LANDSCAPE ECOLOGY STARS REPORT
CHAPTER 13C

Broadscale vegetation patterns within the Interior Columbia River Basin and adjacent areas.

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INTRODUCTION

The abundance and spatial arrangement of habitats or vegetation communities has ecological implications at many scales. Change analyses of broadscale landscape patterns provides insight of the ecological effects of those changes on landscape processes, as well as estimates of suitability for relevant biota. Landscapes are spatially and temporally dynamic, but changes are often more noticeable at some scales than others. For example, coarse patterns may not change substantially, whereas finer-grained patterns have changed significantly. Landscape connectivity, and conversely its fragmentation, directly influences disturbance processes (e.g., insects, pathogens, and fire), which in turn influences vegetation patterns. In addition, the areal extent and patch size of any particular habitat directly affects colonization by individuals (including exotic species), persistence of individuals, persistence of populations, and the number of species within a landscape (Morrison and others 1992).

The conservation of biota at the landscape scale requires an understanding of population dynamics and some notion of how populations may respond to environmental conditions at the landscape scale. Unfortunately, at best, scientists and managers currently have only vague understandings of how populations may respond to varying landscape patterns within the Interior Columbia River Basin (ICRB). In lieu of such information, we offer a working hypothesis that the endemic biota of the ICRB will have the fewest risks to population persistence if landscape patterns approximate those in which the biota have adapted during an ecological time frame (i.e., not evolutionary time frame). Thus, we present a comparison of coarse vegetation patterns that likely existed historically to those that currently occur across the landscape of the ICRB.

A classification scheme utilizing coarse patterns of physiognomic types and structural stages (hereafter physiognomic groups) is useful for understanding disturbance processes and for describing temporal changes of vegetation within a subwatershed. Physiognomic/structural patterns are likely correlated with various successional processes and disturbance regimes (e.g., wildfire, prescribed fire, timber harvest, grazing, insect/pathogen, exotic plant invasion, roading, and urban development).

METHODS

Vegetation Classification and Mapping

Broadscale vegetation was mapped at 1-km^2 resolution to describe current and historical conditions. Menakis and others (1996) described the derivation of the historical and current broadscale vegetation within the ICRB.

Physiognomic Group Patterns

Physiognomic groups were derived from an aggregation of 41 cover types and 25 structural stages having similar gross compositional and structural characteristics (Table 1). Physiognomic group patterns were in turn created by classifying subwatersheds (sixth Field Hydrologic Unit Codes; Figure 1) according to their pattern and composition of dominant physiognomic groups. In the coarsest sense, patterns were simplified as to being uniform, mosaic, or mixed (Table 2). We also developed a more descriptive pattern classification which utilized a hierarchy of pattern and dominant/codominant physiognomic groups (Table 2). We summarized changes of physiognomic group patterns by Ecological Reporting Units (ERUs) within the Interior Columbia River Basin (ICRB; Figure 2; see Jensen and others (1996) for a description of Ecological Reporting Units).

Transition matrices were prepared for each ERU to summarize the changes of physiognomic group patterns between the historical and current periods. Changes were quantified in relation to the physiognomic group (i.e., class change, or proportional change) and in relation to the ERU (i.e., the proportional change of an ERU due to a change of a particular physiognomic group). The most dominant transitions within an ERU were evaluated to develop an understanding of the major pattern changes which had occurred between historical and current periods. In general, to be considered major, fluxes had to occur across a minimum of one percent of an ERU's area.

We conducted a very coarse assessment of fragmentation trends by analyzing the net change in areal extent of ERUs which had fluxed between more uniform and more fragmented landscapes (i.e., uniform to mosaic or mixed, and mosaic to mixed). We used the percentage of the ERU which remained in the same pattern class between historical and current periods to estimate a stability index. Conversely, we calculated a departure index for ERUs to quantify the magnitude of change between historical and current broadscale physiognomic group patterns. The departure index was based on the percentage distance and calculated by:

$$PD = 100 - \left[\frac{200 \sum_k \text{minimum } (h_k, c_k)}{\sum h_k + \sum c_k} \right]$$

where PD = departure index;

k = number of classes;

h_k = the historical value for class k; and

c_k = the current value for class k

ERU departure indices were relativized and classified as low, moderate, and high for relative values less than 32.67, 32.68 to 66.33, and exceeding 66.33, respectively.

