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Broadscale Vegetation Departures within Subbasins of the Interior Columbia River Basin

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INTRODUCTION

Currently, scientists and managers are faced with a lack of information pertaining to the broadscale habitat relationships and population responses to habitat change for most plant and animal species residing in the Interior Columbia River Basin. Estimation of broadscale habitat departures from historical ranges of conditions provides an index of broadscale vegetation changes in the context of natural systems. Grounding habitat change with the dynamics of natural systems provides a means of conducting coarse-filter inferences of risks to species persistence (Hunter 1991). A primary assumption of this coarse-filter approach to habitat assessment is that the conservation of the areal extent of a community or habitat within its historical conditions should also allow species adapted to those ranges to persist into the future. We recognize that the fitness of many, if not most, species are also strongly correlated with fine-scale habitat attributes. However, it is not computationally feasible to perform a fine-scale habitat assessment on a landscape having the extent and complexity of the Interior Columbia River Basin (ICRB).

We compared current broadscale habitat availability within a subbasin to the range of conditions expected historically. We assumed that species' persistence within a subbasin was not at risk if the current area of that species' primary habitat (as described in the Species Environmental Relationship data base, Marcot and others 1996) fell within the 75 percent mid range of the historical data. We assumed risk to persistence increased substantially when habitat availability fell below the 75 percent mid range of the historical data. Furthermore, the likelihood of extirpation within a subbasin increased when habitat availability fell below the 100 percent range of the historical data. Conversely, persistence likelihood within a subbasin increased as habitat availability exceeded the 75 percent mid range of the historical data.

The fragmentation of subbasins where a particular habitat occurs within or above its historical range may also be informative regarding: (1) the connectivity of vegetation structure and composition which more closely approximates historical conditions, and (2) the connectivity of habitats and consequently the local long-term persistence and recolonization potential of species whose fitness is highly correlated with those habitats. Therefore, we quantify several indices of fragmentation and attempt to give some qualitative assessment of fragmentation in the spatial context of subbasins in which a habitat occurs within, or above, its historical range.

METHODS

Terrestrial community type departures were developed to estimate the magnitude of broadscale habitat changes in forestland and rangeland habitats within subbasins. We used 1-km^2 resolution continuous broadscale data, summarized by subbasin to assess habitat departures of forestland and rangeland ecosystems. We aggregated 41 cover types and 21 structural stages into 24 terrestrial community types (Jones and Hann 1996; Appendix Q). We further collapsed the forest terrestrial community types having late-seral single-layered and late-seral multi-layered structures into a "late" class. We then estimated departures from historical ranges of conditions by subbasin for nine forestland terrestrial community types and three non-forest community types (Table 2). We estimated current departures for those terrestrial community types that comprised at least one percent of a subbasin's area for any output period of the historical CRBSUM model run, or for the current condition. Departure values were not determined for anthropogenic community types (e.g., cropland, exotic, urban) and those that remained relatively stable between historical and current periods (e.g., alpine, rock/barren, and water community types). Departures were also not estimated for riparian community types because historical occurrence of riparian cover types was typically underestimated, and current occurrence was typically overestimated (Jones and Hann 1996).

Terrestrial community type departures were determined by comparing the current areal extent of each type to modeled 75th and 100th percentile historical ranges of each type. Historical ranges were developed for individual subbasins using a single 400 year run of CRBSUM, and cover type and structural stage outputs for historic years 0, 50, 100, 200, 300, and 400. Initial conditions for the historical CRBSUM run and their derivations are described by Long and others (1996). The minimum and maximum values from the simulation were used to define the historical range. We then calculated the 75th percentile historical mid range by adding or subtracting 12.5 percent of the historical range to the historical minimum and historical maximum, respectively. Five departure classes were defined based on the relationship between the current area of each community type to its simulated 75th and 100th percentile historical ranges (Table 1, Figure 1).

We estimated four indices of fragmentation of those subbasins in which a community type occurred within or above its historical range: percent area (percentage of those subbasins in which a community comprises a substantial proportion); number of patches, median patch size (count of subbasins within a patch); and maximum patch size.

