grid plots	1926		95	Wallace et al. 1995
fng	landscape samples			146	Wallace et al. 1995
fng	Hellroaring, mid elevation	2480		165	Merrill et al. 1993
<i>Mean</i>			130	126	
Big Sagebrush/Idaho Fescue Sticky Geranium Phase					
tfg	winter range, unburned	2100		129	Norland and Singer 1990 unpubl.
tfg	bench W1	2000	85	65 ^A	Frank and McNaughton 1992
tfg	ridge T1, transition range	2340	102	64 ^A	Frank and McNaughton 1992
tfg	slope S2, summer range	2450	75	49 ^A	Frank and McNaughton 1992
tfg	transition range, Swan Lake Flats	2350	92	47 ^A	Tracy 1996
tfg		1990		123	Merrill et al. 1993
tfg	landscape samples			116	Wallace et al. 1995
<i>Mean</i>			88	85	

Table 3 continued.

HAYDEN VALLEY					
Silver Sage/Idaho Fescue					
kf	FeldDeCa	2450	114	100 ^B	Olenicki and Irby 2003
kf	ArCaFeld	2450	115	94 ^B	Olenicki and Irby 2003
kf		2450	118	63 ^A	Tracy 1996
<i>Mean</i>			117	86	
Big Sagebrush/Idaho Fescue Sticky Geranium Phase					
tfg	ArTrFeld	2450	98	80	Olenicki and Irby 2003
tfg	AtTrFeldDaln	2450	129	106	Olenicki and Irby 2003
tfg	ArTrAgro	2450	165	136	Olenicki and Irby 2003
<i>Mean</i>			130	107	
GRANT VILLAGE					
forest meadow	Feld/Stipa, unburned	2600		100	Tracy 1996
forest meadow	Feld/Stipa, burned	2600		150	Tracy 1996
TUFTED HAIRGRASS MEADOWS					
NORTHERN WINTER RANGE					
dw	mid-high elevation	2660		144	Merrill et al. 1993
FIREHOLE AREA					
dw	GM, fixed cage	2260	125	58	Dawes 1998
dw	GM, moveable cage	2260	139	38	Dawes 1998
dw/poa	TS, fixed cage	2300	127	63	Dawes 1998
dw/poa	TS, moveable cage	2300	176	92	Dawes 1998
<i>Mean</i>			194	159	

Table 3. Continued.

Habitat	Descriptors	Elev- ation m	Un- grazed g m ⁻²	Grazed g m ⁻²	Reference
WET MEADOWS - SEDGE, REEDGRASS, TIMOTHY					
NORTHERN WINTER RANGE					
ww	W2, river terrace, Timothy, Bromus, Bluegrass	2000	446	279 ^A	Frank and McNaughton 1992
ww	W3, bottom, Brome	2000	218	165 ^A	Frank and McNaughton 1992
ww	T2,T3, slope, Timothy, Rushes	2300	261	115 ^A	Frank and McNaughton 1992
ww	S3, bench, Timothy, Sedge	2350	278	141 ^A	Frank and McNaughton 1992
ww	S4, bench, Bluegrass	2400	238	125 ^A	Frank and McNaughton 1992
ww	W4, river terrace, Sedge	2000	564	564 ^A	Frank and McNaughton 1992
ww	M1, L1, moist	1950- 2050	333	229	Frank and Groffman 1998
ww	Riparian	2000	310		Frank et al 1994
ww	Timothy, grid plots	2059		118	Wallace et al. 1995
ww	Timothy, landscape samples			229	Wallace et al. 1995
<i>Mean</i>			331	218	

Table 3. Continued

Habitat	Descriptors	Elev- ation m	Un-grazed g m ⁻²	Grazed g m ⁻²	Reference
HAYDEN VALLEY					
ww	Mesic	2450	236	191 ^B	Olenicki and Irby 2003
ww	CaCa, Reedgrass	2450	246	199 ^B	Olenicki and Irby 2003
ww	Clover	2450	258	235 ^B	Olenicki and Irby 2003
ww	WetCarex	2450	315	255 ^B	Olenicki and Irby 2003
ww	Carex	2450	354	287 ^B	Olenicki and Irby 2003
ww/dw	CarexDeca	2450	263	213 ^B	Olenicki and Irby 2003
<i>Mean</i>			279	230	
THERMAL HABITATS, FIREHOLE RIVER AREA					
hs	MGB, fixed cage	2200	86	28	Dawes 1998
hs	MGB, moveable cage	2200	188	43	Dawes 1998
hs	FFD, fixed cage	2200	65	19	Dawes 1998
hs	FFD, moveable cage	2200	72	18	Dawes 1998
hs	IC, fixed cage	2220	208	21	Dawes 1998
hs	IC, moveable cage	2220	103	28	Dawes 1998
<i>Mean</i>			120	26	

^A Grazed biomass calculated by subtracting consumption from ANPP estimate inside moveable exclosures.

^B Grazed biomass calculated by applying mean percent offtake for plant group to biomass inside moveable exclosures.

Table 4. Synthesis of herbaceous biomass data from forested habitats in and near Yellowstone National Park.