Terrestrial Community Group Patterns

Historical and current patterns of broadscale terrestrial community groups were assessed for the Interior Columbia River Basin Landscape Characterization Area (LCA), an area which extended slightly beyond the boundaries of the ICRB (Figure 3). The historical and current vegetation maps were derived using different methodologies and resolutions (Menakis and others 1996). Consequently, any comparisons of landscape patterns between historical and current periods would be problematic. To ameliorate the problems associated with resolution, we resampled the 1-km^2 current and historical vegetation layers to a 4-km^2 resolution. In addition, we derived 24 broadscale terrestrial community types by aggregating the 41 cover types and 25 structural stages used to classify the historical and current vegetation (Appendix Q). Cover types and structural stages were grouped according to similar moisture, temperature, and elevational gradients, similar structures, and similar use by vertebrate species. We further aggregated the 24 terrestrial community types into 12 terrestrial community groups (Table 3). As Jones and Hann (1996) discussed, we could not accurately assess changes of riparian vegetation types between historical and current periods. Consequently, we did not try to assess pattern changes of any riparian community groups in this paper. Nevertheless, we believed that using a coarser 4-km2 resolution and a coarser classification of vegetation types would improve the comparability of historical and current vegetation patterns.

We used FRAGSTATS (McGarigal and Marks 1993) to estimate class (i.e., terrestrial community groups) and landscape metrics to assess pattern changes of the LCA as a whole, as well as pattern changes of each of the 12 community groups occurring within the LCA (Table 4). Multiple metrics (i.e., areal extent, largest patch index, patch number, and mean patch size) were evaluated to assess fragmentation. Indicators of an increase in fragmentation included a decline of areal extent, largest patch index, and mean patch size, whereas the number of patches would generally be expected to increase. Conversely, indicators of a landscape trending towards uniformity include increasing areal extents, largest patch, and mean patch size indices, whereas the number of patches commonly declines. Because of the coarse resolution of this analysis, and the potential for erroneously concluding differences due to the different mapping methods involved, we assumed ecologically significant changes occurred when current metrics deviated by 20 percent or more from historical metrics.

RESULTS

Physiognomic Group Patterns

Broadscale physiognomic group patterns changed across the majority (62 percent) of the ICRB between historical and current periods. Relative landscape pattern departure indices for eight of 13 ERUs were classified as high (Table 5, Figure 4). Landscape patterns within the Northern Great Basin and Owyhee Plateau ERUs changed the least among the ERUs.

We observed a net gain in more uniform landscapes across nearly four percent of the ICRB. However, this trend varied among physiognomic groups; the forest/woodland physiognomic groups became more uniform, whereas the shrubland and herbland groups became more fragmented. The net gain of more uniform landscapes was largely a result of an increase in the mid-seral forest/woodland physiognomic group across 12 percent of the ICRB. We observed a net loss of 66 percent and 42 percent of the uniform herb and the uniform lowshrub landscapes, respectively. These landscapes were fragmented by agricultural development.

Fragmentation trends were not consistent throughout the ICRB. Fragmentation of landscape patterns of subwatersheds within six ERUs (Blue Mountains, Columbia Plateau, Northern Great Basin, Owyhee Uplands, Southern Cascades, and Upper Snake) increased between historical and current periods (Table 5).

Conversely, landscapes became more homogeneous within seven ERUs (Central Idaho Mountains, Lower Clark Fork, Northern Cascades, Northern Glaciated Mountains, Snake Headwaters, Upper Clark Fork, and Upper Klamath)

Blue Mountains ERU--Landscape patterns changed across 89 percent of the Blue Mountains ERU between historical and current periods (Table 5). We detected a net increase of fragmented landscapes within the ERU during this period, which seemed to have been a result of transitions within the forest/woodland physiognomic group. Shrubland physiognomic groups changed the least. The dominant transition that occurred within the Blue Mountains ERU was the reduction of mixed mid-seral_late-seral single-layered forest/woodland landscapes, which changed mostly into landscapes which had either a more uniform pattern and/or which had lost their late-seral single-layered forest/woodland component. The next most dominant transitions occurred in non-forested habitats where the uniform herbaceous landscapes were converted into mixed herb_agriculture landscapes (i.e., herbaceous landscapes were fragmented by agricultural types).

