APPENDIX E

BIRD POPULATION RESPONSES TO PROJECTED EFFECTS OF CLIMATE CHANGE IN NEVADA: ANALYSIS FOR REVISION OF THE NEVADA WILDLIFE ACTION PLAN

(GREAT BASIN BIRD OBSERVATORY, 2011)

Methods

Bird Data

For modeling landbird population change, we used data from the first ten years of the Nevada Bird Count (NBC) and from recent landbird inventory projects in Nevada that used the same point-count design as NBC for assessing bird populations. Our analyses in this report are restricted to those priority species of the Wildlife Action Plan that are diurnal landbirds with relatively small breeding territories, because point count surveys are designed to estimate densities for these species. Species with large home ranges, waterbirds, shorebirds, and secretive marshbirds are not included in our analyses, nor are landbird species that are so rare in Nevada that reasonable density estimates cannot be derived for their primary breeding habitats.

Nevada Bird Count

The Nevada Bird Count was conceptually developed by the Great Basin Bird Observatory (GBBO) in 2001-2002 and began to be implemented statewide in May 2002. It targets all landbirds of Nevada in a multi-species, habitat-stratified sampling design using primarily the point count method. Long-term trend monitoring was one objective of the program. A shorter-term objective was to generate habitat models for conservation priority species specifically to assist resource management agencies in their goal to manage habitats for bird conservation. This report is one such effort. Large-scale monitoring programs such as the Nevada Bird Count provide a wealth of information that can often be used for purposes not originally anticipated at the start of the program.

The original habitat stratification for the program used landcover types from the original GAP project (1990s), combined into 13 broad "habitat types" dominated by vegetation that correspond roughly with the Biophysical Settings used in the TNC climate change model (TNC 2011), including aspen (*Populus tremuloides*), montane riparian, lowland riparian, coniferous forest, pinyon-juniper (*Pinus* and *Juniperus* spp.), Mountain Mahogany (*Cercocarpus ledifolius*), sagebrush (*Artemisia* spp.), salt desert, Mojave scrub (including *Larrea tridentate* and *Ambrosia dumosa*), agricultural, and wetland. Random selection of NBC monitoring sites entailed a random point scatter generated for each habitat type using GIS, which served as a starting point of a 10-point survey transect. Minor adjustments were made to accommodate accessibility, and all 259 transects were surveyed at least once, and a subset multiple times, resulting in 5178 point surveys available for our analyses after 320 transects from other projects were added (see below).

Other Projects

The Great Basin Bird Observatory has conducted several projects around Nevada that provide additional point count data, doubling the sample size that was used in this report. Most of these involve random selection of transects within the region or habitat type being targeted. The sample of riparian surveys is especially enhanced by this. While these points were randomly selected within a project area, they do not, for the most part, represent point in the original statewide random point scatter, but they were included here, as they represent high-priority landscapes or habitat types around Nevada that would otherwise not have been captured in our models.

The special project sites included regions that have already been identified as important for bird monitoring, either because they support critical populations of birds, for example under Audubon's Important Bird Areas (IBA) program, or because they are undergoing changes in land management or habitat restoration affecting birds. Also, some habitat types are very restricted in Nevada or fall primarily on private lands, for example lowland riparian areas, which makes a GIS approach to random site selection difficult. In these cases, access was obtained first and random placement of the survey transect was done in the field within the boundaries of the accessible area.

Field Methods

Point count surveys are NBC's primary approach to data collection for breeding landbirds (after Ralph et al. 1993), and the same protocol was used for all other data used in this report. Survey routes consisted of habitat-based, mostly off-road walking transects of 10 survey points (300 m apart in open, expansive habitats; 250 m apart in forested, restricted habitats). During a count, all birds detected by visual or auditory cues were recorded. Each point count survey lasted 10 minutes. Most transects were visited once annually during the peak breeding season of most Nevada landbirds, from April 25 through June 30 (Mojave region) and May 25 – July 10 (Great Basin region), between dawn and 10:00 a.m. in fair weather conditions (no strong winds or heavy precipitation). Fly-over sightings and birds at distance greater than 100 m were not included in the analyses for this report. Further details about the survey protocol and sample data sheets can be obtained from the GBBO website (http://www.gbbo.org).