Cover Type-	Descriptors	Observed Biomass g m ⁻²	Reference
Douglas Fir			
DF	Gallatin	24	Hansen et. al. 2000
DF	Northern Range	78	Norland and Singer 1990 unpublished
DF	Northern Range	59	Houston 1982
DF	Northern Range	54	Wallace et al. 1995
Lodgepole Pine			
<i>Burned</i>			
LP0	high elevation (2500 m)	18	Hansen et. al. 2000
LP0	intermediate elevation (2300 m)	23	Hansen et. al. 2000
LP0-2go	burned, iNFertile, high density trees (2560 m)	20	Reed et. al. 1999
LP0-2l3	burned, iNFertile, lOW density trees (2070 m)	71	Reed et. al. 1999
<i>Mature</i>			
LP	high elevation (2500 m)	16	Hansen et. al. 2000
LP	intermediate elevation (2300 m)	24	Hansen et. al. 2000
LP	low elevation (2100 m)	33	Hansen et. al. 2000
Wet Forest			
LP2-2lI/2do	Grant Village	87	Reardon 1991 unpublished
2lI/2d	Grant Village, unburned	95	Tracy 1996
2lI/2d	Grant Village, burned	150	Tracy 1996

Table 5. Initial herbaceous biomass of moist and wet grasslands and shrub grasslands and tallus, based upon data in Table 3.

See Appendix 2 for habitat codes.

Habitat	Herbaceous Biomass g m ⁻²
fn, fng (Idaho fescue, moist)	135
kf (silver sage/Idaho fescue, moist)	117
tfg, fds,fro, kf, pz/d (big sagebrush/Idaho fescue, moist) and other moist habitats	105
dw (tufted hairgrass) and other very moist habitats	162
dw/ww (tufted hairgrass, sedge bogs)	263
ww/iw (Sedge bogs, willow/sedge) and other wet habitats	308
hs (thermal hot spring)	120
ts (tallus)	5

Table 6. Relations between life forms (model bins), model functional groups, plant types, and example species.

Life-form (bin)	Model Functional Group	Plant Types	Example Species
grass	fine grass/sedge	highly palatable grasses, short grasses and sedges, leafy grasses with relatively little stem biomass	bluegrasses, domestics, bluebunch wheat, Idaho fescue, elk sedge, Ross' sedge, needlegrass, tufted hairgrass, wheatgrass
	coarse grass/sedge	tall grasses and sedges, rushes, stemmy mid-height grasses	sedge, reedgrass, rushes, pinegrass
	alpine grass	alpine adapted grasses/sedges, cushion plants	misc.
forb	forb	forbs	misc.
	alpine forb	alpine adapted forbs, cushion plants	misc.
shrub	sage	semideciduous shrubs	big sage, silver sage
	deciduous	short, mid, and tall stature deciduous shrubs	bitterbrush, cinquefoil, snowberry, ninebark, spirea, Oregon grape
	Vaccinium spp.	small stature, slow growing shrub	grouse whortleberry, globe huckleberry
	coniferous	evergreen, needle-leaf shrub	juniper
	willow	riparian, wetland shrubs	willows
tree	conifer	evergreen, needle-leaf trees	lodgepole pine, Douglas fir, Engleman spruce, subalpine fir, whitebark pine
	deciduous	deciduous trees	ASPen, cottonwood

Table 7. Synthesis of data on forb percentage of total herbaceous biomass.

Habitat	Sites	Source	Forb %
Dry Grasslands			
mfm	lower winter range	Coughenour	48
fa	ridgetop	Frank et al 1994	32
fa	upperbench UBB	Frank et al 1994	66
fa	lowerbench	Frank et al 1994	16
fa	northern range	Merrill et al. 1993	18
fd	northern range	Merrill et al. 1993	29
fn	northern range	Merrill et al. 1993	28
fng	northern range	Merrill et al. 1993	36
ta	northern range	Merrill et al. 1993	28
tf	northern range	Merrill et al. 1993	22
tf/tfg	upper winter range	Coughenour 1991	38
tf/tfg	grazed	Singer 1995	37
tf/tfg	ungrazed	Singer 1995	42
tfg	northern range	Norland and Singer 1990 unpubl.	27
tfg	upperbench UVB	Frank et al 1994	8
tfg	slope	Frank et al 1994	59
tfg	unburned, grazed	Singer and Harter 1996	40
tfg	unburned, ungrazed	Singer and Harter 1996	48
tfg	northern range	Merrill et al. 1993	24

Table 7 continued.

Wet			
ww	riparian, northern range	Frank et al 1994	25
Forest Meadow			
LP	Grant Village forest meadow	Reardon 1991 unpublished.	31
Forests			
DF	northern range	Norland and Singer 1990 unpublished	7
dw	northern range	Merrill et al. 1993	19
LP	Colorado	Crouch 1986	46
LP	Grant Village forest	Reardon 1991 unpublished	75
MEAN			34

Table 8. Shrub cover and density in sagebrush steppe inside and outside long-term grazing exclosures, calculated from Norland and Reardon 1996.

Exclosure	Year	Site	Cover %	Density number per ha	Crown diameter cm
Outside	1958	Gardiner	1.09	15000	20.60
		Blacktail	3.04	30000	11.40
		Mammoth	4.35	48000	23.03
		Lamar	0.07		
		Junction Butte	1.52	7000	35.68
		mean, upper	2.24	28333	23.37
	1988	Gardiner	0.87	1000	71.37
		Blacktail	12.17	11000	80.51
		Mammoth	19.57	21000	73.87
		Lamar	8.70		
		Junction Butte	16.30	9000	103.01
		mean, upper	14.18	13667	85.80
Inside	1958	Gardiner	6.52	5000	87.40
		Blacktail	3.26	15000	35.68
		Mammoth	6.52	56000	26.12
		Lamar	5.43	0	
		Junction Butte	1.74	19000	49.73
		mean, upper	4.24	22500	37.18
	1988	Gardiner	36.96	17000	112.84
		Blacktail	11.96	18000	62.37
		Mammoth	47.8	15000	136.65
		Lamar	28.26		
		Junction Butte	18.48	6000	134.30
		mean, upper	26.63	13000	111.11

Table 9. Willow cover data from two studies.