Central Idaho Mountains ERU--Landscape patterns of physiognomic groups changed throughout most (82 percent) of the Central Idaho Mountains ERU between historical and current periods (Table 5). We detected a marginal net increase (6 percent) of uniform landscapes throughout the ERU. A single transition dominated this ERU's landscapes - a decrease in areal extent of mixed mid-seral_early seral landscapes. The transitions within this group suggested that it became more uniform and older.

Columbia Plateau ERU--Landscape patterns changed throughout 87 percent of the Columbia Plateau ERU (Table 5). The ERU appears to have been substantially fragmented - a trend of more fragmented patterns occurred across 47 percent of the ERU. The ERU was dominated by areal declines of the uniform herb and uniform lowshrub landscapes which were extensively converted to the agricultural physiognomic group across nearly 94 and 68 percent of their areas, respectively. Conversely, the extent of mixed herb_agriculture landscapes measurably increased between historical and current periods.

Lower Clark Fork ERU--Landscape patterns across virtually the entire Lower Clark Fork ERU changed between historical and current periods (Table 5). Nearly 85 percent of the ERU has been transformed into more uniform pattern classes. In fact, the uniform pattern class did not occur historically, yet comprised nearly 54% of the ERU in the current period. Transitions were dominated by changes of two patterns. The most dominant change detected was the decrease in the areal extent of mixed mid-seral_early-seral forest/woodland landscapes, and the subsequent increase in the uniform mid-seral forest/woodland landscapes.

Northern Cascades ERU--Landscape patterns throughout nearly the entire Northern Cascades ERU have changed between historical and current periods (Table 5). The major trend in pattern has been toward more homogeneous landscapes, which increased across 27 percent of the ERU. The increased uniformity was mostly attributable to a reduction of mixed mid-seral_late-seral forest/woodland landscapes, and subsequent increase of uniform mid-seral forest/woodland landscapes.

Northern Glaciated Mountains ERU--We detected changes of landscape patterns throughout nearly all of the Northern Glaciated Mountains ERU (Table 5). Landscapes across 59 percent of the ERU became more homogeneous between historical and current periods. The most dominant transitions that occurred involved an increase in uniform mid-seral forest/woodland landscapes at the expense of both early- and late-seral forest/woodland physiognomic groups.

Northern Great Basin ERU--Landscape patterns have remained relatively stable throughout most (69 percent) of the Northern Great Basin ERU, although we detected a marginal net increase (2 percent) of more fragmented subwatersheds (Table 5). Most of the fragmentation was attributable to a reduction of mosaic lowshrub_midshrub landscapes, and subsequent increase in areal extent of mosaic lowshrub_herb and mixed lowshrub_herb landscapes.

Owyhee Uplands ERU--Although we detected a net increase (25 percent) in the proportion of more fragmented landscapes in the Owyhee Uplands, the landscape patterns of most (58 percent) subwatersheds within the ERU did not change between historical and current periods (Table 5). Most of the fragmentation occurred in uniform lowshrub landscapes, which decreased by approximately 37 percent (the dominant transition within the ERU). The majority of this decrease was accounted for by increases in mosaic lowshrub_herb, mixed lowshrub_herb, and mixed herb_agriculture landscapes.

Snake Headwaters ERU--We detected changes of landscape patterns across 92 percent of the Snake Headwaters ERU (Table 5). A substantial (46 percent) trend towards more uniform patterns was evident across nearly 23 percent of the ERU. The increase in uniformity seemed to be attributable to an increase in area of the mid-seral forest/woodland physiognomic group, and subsequent declines of the late-seral forest/woodland and early-seral forest/woodland group. The dominant transitions that occurred within the Snake Headwaters ERU was an increase in uniform mid-seral forest/woodland landscapes at the expense of the mixed mid-seral_late-seral multi-layered, and mosaic mid-seral_late-seral multi-layered landscapes. Other less dominant changes included a decline of mixed midshrub_mid-seral forest/woodland landscapes which changed mostly to mixed midshrub_early-seral forest/woodland landscapes.