Current Map

We used two separate products provided by The Nature Conservancy (TNC 2011):

1) Statewide maps (GIS raster coverage) of potential vegetation types (Biophysical Settings, or BPS) and current vegetation classes within them (SCLASS), created from interpreted satellite or low-flying aircraft imagery.

2) Non-spatial forecast of the anticipated future condition (in 50 years) of ecological systems with climate change effects (and assumptions of minimal management), using refined computerized predictive state-and-transition ecological models.

The foundation of the mapping component was stratification of the landscape into BPSs, which represent potential vegetation types. More specifically, the BPS is the type of dominant vegetation that is expected in the physical environment under natural ecological conditions and disturbance regimes. These types were based on LANDFIRE, Southwestern Regional Gap Analysis Program, and other map sources (for more details, see TNC 2011). Within each BPS, there are several classes of current vegetation condition (SCLASS). These classes include typical successional stages of the "characteristic" natural vegetation, as well as several "uncharacteristic" classes. Uncharacteristic classes are outside of reference condition classes and are caused by anthropogenic disturbances (e.g., non-native annual grass invasion).

The raster of current conditions covers the entire state of Nevada, but only 13 of the 14 phytogeographic regions were included in the TNC modeling effort. The very small Sierra Nevada region, limited to the Carson Range under this mapping effort, was not explicitly modeled because it is small and contains many residential developments, and because TNC completed a separate assessment for the Northern Sierra Nevada reported elsewhere (Low et al. 2011).

The complex state-and-transition models included changes in disturbance regimes as well as simple effects of changes in temperature and precipitation. The following are components of the models that are likely to be particularly important to birds (from TNC 2011):

1) Increased dispersal of non-native species (annual grasses, forbs, and trees) caused by CO_2 fertilization of plant growth during wetter than average years

2) Higher tree mortality during longer growing season droughts

3) Longer period of low flows caused by earlier snowmelt

4) Greater flood variability due to greater frequency of rain-on-snow events, which may favor cottonwood and willow recruitment on currently regulated rivers and creeks

5) More frequent, larger fires in forested systems

6) Longer fire return intervals in shrubland systems due to increased drought frequency preventing fine fuel build up

7) Increased dispersal of pinyon and juniper into shrublands caused by CO_2 fertilization during wetter than average years

8) Greater conifer and deciduous tree species recruitment and growth in wetlands/riparian due to drought and CO_2 fertilization

9) Impaired recruitment of willow and cottonwood due to descending peak flows occurring one month earlier, and limited ability of these species to flower one month earlier in cold drainages

Some of these climate change hypotheses carry contradictory predictions, e.g., increased recruitment of trees vs. more frequent forest fires, which we assume that the overall climate model takes into account. For this report, we used the (unedited) model output from TNC (2011) to predict bird population change based only on habitat shifts and changes in habitat condition predicted by the TNC model.

Bird-Habitat Models

For modeling current bird habitat use, we used the raster map of current vegetation conditions from TNC (2011). The landbird data from the NBC and similar projects in Nevada were limited to a 100 m radius distance from each survey point, because detectability of most landbirds decreases rapidly beyond this distance. We then created a 100 m spatial buffer around each point, and calculated the percentages of each current vegetation cover type within that circle (3.14 ha).

Ideally, we would want to derive bird density estimates from points that are 100% covered by one BPS or SCLASS to make the purest estimate for each vegetation class. However, the majority of Nevada landscapes vary enough to make this impossible, particularly with our randomly selected transect locations. We therefore chose the lower threshold for the minimum area covered by one BPS or SCLASS of 25% (or 50% in more common and widespread vegetation classes). Some survey points were covered by multiple habitat types that met this minimum criterion, in which case they were used to represent each of these habitat types in our predictions.

We also largely eliminated survey points for upland vegetation classes that had riparian cover in the circle, except when the riparian habitat type was the one of interest in the analysis. In some habitat types, such as salt desert or sagebrush, areas near riparian or wetlands show differences in bird use than areas remote from mesic habitats (GBBO 2010). Therefore, if sample size was adequate for those upland habitat types we discarded the points with riparian cover within 100 m in order to get a more typical bird density estimation for the targeted habitat. For riparian habitat covers themselves, we used the 25% cover minimum for inclusion.