Site	Year	Browsing	Cover %
Chadde and Kay 1991			
Mammoth		Browsed	10
Junction Butte		Browsed	14.7
Lamar East		Browsed	7
Lamar West		Browsed	77
Singer 1996			
N. Range	1958	Unbrowsed	9.4
N. Range	1989	Unbrowsed	55.4
N. Range	1958	Browsed	5.8
N. Range	1989	Browsed	27.5

Table 10. Estimated shrub canopy cover in each habitat type.

Cover Type Numeric Code	Habitat Type	Cover %	Cover Type Numeric Code	Habitat Type	Cover %
1	fds	1	65	ts	0
2	fas	1	66	wa	0
3	4so	2	67	ww	0
4	ta	2	68	PIFL	2
5	at	2	69	PIFL/AGSP	2
6	fro	1	70	PIFL/FEID	2
7	4ho	0	71	PIFL/JUCO	15
8	2so	1	72	PSME/AGSP	2
11	mfm	2	73	PSME/FEID	2
12	pz/d	20	74	PSME/CARU	2
14	3lo	75	75	PSME/AGL	75
35	2cl	40	76	PSME/LIBO	5
36	2do	1	77	PSME/CAGE	2
38	2ee	75	78	PSME/JUCO	10
39	2fo	2	79	PSME/ARCO	5
40	2go	5	80	ABLA/PICEA	50
41	2ho	2	81	ABLA/PICEA/MISC	5
42	2i3	75	82	ABLA/PICEA/VACA	75
44	2lg	25	83	ABLA/PICEA/CARU	2
45	2ll	60	84	ABLA/PICEA/JUCO	15
47	3ho	0	85	PIAL/MISC	2
48	4po	30	86	PIAL/CARU	2
49	5go	30	87	POTR	10
50	5jj	30	88	WETFORB	2
51	5mo	50	89	MOISTFORB	2
52	5no	20	90	DRYFORB	2
53	aom	2	91	FEIDhigh	1
54	dw	0	92	AVAL	15

Table 10 continued.

Cover Type Numeric Code	Habitat Type	Cover %	Cover Type Numeric Code	Habitat Type	Cover %
56	fa	2	93	AGRIC	0
57	fn	1	94	URBAN	5
58	fng	2	95	Riparian	26
59	hs	0	96	MISC-CF	15
60	iw	27	97	MISC-HG	2
61	kf	8	98	MISC-SH	13
62	ppx	2			
63, 64	tf, tfg	13 (1987/89) 5 (1970) 3 (1957/61)			

Table 11. Prescribed water table depths for mesic habitats (mm).

Month	Wet Forests	Hairgrass, Hairgrass/ sedge meadows	Thermal Areas	Willow/ sedge	Willow/ sedge Riparian	Hayden and Pelican Valley Moist Sage
Jan.	1000	400	500	200	200	800
Feb.	1000	400	500	200	200	800
Mar.	500	300	500	250	200	500
Apr.	300	250	250	300	250	300
May	500	250	250	200	100	400
June	800	250	250	180	100	400
July	900	250	250	190	150	400
Aug.	1000	250	300	200	200	400
Sept.	1000	250	400	200	200	500
Oct.	1000	300	500	200	200	700
Nov.	1000	400	500	200	200	800
Dec.	1000	400	500	200	200	800

Table 12. Key plant ecophysiological parameters. *denotes a series of x,y pairs defining a function. For example, 0,0,0.1,1.0 means that when x is 0, y is 0, and when x is 0.1, y is 1.0, where x is the variable causing the effect (eg. RWC). When x is greater than the maximum x specified (0.1 here), then y equals the maximum y specified (1.0 here). Similarly when x is less than the minimum x specified, y equals the minimum y specified.

Parameter	Fine-leaved Grass	Dryland Forb	Coarse and Mesic Grasses	Alpine Grass	Sage-brush	Deciduous Shrub	Vaccinium	Willow	Conifer
Maximum photosynthesis rate $\mu\text{mol m}^{-2} \text{s}^{-1}$	16	16	18	16	15	16	16	15	13
Initial slope of photosynthetic light response curve $\mu\text{mol CO}_2 \text{mmol}^{-1} \text{quanta}$	86	86	86	86	86	300	300	30	30
Max., min., opt. temperatures for photosynthesis $^{\circ}\text{C}$	35, 2, 15	35, 2, 15	35, 2, 15	35, -5, 12	40, 0, 18	40, 0, 18	40, 0, 18	30, -2, 15	30, -5, 10
Effect of water (RWC) on photosynthesis*	0,0, 0.4,1	0,0, 0.4,1	0,0,0.4,1	0,0, 0.1,1	0.,0., 0.1,1	0,0, 0.1,1	0,0, 0.1,1	0.4,0.5 0.5,1	0,0, 0.3,1
Stomatal conductance parameter (e_1) $\text{mol m}^{-2} \text{s}^{-1}$	15	15	15	9	9	9	9	8	10
Specific Leaf Weight g m^{-2}	90	90	100	120	167	167	167	75	352
Leaf fraction	0.75	0.75	0.75	0.8					
Effect of water (RWC) on fraction of Ps allocated to roots	0,1, 0.8,0.8	0,1, 0.8,0.8	0,1, 0.8,0.8	0,0.9, 0.8,0.6	0,0.5, 0.8,0.3	0,0.5, 0.8,0.3	NU	0,0.3, 0.8,1	NU
CAG Leaf:Twig					1.	1.0	1.0	1.3	0.7
Maximum and minimum leaf death rates due to water stress d^{-1}	0.07, 0.005	0.07, 0.005	0.07, 0.005	0.033, 0.0075	0.012, 0.0015	0.012, 0.0015	0.012, 0.0015	0.003, 0.0	0.00027 0.00027

Table 12. Continued.