Southern Cascades ERU--We detected broadscale pattern changes across 84 percent of the Southern Cascades ERU (Table 5). Fragmented patterns increased across approximately six percent of the ERU. The dominant transitions involved a decrease in mixed mid-seral_late-seral single-layered forest/woodland landscapes which were replaced by mixed late-seral single-layer_late-seral multi-layered forest/woodland landscapes. The increase of fragmented landscapes occurred primarily in the forest/woodland physiognomic groups. Fragmentation also increased in non-forest physiognomic groups due to agricultural development.

Upper Clark Fork ERU--Landscape patterns varied between historical and current periods on approximately 85 percent of the Upper Clark Fork ERU (Table 5). We detected a substantial increase of more uniform landscapes across 44 percent of the ERU. The dominant transitions that occurred were a result of the development of early-seral forest/woodland physiognomic groups, and to a lesser degree, the areal decline of late-seral forest/woodland groups. For example, uniform mid-seral forest/woodland landscapes increased at the expense of the mosaic mid-seral_early-seral and mixed mid-seral_late-seral multi-layered forest/woodland landscapes.

Upper Klamath ERU--We detected a change of landscape patterns across nearly all (96 percent) of the Upper Klamath ERU (Table 5). Landscape patterns became more uniform across 22 percent of the area. The most dominant transitions suggested that landscapes comprised by the forest/woodland physiognomic groups became older and more homogeneous. For example, the mixed mid-seral_late-seral forest/woodland landscapes transformed into mosaic or uniform late-seral forest/woodland landscapes. These types of transitions occurred across 34 percent of the ERU.

Upper Snake ERU--Most (78 percent) of the landscape patterns of subwatersheds within the Upper Snake ERU changed between historic and current periods (Table 5). A net increase of more fragmented landscapes occurred throughout 16 percent of the ERU. The transition matrices indicated that the increase of fragmented patterns occurred primarily within uniform lowshrub landscapes which were converted to mixed and mosaic patterns that included the herbland physiognomic group. In addition, we also detected an increase in the uniform herb class, nearly all of which originated from the uniform lowshrub class.

Terrestrial Community Group Patterns

Not surprisingly, three anthropogenic terrestrial community groups (i.e., agriculture, urban, and exotics) did not occur historically (Table 3).

Although the agriculture community group comprised approximately 14 percent of the LCA, the exotics and urban community groups did not comprise substantial proportions of the area. The barren, alpine, and water community groups did not vary substantially between historical and current periods.

The most substantial changes in areal extent of a community group across the LCA were the increase of the agriculture group, and subsequent decrease of herbland and shrubland community groups (Table 3). In forested settings, an increasing fragmentation trend was observed between the historical and current periods for the lower montane and, to a lesser extent, subalpine forest community groups. However, the pattern indices of the montane forest community group indicated a trend towards increasing uniformity during this time interval. The lower montane forest community group exhibited significant declines of areal extent and mean patch size, while the number of patches increased. Although the areal extent of the subalpine forest community group did not decline substantially, the mean patch size index decreased significantly, while the patch number index increased significantly.

In non-forest settings the shrubland and herbland community groups became much more fragmented while the upland woodland group had a trend of increasing uniformity. We observed significant declines of areal extent, largest patch, and mean patch size indices for both upland shrubland and upland herbland groups. Conversely, the number of patches of both groups increased significantly between historical and current periods. On the other hand, the upland woodland community group had ecologically significant increasing trends for areal extent, largest patch, and mean patch size indices.

As a whole, the LCA currently appeared to be substantially more fragmented than the historical landscape (Table 6). The largest patch and mean patch size indices decreased significantly, while the patch number index increased. As expected, patch richness increased due to the addition of three anthropogenic community groups (urban, agriculture, and exotic) in the current landscape. Although both diversity and evenness indices increased, and the contagion index decreased, the changes were not ecologically significant.