Inevitably, samples sizes varied among habitat types because of varying amounts of cover types in the landscape. Some rare cover types lacked survey points, and others had too few for analyses. These were either merged in with a similar type (see below) or discarded, if they were too different from other habitat types. Merging of BSPs and SCLASSes resulted in habitats (or habitat types, as they will be called hereafter) and was done using the following rules:

1) Cluster analyses on the point count data were used to combine the BSPs and SCLASSes that were similar from a bird community perspective.

2) Cover types were further merged based on similarity in vegetation structure and composition variables that are considered important to birds (based on WAP Team 2005, GBBO 2010).

3) Condition classes within a single BPS were merged more commonly than condition classes among BPSs, unless the different BPSs were closely related (e.g. different sagebrush types); in a few cases, a very rare BPS was combined with the most similar one that was more common.

4) We tried to get at least 50 survey points in each merged vegetation class, although lower sample sizes were accepted if a cover type was of high interest for climate change planning.

After merging vegetation classes, we recalculated the percent cover of each habitat type in the 100-m-radius buffers and gained some additional sampling points which now met the 25% minimum criterion. Finally, we estimated bird density for each priority landbird species in each habitat type. For this, we calculated the average number of individuals (excluding fly-over observations) detected within 10 minutes and 100 m by taking the mean of multiple visits to each point. These numbers were then averaged over all points assigned to a particular habitat type, and extrapolated to the average detectable density in 40 ha.

Because the main goal was to get the best density estimate for each habitat type (rather than to compare them), we used different minimum cover thresholds for habitat types depending on available sample sizes. We used points with at least 50% of the cover type and no riparian covers for the few cases where this still gave us over 50 survey points. If this sample size was not met, we used the 25% threshold with no riparian, and if the sample size was still low, then we used the 25% threshold with riparian habitat nearby.

A working estimate of statewide population size can then be estimated by multiplying the densities by the number of hectares currently in each habitat type, and summing over all habitat types in each of the 13 regions from the climate model, which can then be summed for the state. These population estimates were only generated for the purpose of estimating effect size of climate change and should thus not be used for other purposes, such as absolute population size estimation for the state. From these population estimates, we deleted estimates obtained for habitat types where a species cannot occur based on its known natural history, as we assume that detections at such survey points were due to the presence of preferred habitats. For some statewide habitat types, data for the Mojave region (which for the purpose of this report, included the Clover-Delamar region identified in TNC 2011) were separated from data for the Great Basin region, but most habitat types were largely restricted to one or the other. Species density estimates only included the regions in which the species is known to nest (Floyd et al. 2007).

Predictions of Climate Change Effects

We used current acreages and model projections for future acreages after 50 years of climate change for each condition class within biophysical settings (TNC 2011) to project expected changes in landbird populations. These predictions carry the same limitations and assumptions as do the predictions for vegetation change, and also assume that habitat change will dictate most changes in bird populations (but see above for cautionary comments).

Projections for bird population change were calculated separately for the 13 regions in Nevada used in this analysis (for details on these regions, see TNC 2011). For birds with statewide breeding distributions, we summed habitat acreages across regions for one statewide total. Southern Nevada species were analyzed using only those appropriate regions (usually Mojave and Clover-Delamar). Some condition classes were projected to change greatly due to climate change, but some of these changes were not available in the current map, either because these classes are currently rare or because the available GIS layers cannot delineate them. In these cases, we made qualitative judgments about expected effects on the birds that occupy the changing habitats that were not mapped.

Results

The distribution of bird-survey transects across the 13 phytogeographic regions of TNC (2011) generally reflect the relative sizes of the regions (Table 1). Exceptions included the Tonopah region due to inaccessible Department of Defense lands, and the Mojave region which was more thoroughly covered than other regions due to strong partner support in Clark County.

Table 1. Existing bird point-count transect coverage of 13 phtogeographic regions identified in TNC (2011).

Phytogeographic Region	NBC Transects
Black Rock Plateau	59
Mojave	136
Calcareous Ranges	125
Clover-Delamar	6
Elko	88
Eastern Sierra Nevada Ranges	40
Eureka	30
Humboldt Ranges	9
Lahontan Basin	20
Owyhee Desert	3

Sierra Nevada	16
Toiyabe	38
Tonopah	5
Walker Corridor	10

The following table lists the Biophysical Settings and Condition Classes for which we have at least some bird data, and the number of survey points with at least 25% of the 100-m-radius circle in that type. The last two columns then show the merged categories and the resulting sample sizes that then meet the 25% minimum criteria.