RESULTS

Eight of 12 terrestrial community types were dominated by subbasins that contained areas of a community type well below its historical mid range (i.e., Class 1 departures), whereas four of 12 community groups were dominated by subbasins that contained areas of a type well above its historical mid range (i.e.,Class 5 departures; Table 2). The average frequency of subbasin membership in Class 1 and Class 5 departures was 48 and 28 percent, respectively. Currently, no community type comprising a substantial component of a subbasin had more than 22 percent of those subbasins in which it occurred within its 75 percent historical mid range (i.e., Class 3 departures). The average frequency of subbasins containing communities within their 75% historical mid range was approximately 14 percent. The greatest deviation from historical ranges occurred in the early- and late-seral lower montane forests - nearly 80 percent of the subbasins contained areas of these community types at levels well below their historical ranges (i.e., Class 1 departures).

Early-seral Lower Montane Forest

The ICRB was nearly exclusively dominated by subbasins (94 percent)in which the early-seral lower montane forest occurred below its 75 percent historical mid range (Table 3, Figure 2). However, the Northern Cascades Ecological Reporting Unit (ERU) was an exception in that it was largely dominated by subbasins in which the early-seral lower montane forest community type occurred within or above its historical range. Five isolated subbasins containing this community within its 75 percent historical mid range occurred in four ERUs: Northern Cascades, Northern Glaciated Mountains, Columbia Plateau, and Central Idaho Mountains (Table 4).

Five patches of 8 subbasins in which the early-seral lower montane forest community occurred within or above its historical range existed within the ICRB (Table 5; Figure 2). Two of these patches existed as isolated individual subbasins; one each in the Blue Mountains and Central Idaho Mountains ERUs. The other five patches were clustered in the northwest corner of the assessment area; two occurred in the Northern Cascades ERU, and one on the western edge of the Northern Glaciated Mountains ERU. The largest patch (three subbasins) occurred within the Northern Cascades ERU. Consequently, any species whose fitness is closely correlated with the areal extent of the early-seral lower montane forest community are likely doing reasonable well in the northwestern portion of the assessment area relative to other areas within the ICRB.

Mid-seral Lower Montane Forest

The ICRB was dominated by subbasins (61 percent)in which the mid-seral lower montane community occurs above its 75 percent historical mid range (Table 3, Figure 3). The dominance of subbasins having Class 5 departures was nearly exclusive in Washington and Oregon with the exception of the southwest corner of the ICRB (e.g., the Upper Klamath ERU and adjacent portions of the Southern Cascade and Northern Great Basin ERUs). Similarly, subbasins having Class 5 departures also dominated large contiguous blocks in western Montana (i.e., the Upper Clark Fork ERU and several adjacent subbasins within the Lower Clark Fork and Northern Glaciated Mountains ERUs) and central Idaho (i.e., the southeastern portion of the Central Idaho Mountains ERU). However, the Upper Klamath ERU, and the Idaho and northwestern Montana portions of the Northern Glaciated Mountains and Lower Clark Fork ERUs were dominated by subbasins classified as Class 1 departures. Nine patches of 13 subbasins contained the mid-seral lower montane forest community type within its historical range (Table 4). Most of these patches were clustered in the west half of the Central Idaho Mountains ERU, and a few adjacent subbasins of the Blue Mountains and Owyhee Uplands ERUs. They contained one to three subbasins (median = 1.0 subbasins).

There were two patches of 77 subbasins (71 percent of the subbasins comprised by a substantial component of this community type) in which the mid-seral lower montane forest community occurred within or above its historical range (Table 5; Figure 3). One patch was relatively small (two subbasins) and isolated in the southern portion of the Upper Klamath ERU. The second patch was large (75 subbasins), and although it contained some gaps, it was well distributed throughout the rest of the ICRB. Consequently, those species whose fitness is closely correlated with the areal extent of the mid-seral lower montane forest community, should be doing relatively well across most of the ICRB. However, as stated above, there are areas within the assessment area where the persistence of these species may be in serious jeopardy (e.g., northern Upper Klamath, the western portion of the Northern Great Basin, much of the eastern portion of the Northern Glaciated Mountains, Lower Clark Fork, and western portion of the Central Idaho Mountains ERUs).