DISCUSSION

Our comparison of historical and current landscape patterns had inherent problems as a consequence of differing methodologies and resolutions used in developing each broadscale vegetation layer. We tried to lessen the inherent problems by resampling at a much broader resolution (i.e., 4-km^2), by comparing relatively coarse vegetation types (i.e., terrestrial community groups), and by only considering relatively large magnitudes of change (i.e., $\geq$ 20 percent) as being ecologically significant. However, at best, our conclusions resulting from the comparison of values derived from different methods (let alone different time periods) should be regarded as working hypotheses. In addition, many, if not most, changes of landscape patterns occur at a much finer scale than we used in our analysis. Consequently, our study likely overlooked all of the more subtle changes that have occurred, and only captured those changes of the broadest context.

Taken in its entirety, the landscape of the Interior Columbia River Basin and adjacent areas has become substantially more fragmented between historical and current periods. However, the coarse-grained fragmentation that occurred within the area as a whole, was not consistently apparent among the broadscale vegetation types (i.e., broadscale terrestrial community groups or physiognomic groups) that we assessed, or among ERUs. For example, landscape patterns throughout roughly one-half of the ERUs were became more fragmented, while patterns became more homogenous throughout other ERUs. In addition, we detected increasing fragmentation trends within four terrestrial community groups (lower montane forest, subalpine forest, upland herblands, and upland shrubland), but a trend of increasing homogeneity within two community groups (montane forest and upland woodland). The two opposing trends are not at all independent. The montane forest community group seems to have expanded throughout the LCA, at the expense of the lower montane forest, and to a lesser extent, the subalpine forest community. Similarly, in the non-forest settings, the upland woodland community group has expanded into the upland shrubland, and to a lesser extent, the upland herbland community. However, the substantial fragmentation of the upland herbland and upland shrubland community groups was predominantly a consequence of the agricultural conversion of 14 percent of the LCA.

Four primary agents of change were largely responsible for the coarse landscape pattern changes we detected. In forested environments, the primary agents of change included successional processes, fire suppression, and timber harvest activities. As a consequence, a large proportion of the lower montane forest community group has converted to the montane forest community group. On the one hand, fire suppression and successional processes have permitted many of the shade-tolerant and fire-intolerant species (e.g. Douglas-fir

(*Pseudotsuga menziesii*) and grand-fir (*Abies grandis*)), more commonly associated with the montane forest community, to invade and prosper on sites that would have been expected to support the lower montane forest community which is dominated by ponderosa pine (*Pinus ponderosa*). Timber extraction activities have commonly exacerbated this situation by targeting the removal of ponderosa pine and promoting stand development of Douglas-fir and grand fir. Fire suppression, in non-forest environments, has also contributed to the expansion of the upland woodland community into the upland shrubland community group. However, as stated above, agricultural development within the upland herbland and upland shrubland community groups has been the dominant agent of change within non-forest environments.

Our analysis would suggest that a species whose fitness is positively correlated to an increasing area of, and larger and likely more contiguous patches of the agriculture, exotics, montane forest, and upland woodland community groups would probably have a higher probability of long-term persistence today, than they had historically. On the other hand, those species whose fitness is negatively correlated to the extensive fragmentation of the lower montane forest, upland herbland, and upland shrubland community groups are likely most at risk.

SUMMARY

Broadscale vegetation patterns within the Interior Columbia River basin and adjacent areas have changed significantly between historical and current periods. Significant changes were detected for the landscape as a whole, as well as within the lower montane forest, montane forest, subalpine forest, upland herbland, upland shrubland, and upland woodland community groups. The landscape as a whole, and the subalpine forest, lower montane forest, upland herbland, and upland shrubland community groups have been extensively fragmented. However, a trend of increasing homogeneity was detected within the montane forest and upland woodland community groups. The factors primarily responsible for the observed changes in broadscale vegetation patterns between historical and current periods include successional processes, fire suppression, timber management activities, and agricultural development.

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Figure Captions:

Figure 1--Subwatersheds of the Interior Columbia Basin.

Figure 2--Ecological Reporting Units (ERUs) of the Interior Columbia Basin.

Figure 3--Landscape Characterization Area for the Interior Columbia Basin.

Figure 4--Broadscale Vegetation Pattern Departure Index by ERU.

Table Captions:

Table 1--Coarse landscape patterns of physiognomic[1] groups within subwatersheds of the Interior Columbia River Basin.

Table 2--Physiognomic groups used to assess coarse landscape patterns of subwatersheds within the Interior Columbia River Basin.

Table 3--Broadscale class metrics for the Interior Columbia River Basin landscape characterization area.