Parameter	Fine-leaved Grass	Dryland Forb	Coarse Grass	Alpine Grass	Sage-brush	Deciduous Shrub	Vaccinium	Willow	Conifer
Temperature for growth initiation °C	7	7	5	1	5	5	5	6.5	0
Water (RWC) for growth initiation	0.3	0.3	0.3	0.3	0.1	0.1	0.1	0.35	0.1
Leaf death rate at phenophase 4 d ⁻¹	0.05	0.05	0.02	0.05	0.0035	0.1	0.008	0.1	0.001
Phenophase vs. growth days*	0,0,30,1,60,2,90,3,120,4	0,0,30,1,60,2,90,3,120,4	0,0,30,1,60,2,90,3,120,4	0,0,15,1,30,2,50,3,60,4	0,0,30,1,60,2,90,3,120,4	0,0,30,1,60,2,90,3,120,4	0,0,30,1,60,2,90,3,120,4	0,0,30,1,60,2,90,3,120,4	0,0,30,1,60,2,90,3,120,4
TranSFer rate from standing dead to litter d ⁻¹	0.003	0.005	0.003	0.003	0.05	0.05	0.05	0.03	0.05

Table 13. Allometric parameters for woody plants in 5th largest size/age classes (of 6).

Parameter	Upland Shrub	Deciduous Shrub	Willow	Vaccinium	Conifer
Height -m	0.67	0.67	3.4	0.24	25.0
Crown diameter - m	0.67	0.67	2.95	0.24	5.5
Stem diameter - mm	not used	not used	not used	not used	413
Leaf - kg	0.105	0.105	1.0	0.011	24.6
Total stem and branch - kg	0.6	0.6	6.9	0.021	727
Fine branch - kg	0.16	0.16	4.13	0.016	72.7
Total roots - kg	0.168	0.168	5.0	0.017	276.0
Fine roots - kg	0.081	0.081	1.0	0.011	24.6
Fine root density - g m ⁻²	350	350	2000	350	932

Table 14. Population parameters for herbaceous plants. * denotes x,y pairs defining a function (see Table 12 caption)..

Parameter	Fine-leaved Grass	Dryland Forb	Coarse Grass	Alpine Grass
Endogenous seed-based reproduction yr^{-1}	0.01	0.015	0.02	0.01
Exogenous seed-based reproduction yr^{-1}	0.01	0.01	0.02	0.01
Vegetative growth rate vs. actual shoot : potential shoot ratio*	0.25,-0.15,1.,0.09,1.25,0.	0.25,-0.15,1.,0.07,1.25,0	0.25,-0.1,1.,0.15,1.25,0.	0.25,-0.05,1.,0.05,1.25,0
Effect of herbaceous root biomass on establishment*	300,1,1000,0	300,1,1000,0	700,1,2200,0	300,1,1000,0

Table 15. Plant population model parameters for woody plants, for the 5th size/age class. * indicates x,y pairs defining a function (see Table 12 caption).

Parameter	Sagebrush	Deciduous Shrub	Vaccinium	Willow	Conifer
Establishment rate - m ² canopy / m ² canopy / mo	5.5x10 ⁻⁵	4.0x10 ⁻⁵	10.0x10 ⁻⁵	0.005	0.001
Effect of water (RWC) on establishment*	NU	NU	NU	0.8,0.2,1.,1.	0.8,0.,1.,1.
Suckering rate per cut stem (plants plant ⁻¹)	0	0	0	0.125	0
Effect of herbaceous biomass on establishment	10,1,150,0	10,1,150,0	10,1,150,0	300,1,500,0	10,1,800,0.5
Effect of woody cover (fraction) on establishment*	0.11,1,0.12,0.0	0.1,1.,0.85,0	0.1,1.,0.85,0	0.2,1.0,0.3,0.3,0.9,0	0.9,1.,1.,0.
Nominal plant mortality rate yr ⁻¹	0.015	0.015	0.015	0.009	0.003
Minimum diameter increment for slow growth mortality (m yr ⁻¹ crown for shrub, mm yr ⁻¹ stem for trees)	0.015	0.015	0.00025	0.05	1.0
Slow growth mortality rate yr ⁻¹	0.05	0.05	0.025	0.015	0.03
Fraction plants killed vs. fraction CAG browsed*	0	0	0	NU	NU
Fraction branch killed vs. fraction CAG browsed or stems browsed (willow)*	0,0,1.0,0.1	0,0,1.0,0.1	0,0,1.0,0.1	0.,0.,1.,.15	NU

Table 16. Annual precipitation, NDVI in non-forested areas, and herbaceous biomass predicted from the biomass model equations using elevation.