Late-seral Lower Montane Forest

The ICRB was dominated by subbasins (78 percent) in which the late-seral lower montane forest community type occurred well below its historical range (Table 3, Figure 4). Notable exceptions included the Upper Klamath and adjacent portions of the Southern Cascades and Northern Great Basin ERUs. The Upper Klamath ERU and two adjacent subbasins with the Northern Great Basin ERU formed a relatively large contiguous patch of subbasins that contained this community type well above its historical range. Three relatively small (patch size range = 1 to 6 subbasins, median patch size = 2 subbasins; Table 4) and isolated patches of subbasins that had this community type within their historical ranges occurred in south-central Oregon, central Idaho, and southeastern Idaho.

The persistence of those species which rely heavily upon the areal extent of the late-seral lower montane forest community is likely at risk across most of the ICRB. There were only three relatively isolated patches of 17 subbasins in which this community occurred within or above its historical range, and consequently, where these species might be doing relatively well (Table 5;

Figure 4). The largest of these patches (14 subbasins) was located within the Upper Klamath ERU, southern portions of the Southern Cascades and Columbia Plateau ERUs, and southwestern portions of the Northern Great Basin ERU. The two other patches were relatively small (one to two subbasins), and were isolated within the center of the Central Idaho Mountains ERU, and the Upper Snake and Snake Headwaters ERUs.

Early-seral Montane Forest

Although the ICRB was dominated by subbasins (51 percent) in which early-seral montane forest occurred below their 75 percent historical mid range (Table 3, Figure 5), large portions of the Northern Cascades, Southern Cascades, Blue Mountains, and Central Idaho Mountains ERUs were dominated by subbasins in which this community occurred within or above their historical range. Seventeen relatively small and isolated patches of 23 subbasins that contained this community within its historical range were distributed throughout the ICRB (Table 4; range of patch size = 1 to 5 subbasins; median patch size = 1.0 subbasin).

There were 12 patches of 69 subbasins, widely distributed throughout most of the ICRB, in which the early-seral montane forest community occurred within or above its historical range (Table 5; Figure 5). Patch size of these areas ranged from one to 34 subbasins (median = 3.5 subbasins). The largest contiguous patch spanned a large proportion of the Blue Mountains and Central Idaho Mountains ERUs. Relatively large patches (i.e., at least four contiguous subbasins) also existed within the Northern Cascades, Southern

Cascades, Northern Glaciated Mountains, Lower Clark Fork, and Snake Headwaters ERUs.

Mid-seral Montane Forest

Fifty-nine percent of the subbasins comprised by at least one percent of the mid-seral montane forest community contained that community above its 75 percent historical mid range (Table 3, Figure 6). However, large portions of the Southern Cascade, Upper Klamath, and Central Idaho Mountain ERUs were dominated by subbasins in which this community occurs below its historical mid range. Twenty-five (19 percent) subbasins were comprised by this community within its historical range and were distributed across the ICRB in 14 patches ranging in size from 1 to 7 subbasins (Table 4; median patch size = 1.0 subbasin). The largest of these patches occurred in the Columbia Plateau, Snake Headwaters, and Upper Snake ERUs.

Most (78 percent) of the subbasins that had substantial areas of the mid-seral montane forest community contained areas of that community at levels within or exceeding the historical range (Table 5; Figure 6). Six patches comprised by 103 subbasins, ranging in size from one to 95 subbasins (median = 1.5 subbasins) were well distributed throughout all but the southwest corner of the assessment area. With the exception of the Upper Klamath ERU, the largest patch occurred within portions of all ERUs. Species whose fitness is strongly correlated with the areal extent of the mid-seral montane forest community should be doing relatively well in all areas of the ICRB, except within large areas of the Southern Cascades, Upper Klamath, Northern Great Basin, and

Central Idaho Mountains ERUs.