Table 2. Merged cover types and their new habitat-type names used in this report for habitat modeling. Listed are Biophysical Settings (BPS) and Condition Classes (SCLASS) numbers and names from TNC (2011), the number of bird survey points available for each cover type (cover types with no bird data are not included), the habitat types resulting from merging cover types, and the final number of bird survey points in the merged cover types that met the 25% minimum cover threshold. Sample sizes in habitat types may be higher than the sum of sample sizes in the original cover types, because in some cases, the merging resulted in additional survey points meeting the minimum cover threshold.

BPS	BPS Name	SCLASS	SCLASS Name	# Points	Habitat Type Name	# Points
1087	Creosotebush	1	A:early	137	Creosote, Early	137
1087	Creosotebush	2	B:late-closed	188	Creosote, Late	188
10821	Blackbrush mesic	1	A:early	28	Blackbrush, Early	146
10820	Blackbrush thermic	1	A:early	100		
10820	Blackbrush thermic	2	B:late-closed	363	Blackbrush-thermic, Late	363
10821	Blackbrush mesic	2	B:mid-closed	72	Blackbrush-mesic, Late	133
10821	Blackbrush mesic	3	C:late-closed	42		
10821	Blackbrush mesic	14	shrub-annual-per	7	Blackbrush, shrub/annual	9
10820	Blackbrush thermic	14	shrub-annual-per	1		
1081	Mixed Salt Desert	1	A:early	9	Salt Desert, Early	9
1081	Mixed Salt Desert	2	B:late-open	231	Salt Desert, Mid/Late	231
1081	Mixed Salt Desert	3	C:late-open	22	SD-Greasewood, Late	119
1153	Greasewood	2	B:late-closed	100		
1081	Mixed Salt Desert	10	annual grassland	14	Salt Desert, shrub/annual	86
1081	Mixed Salt Desert	14	shrub-annual-per	68		
1153	Greasewood	10	annual grassland	2	Greasewood, shrub/annual	92
1153	Greasewood	14	shrub-annual-per	89		
1125	Big SAGE Steppe	1	A:early	2	Sagebrush, Early	26
10801	Big SAGE upland	1	A:early	4		
1126	Montane SAGE Steppe	1	A:early	4		
10800	Wyoming Big SAGE	1	A:early	6		
1124	Low SAGE Steppe	1	A:early	0		
1079	Low-Black SAGE	1	A:early	6		
1079	Low-Black SAGE	2	B:mid-open	82	Low/Black Sage, Mid/Late	112