Elevation m	Precipitation cmyr⁻¹	NDVI	Biomass Model g m⁻²
<1700 (1600)	317	0.168	52
1700-2000	428	0.337	93
2000-2200	543	0.432	102
2200-2400	701	0.448	127
2400-2600	805	0.290	94
2600-2800	924	0.208	65
>2800	1076	0.200	40

Table 17. Observed and predicted herbaceous aboveground biomass in August, and cumulative annual aboveground net primary production (ANPP) through October for major non-forest types, pre- and post 1988 fires. Standard deviation indicates spatial rather than temporal variance. See Appendix 2 for habitat codes. Observed data values are derived from the synthesis of data in Table 3. UG-ungrazed, G-grazed.

Habitat	Location	km ²	Habitat	Observed Biomass g m ⁻²		Predicted Biomass g m ⁻²		Predicted ANPP g m ⁻²	
				Mean	Range	1969-1981	1982-2001	1969-1981	1982-2001
Dry Grasslands, Sagebrush Grasslands	Lower Northern Winter Range	123	tf,tfg	47 (UG) 47 (G)	41-53 (UG) 41-52 (G)	49±10	46±10	58±13	57±13
	Upper Northern Winter Range	60	tf,fa	66 (UG) 76 (G)	41-92 (UG) 57-138 (G)	77±6	76±14	102±12	102±18
	Hayden Valley	1	tf	87 (UG) 72 (G)	83-91 (UG) 68-75 (G)	90	80	116	102
	Firehole/ Madison/ West	28	tf,fa	76 (UG) 26 (G)	70-71 (UG) 24-28 (G)	72±16	71±14	88±23	87±22
Moist Grasslands, Sagebrush Grasslands	Upper Northern Winter Range	47	fng, tfg	97 (UG) 102 (G)	75-130 (UG) 47-165 (G)	105±7	95±6	132±6	123±6
	Hayden Valley	65	tfg,kf, fds	123 (UG) 96 (G)	98-165 (UG) 63-136 (G)	113±29	112±29	149±39	153±41
	Pelican Valley	18	kf	-	-	107±3	96±2	172±11	165±7
Tufted Hairgrass Meadows	Upper Northern Winter Range	9	dw	144 (UG) -	144 (UG) -	138±17	127±20	198±8	198±17
	Hayden Valley	2	dw	194 (UG) 159 (G)	183-208 (UG) 150-170 (G)	132±1	109±1	206±11	187±5
	Firehole/ Madison/ West	13	dw	142 (UG) 79 (G)	125-176 (UG) 38-92 (G)	126±11	114±10	164±27	156±22
Sedge Meadows, Sedge/Willow, Riparian	Upper Northern Winter Range	7	ww	331 (UG) 218 (G)	218-564 (UG) 115-564 (G)	344±101	328±100	535±171	527±173
	Hayden Valley	9	ww	279 (UG) 230 (G)	236-354 (UG) 191-287 (G)	204±105	208±103	308±172	312±172
	Firehole/ Madison/ West	22	ww	-	-	202±92	210±94	269±142	309±161

Table 17. Continued

Habitat	Location	km ²	Habitat	Observed Biomass g m ⁻²		Predicted Biomass g m ⁻²		Predicted ANPP g m ⁻²	
				Mean	Range	1969-1981	1982-2001	1969-1981	1982-2001
Hot Springs Vegetation	Firehole/Madison/West	47	hs	120 (UG) 26 (G)	72-188 (UG) 18-43 (G)	117±12	112±12	139±15	148±25
	Hayden Valley	1	hs	-	-	112±8	107±3	152±13	153±9
	Pelican Valley	2	hs	-	-	100±1	93±3	151±3	143±1
High Meadows	Mirror Plateau	26	fa, fn, fng	-	-	84±24	76±22	106±29	97±29
Alpine Tundra	East	16	at	-	-	34±39	54±46	58±66	85±72

Table 18. Simulated herbaceous biomass and aboveground net primary production (ANPP) for two periods in the predominant non-forested habitat types, and the herbaceous biomass estimated from the data model.

Habitat	Habitat Code	Area km ²	Simulated Biomass g m ⁻²		Simulated ANPP g m ⁻²		Data Model Biomass g m ⁻²
			1969-1988	1989-2001	1969-1988	1989-2001	
Idaho Fescue/Hairgrass	fds	35	54 ₊₁₉	53 ₊₁₈	67 ₊₃₀	72 ₊₂₈	71 ₊₂₅
Idaho Fescue/Bluebunch Wheatgrass	fa	17	62 ₊₂₄	57 ₊₂₂	80 ₊₃₁	74 ₊₂₉	72 ₊₁₄
Idaho Fescue/Bluebunch Wheatgrass	fas	21	72 ₊₁₄	69 ₊₁₄	89 ₊₁₉	88 ₊₁₉	73 ₊₁₂
Bluebunch Wheatgrass/ Sandberg's Bluegrass	aom	9	52 ₊₂₃	31 ₊₂₂	42 ₊₃₀	43 ₊₃₁	50 ₊₆
Idaho Fescue/ Bearded Wheatgrass	fn	46	83 ₊₂₅	75 ₊₉₉	111 ₊₃₅	100 ₊₃₁	84 ₊₅₈
Tufted Hairgrass	dw	50	95 ₊₄₀	87 ₊₃₇	138 ₊₆₂	129 ₊₅₈	105 ₊₆₄
Alpine Tundra	at	110	44 ₊₄₇	65 ₊₄₈	71 ₊₇₂	98 ₊₇₂	54 ₊₂₈
Idaho Fescue/Wheatgrass/Sticky Geranium	fng	343	62 ₊₃₀	57 ₊₂₇	82 ₊₄₁	76 ₊₃₈	62 ₊₅₂
Hot Springs Vegetation	hs	28	108 ₊₂₀	102 ₊₂₁	138 ₊₂₉	140 ₊₃₅	-
Silver Sage/Idaho Fescue	kf	58	98 ₊₂₈	89 ₊₂₆	154 ₊₄₉	143 ₊₄₅	99 ₊₃₃
Big Sagebrush/ Bluebunch Wheatgrass	ta	6	37 ₊₂₉	34 ₊₂₆	51 ₊₃₈	50 ₊₃₇	57 ₊₈
Big Sagebrush/Idaho Fescue	tf	226	67 ₊₁₉	64 ₊₁₈	85 ₊₂₆	83 ₊₂₅	63 ₊₁₂
Big Sagebrush/Idaho Fescue/Sticky Geranium	tfg	315	85 ₊₂₉	81 ₊₂₈	115 ₊₄₃	109 ₊₄₁	86 ₊₃₀
Sedge Meadows, Riparian, Willow	ww,iw, rip	181	231 ₊₁₁₄	226 ₊₁₁₅	340 ₊₁₈₆	350 ₊₁₉₂	295 ₊₁₈