Late-seral Montane Forest

The ICRB was dominated by subbasins (63 percent) in which late-seal montane forest occurred below its 75 percent historical mid range (Table 3, Figure 7). However, most of the subbasins in Oregon, and many of those within the Central Idaho Mountain ERU contained areas of the late-seral montane community which was well above its historical range. Seven patches of subbasins comprised by the late-seral montane forest community type within its historical mid range (9 percent) were widely distributed across the ICRB (Table 4). The median patch size of these areas was two subbasins (range = 1 to 3 subbasins).

The distribution of subbasins in which the late-seral montane forest community existed within or above its historical range was nearly the converse of that of the mid-seral montane forest community (Figures 6 and 7). There were three patches of 47 subbasins that contained areas of this community within or above its historical range (Table 5). The largest patch (43 subbasins) spanned large areas of the Southern Cascades, Columbia Plateau, Upper Klamath, Blue Mountains, and Central Idaho Mountains ERUs (Figure 7). The other two patches were isolated predominantly within the Northern Cascades (three subbasins) and Snake Headwaters (one subbasin) ERUs. Consequently, we would expect productive populations of those species whose fitness is strongly correlated to the abundance of the late-seral montane forest community across most of the Oregon and Central Idaho portions of the assessment area. Conversely, we would anticipate there to be a high risk of extirpation of these species across much of eastern Washington, northern and southeastern Idaho, and those portions of Montana and Wyoming within the assessment area.

Early-seral Subalpine Forest

Most (56 percent)subbasins comprised by at least one percent of the early-seral subalpine forest community type contained areas of this community at levels above their 75 percent historical mid ranges (Table 3, Figure 8). However, a large portion of the Northern Glaciated Mountains and Upper Clark Fork ERUs were exceptions, in that this community occurred below its historical range. Subbasins in which the early-seral subalpine forest community type occurred within its historical range (20 percent) were concentrated within the Northern Cascades, Lower Clark Fork, and Central Idaho Mountains ERUs. There were six patches of these areas, that ranged in size from one to five subbasins (Table 4; median patch size = 1.5 subbasins).

We would expect that there would be little risk of local extirpation of those species whose fitness is strongly correlated to the abundance of the early-seral subalpine forest community within most (76 percent) of the subbasins in which this community comprised a substantial component. Four patches, comprised by 57 subbasins in which the early-seral subalpine forest community occurred within or above its historical range were widely distributed throughout the ICRB (Table 5; Figure 8). These patches ranged in size from one to 43 subbasins (median = 6.5 subbasins). One isolated subbasin occurred within the Southern Cascades ERU. Another relatively large patch (eight subbasins), which extended throughout the Northern Cascades ERU, was separated by a large distance from like patches in the Southern Cascades and Northern Glaciated Mountains ERUs. However, the two remaining patches nearly interconnected the entire eastern portion of the ICRB, from the Northern Glaciated Mountains ERU to the Snake Headwaters ERU.

Mid-seral Subalpine Forest

Of those subbasins comprised by at least one percent of the mid-seral subalpine forest community type, 47 percent contained areas of it below their 75 percent historical mid ranges (Table 3, Figure 9). These areas were clustered within the Northern Cascades, Southern Cascades, Upper Klamath, Blue Mountains, and Central Idaho Mountains ERUs. However, several relatively large areas of the Northern Glaciated Mountains, Lower Clark Fork, Upper Clark Fork, and Snake Headwaters ERUs were dominated by subbasins in which the mid-seral subalpine community occurred within or above its historical range. Ten patches of 18 subbasins existed that contained this community within its historical mid range (Table 4). These ranged in size from one to five subbasins (median = 1.5 subbasins), the largest of which straddled the Northern Glaciated Mountains and Lower Clark Fork ERUs.