BPS	BPS Name	SCLASS	SCLASS Name	# Points	Habitat Type Name	# Points
1079	Low-Black SAGE	3	C:late-open	26		
1124	Low SAGE Steppe	3	C:late-closed	124	Low Sage, Mid/Late	173
1124	Low SAGE Steppe	2	B:mid-open	50		
10800	Wyoming Big SAGE	3	C:late-closed	130	WY Big Sage, Late	129
10801	Big SAGE upland	2	B:mid-open	15	Big Sage upland, Mid/Late	70
10801	Big SAGE upland	3	C:mid-closed	25		
10801	Big SAGE upland	4	D:late-open	22		
10800	Wyoming Big SAGE	2	B:mid-open	120	Big Sage, Mid-open	136
1125	Big SAGE Steppe	2	B:mid-open	14		
1125	Big SAGE Steppe	3	C:mid-closed	78	Big Sage, Mid-closed	78
1126	Montane SAGE Steppe	2	B:mid-open	62	Mtn Sage, Mid-open	62
1126	Montane SAGE Steppe	3	C:mid-closed	320	Mtn Sage, Mid-closed	318
1126	Montane SAGE Steppe	4	D:late-open	27	Mtn Sage, Late-open	27
1126	Montane SAGE Steppe	5	E:late-closed	82	Mtn Sage, Late-closed	82
1079	Low-Black SAGE	4	D:late-closed	47	Low/Big Sage, Late-closed	70
10801	Big SAGE upland	5	E:late-closed	22		
10800	Wyoming Big SAGE	14	shrub-annual-per	273	Big Sage, shrub/annual	360
10801	Big SAGE upland	14	shrub-annual-per	25		
10800	Wyoming Big SAGE	10	annual grassland	4	Sage, annual grass	9
1125	Big SAGE Steppe	10	annual grassland	0		
10801	Big SAGE upland	10	annual grassland	2		
1079	Low-Black SAGE	10	annual grassland	0		
10801	Big SAGE upland	8	depleted	35	Big Sage, depleted	35
1124	Low SAGE Steppe	8	depleted	4	Low Sage, depleted	105
1079	Low-Black SAGE	8	depleted	99		
1125	Big SAGE Steppe	14	shrub-annual-per	6	Sage, shrub/annual	52
1079	Low-Black SAGE	14	shrub-annual-per	45		
1126	Montane SAGE Steppe	14	shrub-annual-per	137	Mtn Sage, shrub/annual	137
1126	Montane SAGE Steppe	8	depleted	156	Mtn Sage, depleted	156
1126	Montane SAGE Steppe	10	annual grassland	46	Mtn Sage, annual grass	46
10800	Wyoming Big SAGE	9	tree-annual-grass	265	Big Sage, tree-encroach	272
10801	Big SAGE upland	13	tree-encroached	2		
10801	Big SAGE upland	9	tree-annual-grass	0	Mixed-Sage, tree-encroach	3
1126	Montane SAGE Steppe	13	tree-encroached	1		
1079	Low-Black SAGE	9	tree-annual-grass	3		
1124	Low SAGE Steppe	13	tree-encroached	2	Low Sage, tree-encroach	41
1079	Low-Black SAGE	13	tree-encroached	38		
1086	Mountain Shrub	1	A:early	1	Mountain Shrub/Chapparal	45
1086	Mountain Shrub	2	B:mid-open	0		
1086	Mountain Shrub	3	C:mid-closed	4		

BPS	BPS Name	SCLASS	SCLASS Name	# Points	Habitat Type Name	# Points
1086	Mountain Shrub	8	depleted	0		
1086	Mountain Shrub	13	tree-encroached	18		
1086	Mountain Shrub	14	shrub-annual-per	4		
1103	Chaparral	1	A:early	0		
1103	Chaparral	2	B:late-closed	8		
1103	Chaparral	14	shrub-annual-per	0		
1062	Mountain Mahogany	1	A:early	29	Mountain Mahogany	110
1062	Mountain Mahogany	2	B:mid-closed	10		
1062	Mountain Mahogany	3	C:mid-open	2		
1062	Mountain Mahogany	4	D:late-open	10		
1062	Mountain Mahogany	5	E:late-closed	20		
1062	Mountain Mahogany	9	tree-annual-grass	0		
1062	Mountain Mahogany	10	annual grassland	0		
1019	Pinyon-Juniper	1	A:early	12	Pinyon/Juniper, Early	83
1019	Pinyon-Juniper	2	B:mid-open	6		
1019	Pinyon-Juniper	3	C:mid-open	51		
1019	Pinyon-Juniper	4	D:late-open	166	Pinyon/Juniper, Late	200
1052	Mixed Conifer	1	A:early	0	Mixed Conifer/ Dry Pine	146
1052	Mixed Conifer	2	B:mid-closed	16		
1052	Mixed Conifer	3	C:mid-open	4		
1052	Mixed Conifer	4	D:late-open	0		
1052	Mixed Conifer	5	E:late-closed	20		
1054	Ponderosa Pine	1	A:early	0		
1054	Ponderosa Pine	2	B:mid-closed	1		
1054	Ponderosa Pine	3	C:mid-open	1		
1054	Ponderosa Pine	4	D:late-open	0		
1054	Ponderosa Pine	5	E:late-closed	28		
1031	Jeffery Pine	1	A:early	3		
1031	Jeffery Pine	2	B:mid-closed	60		
1031	Jeffery Pine	3	C:mid-open	19		
1031	Jeffery Pine	4	D:late-open	0		
1031	Jeffery Pine	5	E:late-closed	0		
1031	Jeffery Pine	10	annual grassland	0		
1032	Red Fir	1	A	7	Red Fir	57
1032	Red Fir	2	B	54		
1032	Red Fir	3	C	1		
1032	Red Fir	4	D	0		
1032	Red Fir	5	E	2		
1055	Spruce Fir	1	A:early	1	Spruce/ Fir	53
1055	Spruce Fir	2	B:mid-closed	9		