Table 19. Simulated percent of herbaceous aboveground biomass that is forbs.
See Appendix 2 for habitat codes.

Habitat	Area	Predominant Habitat Types	Forb %
Dry Grasslands, Sagebrush Grasslands	Lower Northern Winter Range	tf,tfg	38
	Upper Northern Winter Range	tf,fa	39
	Hayden Valley	tf	34
	West Side	tf,fa	37
Moist Sagebrush Grasslands	Upper Northern Winter Range	fng	36
	Hayden Valley	tfg,kf	39
	Pelican Valley	kf	38
Tufted Hairgrass Meadows	Upper Northern Winter Range	dw	34
	Hayden Valley	dw	28
	Firehole	dw	29
Sedge Meadows	Upper Northern Winter Range	ww	6
	Hayden Valley	ww	6
	Firehole	ww	5
Hot Springs Vegetation	Firehole	hs	40
	Hayden Valley	hs	32
	Pelican Valley	hs	39
High Meadows	Mirror Plateau	fa,fn,fng	33
Alpine Tundra	East	at	50

Table 20. Simulated herbaceous biomass of dry, moist, and wet habitats at different elevations, and on different soil substrates.

Elevation m	Dry			Moist			Wet		
	All	Rhyo- lite	Ande- site	All	Rhyo- lite	Ande- site	All	Rhyo- lite	Ande-site
<1700	52 ₊₁₆	-	-	69 ₊₁₄	-	-	97 ₊₇₈	-	-
1700- 2000	73 ₊₂₃	84 ₊₇₆	88 ₊₁₆	80 ₊₃₃	-	97 ₊₆₀	97 ₊₁₃₀	-	240 ₊₁₃₂
2000- 2200	85 ₊₂₁	70 ₊₂₆	91 ₊₂₀	75 ₊₃₉	66 _{+ 26}	95 ₊₁₃	110 ₊₁₀₃	142 ₊₈₇	220 ₊₁₀₄
2200- 2400	91 ₊₃₁	71 ₊₃₉	93 ₊₂₇	93 ₊₃₄	91 ₊₃₀	98 ₊₂₃	125 ₊₁₂₂	153 ₊₁₁₀	190 ₊₁₃
2400- 2600	78 ₊₄₁	64 ₊₅₁	76 ₊₃₁	82 ₊₃₇	80 ₊₃₄	84 ₊₂₀	103 ₊₁₂₄	116 ₊₇₄	208 ₊₁₂₇
2600- 2800	52 ₊₅₀	37 ₊₂₅	49 ₊₃₀	42 ₊₃₃	46 ₊₂₀	65 ₊₁₂	23 ₊₃₉	22 ₊₃₇	99 ₊₆
>2800	35 ₊₅₁	16 ₊₂₂	10 ₊₁₉	26 ₊₂₆	-	29 ₊₂₁	5 ₊₇	22 ₊₄	-
Mean		57	68		71	86		108	179

Table 21. Predicted herbaceous aboveground biomass in August and cumulative annual aboveground net primary production (ANPP) through October for major forest types, pre- and post 1988 fires. Averages over all grid-cells of that type. Standard deviation indicates spatial rather than temporal variance. LP-lodgepole pine, DF-Douglas Fir. See Appendix 2 for habitat codes.

Cover/Understory	Habitat Type	Predicted Biomass g m ⁻²		Predicted ANPP g m ⁻² yr ⁻¹	
		1969-1988	1989-2001	1969-1988	1989-2001
LP/Elk Sedge	2ho	38±14	39±14	46±18	47±17
LP,DF/Pinegrass, Forb	2go	38±22	47±27	50±33	63±38
DF/Deciduous Shrub, Coarse Grass (northern range)	5no	54±31	59±32	72±43	80±45
LP/Bitterbrush	4po	26±15	28±15	32±18	34±18
LP/Vaccinium	2ll	24±12	23±12	30±14	28±13
LP/Vaccinium, Forb	2cl	21±10	20±10	34±21	28±14
LP/Meadowrue, Coarse Grasses	2fo	78±26	81±26	102±37	108±37
WB/Vaccinium	3lo	13±8	12±9	15±9	14±10
Wet Forests/Coarse Grasses	2d0	70±28	77±30	92±39	102±43
LP/Globe Huckleberry	2ee	30±14	31±17	39±18	40±23

Table 22. Simulated herbaceous biomass in compared to mean values in all grid-cells of each habitat type in the data model biomass map. LP-lodgepole pine, DF -Douglas fir, SF-spruce/fir, WB-whitebark pine, 2II-subalpine fir, 2d0-wet forest. Numbers refer to successional stage where 0 is the post-fire regeneration stage.