Table 4--Landscape metrics used to assess broadscale vegetation patterns.

Table 5--Summary of broadscale physiognomic group pattern changes within Ecological Reporting Units of the Interior Columbia River Basin.

Table 6--Historical and current landscape metrics for the Columbia River Basin Landscape Characterization Area.

Figures 1, 2, 3, and 4 are not available

Table 2--Coarse landscape patterns of physiognomic[1] groups within subwatersheds of the Interior Columbia River Basin.

Pattern	Description	Example
Uniform	The dominant physiognomic group comprises a minimum of 80% of the subwatershed.	Uniform_*dominant physiognomic group*; e.g., Uniform_FRWDSTLM.
Mosaic	The dominant physiognomic group comprises 60-80% of the subwatershed.	Mosaic_*dominant physiognomic group*_ *codominant physiognomic group*; e.g., Mosaic_FRWDSTLM_FRWDSTLS.
Mixed	The dominant physiognomic group comprises less than 60% of the subwatershed.	Mixed_*physiognomic group1*_ *physiognomic group2*; Mixed patterns are named by the two most dominant physiognomic groups, but order is not indicative of dominance. e.g., Mixed_SHBSTLOW_SHBSTMID.

[1]See Table 1 for description of physiognomic groups.

Table 1--Physiognomic groups used to assess coarse landscape patterns of subwatersheds within the Interior Columbia River Basin.

Physiognomic Group Code	Physiognomic Group Description
AGRICUST	Agricultural types including irrigated and nonirrigated cropland, hayland, and seeded pasture.
FRWDSTES	Forest/woodland early-seral structures. Includes stand initiation, and early-seral herb and shrub stages of forest and woodlands.
FRWDSTLM	Forest/woodland late-seral multi-layered.
FRWDSTLS	Forest/woodland late-seral single-layered.
FRWDSTMS	Forest/woodland mid-seral structures including stem exclusion open and closed, understory reinitiation, and young multi-storied stands.
HERBLDST	Herbland structures including both native and exotic grasses and forbs, and sedge dominated open and closed stands.
ROCKST	Rock and barren structures.
SHBSTLOW	Low shrub structures including open and closed shrub stands less than 0.76 m in height.
SHBSTMID	Mid shrub structures including open and closed shrub stands 0.76 - 2.0 m in height.
SHBSTTAL	Tall shrub structures including both open and closed shrubs exceeding 2.0 m in height.
URBANST	Urban and industrial areas.
WATERST	Water

Table 3--Broadscale class metrics for the Interior Columbia River Basin landscape characterization area.

Terrestrial Community Group	Period / Change	Class Metric[1]				
		%LAND	LPI	NP	MPS	ED
Agriculture	Historical	0.0	0.0	0.0	0.0	0.0
	Current	14.4	6.50	15495	7637	0.77
	%Change[2]	N.A.[3]	N.A.	N.A.	N.A.	N.A.
Alpine	Historical	0.5	0.09	208	1790	0.05
	Current	0.5	0.09	208	1788	0.05
	%Change	0.0	0.00	0.00	-0.1	0.00
Barren/rock	Historical	0.3	0.04	136	1612	0.03
	Current	0.3	0.04	136	1612	0.03
	%Change	0.0	0.00	0.00	0.00	0.00
Exotics	Historical	0.0	0.00	0.00	0.00	0.00
	Current	1.4	0.06	870	1323	0.18
	%Change	N.A.	N.A.	N.A.	N.A.	N.A.
Lower Montane Forest	Historical	12.3	1.87	1029	9790	0.65
	Current	9.6	2.08	1865	4231	0.76
	%Change	-21.7	11.2	81.2	-56.8	16.9
Montane Forest	Historical	23.1	10.32	1488	12741	1.29
	Current	27.4	10.59	1419	15829	1.38
	%Change	18.5	2.6	-4.6	24.2	7.0
Subalpine Forest	Historical	5.9	0.7	792	6133	0.45
	Current	5.8	0.59	1294	3684	0.54
	%Change	-1.9	-15.7	63.4	-39.9	20.0
Upland Shrubland	Historical	38.0	29.85	827	37706	0.56
	Current	28.8	24.03	1141	20755	0.68
	%Change	-24.1	-19.5	38.0	-45.0	21.4
Upland Herbland	Historical	15.0	6.24	1215	10129	0.65
	Current	5.6	0.49	2005	2292	0.56
	%Change	-62.6	-92.1	65.0	-77.4	-13.8
Upland Woodland	Historical	2.2	0.29	1320	1364	0.27
	Current	2.6	0.53	1113	1939	0.27
	%Change	20.1	82.8	-15.7	42.2	0.00
Urban	Historical	0.0	0.0	0.0	0.0	0.0
	Current	0.1	0.02	128	881	0.02
	%Change	N.A.	N.A.	N.A.	N.A.	N.A.
Water	Historical	0.9	0.07	370	2018	0.08
	Current	0.9	0.07	370	2014	0.08
	%Change	0.0	0.00	0.00	-0.2	0.00