BPS	BPS Name	SCLASS	SCLASS Name	# Points	Habitat Type Name	# Points
1055	Spruce Fir	3	C:mid-open	12		
1055	Spruce Fir	4	D:late-closed	29		
1033	Subalpine Woodland	3	C	0		
1033	Subalpine Woodland	4	D	1		
1050	Lodgepole Pine	4	D	1		
1050	Lodgepole Pine	5	E	1		
1020	Limber-Bristlecone	1	A:early	4	Subalpine Pine	52
1020	Limber-Bristlecone	2	B:mid-open	14		
1020	Limber-Bristlecone	3	C:late-open	26		
11551	Washes	1	A:early	28	Washes	84
11551	Washes	2	B:mid-closed	28		
11551	Washes	3	C:late-closed	33	Washes, Late	33
11551	Washes	16	exotic forb	12		
11550	Warm Desert Riparian	1	A:early	32	Warm Desert Ripar, CHAR	76
11550	Warm Desert Riparian	2	B:mid-closed	7		
11550	Warm Desert Riparian	3	C:mid-open	16		
11550	Warm Desert Riparian	4	D:late-closed	3		
11550	Warm Desert Riparian	5	E:late-closed	0		
11550	Warm Desert Riparian	16	exotic forb	93	Warm Desert Ripar, exotic	93
1154	Montane Riparian	1	A:early	113	Montane Riparian, Early	112
1154	Montane Riparian	2	B:mid-open	70	Montane Riparian, Late	223
1154	Montane Riparian	3	C:late-closed	87		
1154	Montane Riparian	16	exotic forb	136	Montane Riparian, Exotic	136
1154	Montane Riparian	18	desertified	138	Montane Riparian,	136
1160	Subalpine Riparian	1	A:early	0	Subalpine Riparian	31
1160	Subalpine Riparian	2	B:mid-open	18		
1160	Subalpine Riparian	3	C:late-closed	1		
1160	Subalpine Riparian	16	exotic forb	1		
1011	Aspen Woodland	1	A:early	36	Aspen Woodland	151
1011	Aspen Woodland	2	B:mid-closed	23		
1011	Aspen Woodland	3	C:late-closed	6		
1011	Aspen Woodland	8	depleted	34		
1011	Aspen Woodland	4	D:late-open	42	Aspen Wood, Late	42
1061	Aspen-Mixed Conifer	1	A:early	1	Aspen Mixed-Conifer	20
1061	Aspen-Mixed Conifer	2	B:mid-closed	0		
1061	Aspen-Mixed Conifer	3	C:mid-closed	10		
1061	Aspen-Mixed Conifer	4	D:late-open	0		
1061	Aspen-Mixed Conifer	5	E:late-closed	67	Aspen Mixed-Con, Late	67

The current and future projected area coverage (in hectares) of each of the resulting 55 habitat types are listed in Table 3, calculated from the model of TNC (2011). with the initial and projected hectares (statewide), and the proportional change over the 50 year timeframe. The final three columns are the number of bird surveys points in each, according to the three filter options explored. The option in bold is the one selected for final analyses.

Table 3. **Merged vegetation categories used in this report** (from Table 2), with the total hectares under current conditions (statewide), and the projected number of hectares remaining after 50 years with a model including climate change and minimum management (average, reported to us by TNC). The proportion remaining after 50 years is calculated directly from the previous two columns (projected/initial). The final three columns are the number of bird surveys points with at least 25% of the 100-m buffer in that category (column 1), with at least 25% and no riparian in the other 75% (column 2), and with at least 50% and no riparian. The option in **bold** is the one selected for final analyses.