Cover Type	Elevation m	Area km2 pre 1988	Area km2 post 1988	Data Model Biomass 1989-2001 g m ⁻²	Data Model Biomass 1989-2001 g m ⁻²	Simulated Biomass 1969-1988 g m ⁻²	Simulated Biomass 1989-2001 g m ⁻²
Douglas Fir							
DF	1700-2000	80	64	63+3	63+3	45+15	46+11
DF	2000-2200	219	151	54+ 5	53+4	55+23	57+18
DF	2200-2400	190	152	44+ 4	42+6	54+21	62+19
Lodgepole Pine							
LP	2000-2200	286	102	31+ 2	32+2	33+14	40+15
LP	2200-2400	1059	568	26+ 8	26+8	36+19	41+20
LP	2400-2600	1805	1201	21+9	20+8	32+18	35+17
LP	2600-2800	429	270	14+4	13+37	29+18	20+25
Whitebark Pine							
WB	2600-2800	503	337	12+ 5	12+5	28+14	30+13
Wet Forest							
LP2-2II/2do, 2II/2do	2200-2400	68	68	94+ 5	95+5	73+22	81+24
LP2-2II/2do, 2II/2do	2400-2600	221	221	89+11	90+11	67+27	70+29

Table 23. For forests that burned in 1988, simulated herbaceous biomass in compared to mean values in all grid-cells of each habitat type in the data model biomass map. LP-lodgepole pine, DF -Douglas fir, WB-whitebark pine, 2II-subalpine fir, 2d0-wet forest. 0 is the post-fire regeneration stage.

Cover Type	Elevation m	Area km2	Data Model Biomass 1969-1988 g m ⁻²	Data Model Biomass 1989-2001 g m ⁻²	Simulated Biomass 1969-1988 g m ⁻²	Simulated Biomass 1989-2001 g m ⁻²
Douglas Fir						
DF-DF0	1700-2000	9	63+3	64+3	65+9	62+25
DF-DF0	2000-2200	28	54+3	51+9	55+20	52+32
DF-DF0	2200-2400	22	43+3	40+9	49+18	49+30
Lodgepole Pine31 13						
LP-LP0	2000-2200	171	31+ 2	32+5	31+13	30+38
LP-LP0	2200-2400	466	26+8	27+9	37+17	29+25
LP-LP0	2400-2600	560	23+10	23+10	33+15	24+24
LP-LP0	2600-2800	191	14+ 5	14+7	28+16	21+25
Whitebark Pine						
WB-WB0	2600-2800	124	12+5	12+6	12+20	12+19
Wet Forest						
LP2-2II/2do, 2II/2do	2200-2400	32	93+6	96+6	69+24	77+ 27
LP2-2II/2do, 2II/2do	2400-2600	79	83+13	85+14	56+27	69+30

Table 24. Simulated shrub cover (percent) in non-forested habitats in different areas. Habitat codes in Appendix 2.

Habitat	Area	Predominant Habitat Types	Shrub Cover 1969-1988	Shrub Cover 1989-2001
Dry Grasslands, Sagebrush Grasslands	Lower Northern Winter Range	tf,tfg	5.6 \pm 2.0	6.8 \pm 2.5
	Upper Northern Winter Range	tf,fa	7.9 \pm 5.0	8.0 \pm 6.6
	Firehole/West Side	tf,fa	6.8 \pm 2.7	7.3 \pm 1.8
Moist Sagebrush Grasslands	Upper Northern Winter Range	fng	14.4 \pm 3.0	13.5 \pm 4.9
	Hayden Valley Big Sage	tfg	5.6 \pm 1.0	7.2 \pm 1.3
	Hayden Valley Silver Sage	kf	10.2 \pm 2.5	9.9 \pm 3.1
	Pelican Valley	kf	10.3 \pm 2.5	9.9 \pm 3.0
High Meadows	Mirror Plateau	fa,fn,fng	14.3 \pm 13.3	13.9 \pm 1.5
Alpine Tundra	East	at	8.4 \pm 4.9	11.5 \pm 5.9
Willow/Sedge, Riparian	Upper Northern Winter Range	iw,rip	31.6 \pm 17.7	33.3 \pm 18.0
	Entire Area	iw, rip	32.8 \pm 22.0	35.3 \pm 23.3

Table 25. Simulated total shrub aboveground primary production (ANPP) and overstory shrub canopy cover in important habitat types.