[1] See McGarigal and Marks (1993) and Table 1 for description of class metrics.
[2] %Change = Proportional change between historical and current periods
[3] N.A. = not applicable as the community group did not occur historically.

Table 4--Landscape metrics used to assess broadscale vegetation patterns.

Metric[1]	Scale[1]	Description (units)
%LAND	Class	Percent of the landscape (%)
LPI	Class/landscape	Largest Patch Index (%)
NP	Class/landscape	Number of patches (#)
MPS	Class/landscape	Mean Patch Size (ha)
ED	Class/landscape	Edge Density (m/ha)
SHDI	Landscape	Shannon's Diversity Index
SIDI	Landscape	Simpson's Diversity Index
PR	Landscape	Patch Richness (#)
SHEI	Landscape	Shannon's Evenness Index
SIEI	Landscape	Simpson's Evenness Index
CONTAG	Landscape	Contagion Index

[1]Adoped from McGarigal and Marks (1993).
[2]Scales: Class indicates that metric is calculated for individual habitat types (i.e., terrestrial community group), whereas landscape indicates that metric is calculated for the landscape as a whole, regardless of habitat type.

Table 5--Summary of broadscale physiognomic group pattern changes within Ecological Reporting Units of the Interior Columbia River Basin.

Ecological Reporting Unit	Fragmentation Trend[1]	Stability Index[2] (%)	Departure of Landscape Pattern
Blue Mountains	(++)	11	High
Central Idaho Mountains	(--)	18	Moderate
Columbia Plateau	(+++)	13	High
Lower Clark Fork	(---)	3	High
Northern Cascades	(--)	6	High
Northern Glaciated Mountains	(---)	5	High
Nothern Great Basin	(+)	69	Low
Owyhee Uplands	(++)	58	Low
Snake Headwaters	(---)	8	High
Southern Cascades	(++)	14	Moderate
Upper Clark Fork	(---)	15	High
Upper Klamath	(--)	4	High
Upper Snake	(++)	22	Moderate

[1]Fragmentation assessment of coarse (i.e., uniform, mosaic, and mixed) landscape patterns; (+) = Slightly fragmented (≤ 5% trend); (++) = Moderately fragmented (6-30% trend); (+++) = Substantially fragmented (≥31% trend); (-) = Slightly more uniform (≤ 5% trend); (--) = Moderately more uniform (6-30% trend; (---) = Substantially more uniform (≥31% trend).
[2]Stability index = proportion of landscape patterns that remained stable between historical and current periods.
[4] Landscape departure indices were relativized among ERUs. Low departures have PD <33.7; Moderate departures have PD = 32.7 to 66.3; High departures have PD >66.3. See text for derivation of PD.

Table 6--Historical and current landscape metrics for the Columbia River Basin Landscape Characterization Area.

Metric[1]	Historical	Current	% Change[2]
LPI	29.85	24.02	-19.50
NP	8222	13154	59.98
MPS	9990	6244	-37.49
ED	2.11	2.78	31.79
SHDI	1.67	1.90	13.51
SIDI	0.76	0.80	5.65
PR	11	14	27.27
SHEI	0.70	0.72	3.15
SIEI	0.84	0.87	3.46
CONTAG	48.72	44.50	-8.63

[1]See McGarigal and Marks (1993) and Table 1 for description of landscape metrics.
[2]% Change = (Current - Historical)/Historical * 100%