NAME	INITIAL HECTARES	PROJECTED 50 YR CC HECTARES	PROPORTION REMAINING 50 YR	POINTS 25%	POINTS 25% NO RIP	POINTS 50% NO RIP
Creosote, Early	310,088	52,677	0.17	137	121	**74**
Creosote, Late	592,274	699,389	1.18	188	165	**85**
Blackbrush, Early	753,132	618,218	0.82	146	138	**54**
Blackbrush-thermic, Late	99,566	128,585	1.29	363	337	**180**
Blackbrush-mesic, Late	975,869	804,681	0.82	133	**96**	31
Blackbrush, shrub/annual	61,612	280,329	4.55	9	**8**	3
Salt Desert, Early	152,214	478,492	3.14	9	8	**8**
Salt Desert, Mid/Late	2,555,571	1,690,351	0.66	231	126	**75**
SD-Greasewd, Late	1,763,477	1,730,951	0.98	119	**82**	47
Salt Desert, shrub/annual	1,358,474	1,758,856	1.29	86	**66**	31
Greasewood, shrub/annual	228,856	399,088	1.74	92	**79**	38
Sagebrush, Early	385,198	936,273	2.43	**26**	16	0
Low/Black Sage, Mid/Late	982,465	786,973	0.80	112	**86**	23
Low Sage, Mid/Late	527,249	438,122	0.83	173	99	**64**
WY Big Sage, Late	397,562	523,017	1.32	129	**65**	31
Big Sage upland, Mid/Late	776,199	660,058	0.85	70	**55**	11
Big Sage, Mid-open	851,357	457,022	0.54	136	**48**	26
Big Sage, Mid-closed	235,536	174,208	0.74	78	**51**	24
Mtn Sage, Mid-open	693,382	690,185	1.00	62	**52**	16
Mtn Sage, Mid-closed	2,093,449	1,106,313	0.53	318	289	**178**
Mtn Sage, Late-open	216,566	303,032	1.40	**27**	16	3
Mtn Sage, Late-closed	350,873	279,411	0.80	82	**51**	16
Low/Big Sage, Late-closed	276,391	286,545	1.04	70	**52**	12
Big Sage, shrub/annual	857,049	453,712	0.53	360	230	**101**
Sage, annual grass	330,785	1,071,553	3.24	**9**	7	1
Big Sage, depleted	154,232	148,548	0.96	**35**	18	5
Low Sage, depleted	679,390	595,727	0.88	105	**84**	38
Sage, shrub/annual	212,868	374,491	1.76	**52**	39	15
Mtn Sage, depleted	680,489	493,324	0.72	156	**96**	33
Mtn Sage, shrub/annual	597,771	484,980	0.81	137	84	**53**
Mtn Sage, annual grass	245,797	391,558	1.59	**46**	31	6

NAME	INITIAL HECTARES	PROJECTED 50 YR CC HECTARES	PROPORTION REMAINING 50 YR	POINTS 25%	POINTS 25% NO RIP	POINTS 50% NO RIP
Big Sage, tree-encroach	1,968,035	1,788,612	0.91	272	166	**58**
Mixed-Sage, tree-encroach			8.62	3	2	0
Low Sage, tree-encroach	387,293	354,119	0.91	**41**	35	13
Mountain Shrub/Chapparal	112,698	98,563	0.87	**45**	24	12
Mountain Mahogony	248,170	239,471	0.96	**110**	26	14
Pinyon/Juniper, Early	741,774	556,470	0.75	83	**57**	16
Pinyon/Juniper, Late	1,180,690	1,294,859	1.10	200	108	**67**
Mixed Conifer/ Dry Pine	76,482	80,036	1.05	146	**53**	43
Red Fir				**57**	35	34
Spruce/ Fir	27,024	28,956	1.07	**53**	32	16
Subalpine Pine	53,902	55,814	1.04	**52**	31	21
Washes	122,763	20,609	0.17	**84**	83	13
Washes, Late	16,226	137,753	8.49	**33**	33	3
Warm Desert Ripar, CHAR	66,215	370	0.01	**76**	76	37
Warm Desert Ripar, exotic	286	3,202	11.19	**93**	93	56
Montane Riparian, Early	72,173	22,679	0.31	**112**	112	44
Montane Riparian, Late	129,886	107,614	0.83	**223**	223	31
Montane Riparian, Exotic	115,384	152,829	1.32	**136**	136	57
Montane Riparian, Desertif	110,638	112,875	1.02	**136**	136	19
Subalpine Riparian	31,963	28,346	0.89	**31**	31	2
Aspen Woodland	96,138	142,896	1.49	**151**	151	47
Aspen Wood, Late	121,537	63,659	0.52	**42**	42	16
Aspen Mixed-Conifer	8,924	24,509	2.75	**20**	20	4
Aspen Mixed-Con, Late	64,317	40,615	0.63	**67**	67	25