Most subbasins (53 percent), in which the mid-seral subalpine forest community comprised a substantial component, contained that community at levels within or exceeding its historical range. Consequently, there should be little risk of local extirpation within most subbasins of those species whose fitness is strongly correlated to the availability of that community. Five patches of 49 subbasins in which the mid-seral subalpine forest community occurred within or above its historical range were well distributed across the eastern portion of the assessment area (Table 5; Figure 9). The largest patch (39 subbasins) extended down the spine of the Northern Rocky Mountains, from the Northern Glaciated Mountain ERU to the Snake Headwaters ERU. Three patches (located on the border of the Northern and Southern Cascades ERUs, in northeastern Washington, and in southcentral Idaho, respectively) would likely have higher risks of species extirpation because they were much more isolated from the other two, more closely connected patches.

Late-seral Subalpine Forest

The majority (72 percent) of subbasins having a measurable component of the late-seral subalpine forest community type contained that community type at a level below its 75 percent historical mid range (Table 3, Figure 10). Notable exceptions included the Upper Klamath and southern portion of the Central Idaho Mountains ERUs, where the late-seral subalpine forest community type of most subbasins was within or exceeded its historical mid range. Only 11 subbasins (12 percent) were comprised by this community type at a level within its historical mid range, and all but one of these were located within or immediately adjacent to the Central Idaho Mountains ERU. The largest contiguous patch of subbasins that contained this community type within its historical range was comprised by seven subbasins (Table 4; range = 1 to 7 subbasins; median patch size = 1.5 subbasins).

Species whose fitness is strongly correlated to the abundance of the late-seral subalpine forest have a high risk of local extirpation across most (72 percent) of the subbasins in which this community comprised a substantial component (Table 5). However, two relatively large (six and 21 subbasins, respectively) patches of 27 subbasins existed in which this community type occurred within or exceeded its historical range (Figure 10). Although relatively large, these two patches were widely separated. One patch largely occurred in the Upper Klamath ERU, whereas the second patch existed predominantly in the Central Idaho Mountains ERU.

Upland Herblands

Approximately 81 percent of the subbasins that had a measurable component of the upland herblands community type, contained it at a level below its 75 percent historical mid range (Table 3, Figure 11). With the exception of three entire subbasins, and portions of four others, all subbasins within the Oregon and Washington portions of the assessment area had areas of the upland herbland community type below the historical mid range. Although the Idaho and Montane areas were also dominated by subbasins in which the upland herbland community occurred below its historical mid range, there were notable exceptions within the Central Idaho Mountain, Upper Snake, and Snake Headwaters ERUs, where this type occurred within or above its historical range. The 20 subbasins (12 percent) that had this community type within its historical mid range were distributed across 13 relatively small and isolated patches (Table 4; patch size range = 1 to 4 subbasins; median patch size = 1.0 subbasin).

We believe there to be a high risk of local extirpation for those species dependent on the abundance of the upland herbland community type within most (71 percent) subbasins having a substantial component of this community. However, there were 11 patches of 30 subbasins in which the upland herbland community type occurred within or above its historical range, and where we would expect there to be a lower risk of local extirpation (Table 5; Figure 11). Eight of 11 of these patches were concentrated within the Central Idaho Mountains, Owyhee Uplands, Upper Snake, and Snake Headwaters ERUs. The largest patch (11 subbasins) occurred within the Central Idaho Mountains ERU. The Oregon and Washington portions of the assessment area contained five small patches, comprised by single subbasins, which were isolated by enormous distances from each other. The remaining patches, that ranged in size from one to five subbasins, were located in relatively close proximity to each other.

Upland Shrublands

The ICRB was dominated by subbasins (61 percent) in which the upland shrubland community occurred below its 75 percent historical mid range (Table 3, Figure 12). The 31 subbasins in which this community occurred within its historical mid range were distributed across nine patches that ranged in size from one to 11 subbasins (Table 4; median patch size = 2.0 subbasins), and were predominantly concentrated within the Northern Great Basin and Owyhee Uplands ERUs.