Habitat Type		Total ANPP g m ⁻² yr ⁻¹		Overstory Cover %	
		1969-1988	1989-2001	1969-1988	1989-2001
Forested					
Douglas Fir/Spirea	5jj	207 <u>±</u> 54	215 <u>±</u> 57	31 <u>±</u> 7	31 <u>±</u> 7
Douglas Fir/Ninebark	5mo	152 <u>±</u> 45	128 <u>±</u> 59	19 <u>±</u> 6	16 <u>±</u> 7
Douglas Fir/SnoWBerry	5no	96 <u>±</u> 31	79 <u>±</u> 33	10 <u>±</u> 4	8 <u>±</u> 4
Subalpine Fir/Grouse Whortleberry/ Whitebark Pine	2l3	237 <u>±</u> 77	258 <u>±</u> 80	36 <u>±</u> 11	42 <u>±</u> 15
Subalpine Fir/Grouse Whortleberry	2ll	166 <u>±</u> 81	182 <u>±</u> 92	21 <u>±</u> 10	34 <u>±</u> 15
Subalpine Fir/Globe Huckleberry	2ee	190 <u>±</u> 75	226 <u>±</u> 86	28 <u>±</u> 8	19 <u>±</u> 8
Wet Forests	2do	14 <u>±</u> 6	77 <u>±</u> 47	1 <u>±</u> 1	1 <u>±</u> 1
Non-forested					
Big Sagebrush/ Idaho Fescue	tf	28 <u>±</u> 9	33 <u>±</u> 16	5 <u>±</u> 2	6 <u>±</u> 3
Big Sagebrush/ Idaho Fescue/Sticky Geranium	tfg	21 <u>±</u> 10	21 <u>±</u> 15	4 <u>±</u> 2	4 <u>±</u> 3
Silver Sage/Idaho Fescue	kf	41 <u>±</u> 12	41 <u>±</u> 14	10 <u>±</u> 3	9 <u>±</u> 3
Willow	iw	232 <u>±</u> 93	244 <u>±</u> 9	48 <u>±</u> 19	51 <u>±</u> 19
Riparian	rip	142 <u>±</u> 102	143 <u>±</u> 10	30 <u>±</u> 21	32 <u>±</u> 23

Table 26. Simulated tree aboveground net primary production($\text{g m}^{-2} \text{yr}^{-1}$) and canopy cover for primary tree cover types, pre and post 1988 fires. LP-lodgepole pine, DF -Douglas fir, SF-spruce/fir, WB-whitebark pine, NF-non-forested. Numbers refer to successional stage where 0 is new stands post-fire. The areal extent of the cover type is also shown.

Cover Type	Area km ²		Tree ANPP $\text{g m}^{-2}\text{yr}^{-1}$		Canopy Cover	
	1969-1988	1989-2001	1969-1988	1989-2001	1969-1988	1989-2001
LP0	195	1608	518+131	131+ 56	63+14	18+17
LP1	420	265	429+92	381+95	73+14	72+12
LP2	1510	975	202+38	188+43	52+7	51+5
LP3	946	439	180+44	172+59	45+6	46+8
DF/NF	183	137	137+37	127+37	31+10	35+7
DF0	17	102	517+112	172+239	74+ 15	19+17
DF1	8	1	383+29	483	43+24	72
DF2	38	38	256+68	236+10	71+1	67+1
DF3	54	52	255+73	236+9	54+10	66+1
WB0	44	247	201+94	85+98	28+10	14+13
WB1	64	49	420+146	370+130	63+19	67+
WB2	20	20	202+9	189+13	55+1	51+1
WB3	118	118	161+5	149+95	31+8	33+7
SF0	2	81	448+6	72+58	54+10	9+8
SF1	7	7	473+28	436+27	81+3	80+4
SF3	397	244	165+31	151+36	42+7	41+5

Table 27. Overstory shrub and tree cover and total shrub and tree aboveground net primary production (ANPP) by elevation zone. These are values for grid-cells classified as forested.

Elevation m	Overstory Shrub Cover in Forested Grid Cells %		Tree Cover %		Overstory and Understory Shrub ANPP g m ⁻² yr ⁻¹		Tree ANPP g m ⁻² yr ⁻¹	
	1969-1988	1988- 2001	1969- 1988	1988- 2001	1969- 1988	1988- 2001	1969- 1988	1988-2001
<1700 (1600)	37	44	24	23	200	245	93	85
1700- 2000	11	11	46	40	80	74	198	174
2000- 2200	11	11	52	33	92	88	236	165
2200- 2400	13	15	54	36	106	117	238	171
2400- 2600	16	19	53	40	126	134	226	175
2600- 2800	25	29	42	31	171	184	179	125
>2800 (2900)	26	30	28	23	169	181	115	91

Table 28. Aboveground net primary production ($\text{kg ha}^{-1} \text{ yr}^{-1}$) by ASPECT class, on slopes >10 degrees, forested plus non-forested, all elevations.

ASPECT	Grass	Forb	Herb- aceous	Shrub	Tree	Total	Tree Cover %	Shrub Cover %
North	427	106	533	1455	1222	3211	28	21
East	436	128	564	1272	1138	2975	26	19
South	414	166	581	1178	1006	2766	23	18
West	389	140	529	1402	1106	3038	25	21

Table 29. Aboveground net primary production ($\text{kg ha}^{-1} \text{ yr}^{-1}$) by ASPECT class, on slopes >10 degrees, non-forested, all elevations.

ASPECT	Grass	Forb	Herb- aceous	Shrub	Total	Shrub Cover %
North	353	239	593	541	1134	9
East	450	267	718	425	1143	7
South	450	287	737	479	1216	8
West	410	280	691	635	1326	10

Table 30. Aboveground net primary production ($\text{kg ha}^{-1} \text{ yr}^{-1}$) by ASPECT class, on slopes >10 degrees, non-forested, elevations less than 2000 m only.

ASPECT	Grass	Forb	Herb- aceous	Shrub	Total	Shrub Cover %
North	546	304	852	582	1434	9
East	527	294	823	320	1143	5
South	445	256	702	363	1065	6
West	428	273	702	364	1066	6