Although we projected a high risk of local extirpation of those species dependent upon the availability of the upland shrubland community type across most of the ICRB, the Northern Great Basin, Owyhee Upland, and a large portion of the Central Idaho Mountain ERUs were dominated by subbasins in which the upland shrubland community type occurred within or above its historical range. Eight patches of 52 subbasins existed in which this community occurred within or above its historical range (Table 5). The largest patch (39 subbasins) was continuous throughout the Northern Great Basin, Owyhee Upland, and Central Idaho Mountains ERUs. The seven remaining patches ranged in size from one to six subbasins, and were widely distributed across the Northern Cascades, Columbia Plateau, Blue Mountains, Northern Glaciated Mountains, and Upper Clark Fork ERUs.

Upland Woodlands

Subbasins comprised by a substantive component of the upland woodland community type were nearly evenly distributed by those which contained this type below its 75 percent historical mid range (41 percent), and those in which this community type occurred above that range (46 percent; Table 3; Figure 13). The 14 subbasins (13 percent) in which the upland woodland community type occurred within its historical mid range were widely distributed across the ICRB in nine patches that ranged in size from one to four subbasins (Table 4; median patch size = 1.0 subbasins).

The risk to persistence of those species dependent upon the availability of the upland woodland community type should be relatively low within most (59 percent) subbasins in which this community comprised a substantial component (Table 5). Four patches of 63 subbasins in which the upland woodland community occurred within or above its historical range were widely distributed across all but the northern Idaho and Montana portions of the assessment area. The largest patch (58 subbasins) extended from the western Northern Glaciated Mountains, through the Northern Cascades, Columbia Plateau, Southern Cascades, Blue Mountains, Northern Great Basin, and Owyhee Uplands ERUs. The three remaining patches, which ranged in size from one to four subbasins, were located in the Central Idaho Mountains and Snake Headwaters ERUs.

DISCUSSION

Of all terrestrial community type groups for which we determined departure indices, the lower montane forest communities have deviated the most from their historical structures. Within forested settings, the montane and subalpine forest structures were relatively more similar to their historical conditions than lower montane forest structures. The average subbasin frequency within Class 3 departures across early-, mid-, and late-seral structures was approximately seven percent, 15 percent, and 17 percent for lower montane, montane, and subalpine communities, respectively. No more than 10 percent of the subbasins comprised by measurable components of lower montane forest communities contained those communities within their 75 percent historical mid range. However, two community types in each of the montane and subalpine forest settings approached nearly 20 percent frequency of subbasins falling within their respective historical mid ranges (Table 3). Since lower montane forest settings tend to have shorter fire-return intervals, occur on more accessible landforms (e.g., more level topography), and are usually closer to human settlements, they typically have been affected by past fire suppression and timber harvest activities to a much higher degree than either montane or subalpine forest settings. Conversely, subalpine forest settings probably more closely approximate their historical conditions because successional change occurs much slower in colder environments, they have a higher relative proportion of area allocated to wilderness and wilderness-like management prescriptions, and they are typically much less accessible to efficient fire suppression and timber harvest activities.

Our departure indices indicated that an homogenization of forest structures occurred in the lower montane and montane forest settings. The frequency of subbasins in which early- and late-seral structures were presently below their historical ranges was relatively high (51 to 84 percent), as was the frequency of subbasins in which mid-seral structures occurred above their historical ranges (approximately 58 percent). Thus, across most of the ICRB in which lower montane and montane forest settings comprised a measurable component of the subbasins, early- and late-seral structures declined, whereas mid-seral structures increased.

The above pattern of forest structure homogenization was not apparent within subalpine forest settings. The frequencies of subbasins were dominated by those in which early-seral structures exceeded their historical ranges, whereas mid- and late-seral structures occurred below their respective historical ranges. The observed decline of mid- and late-seral structures within subalpine forest settings was likely attributable to timber harvest activities and the relatively recent occurrences of large wild fires.

The significant declines we observed with the upland herbland community type within most (81 percent) of the subbasins across the ICRB was primarily attributable to agricultural development, and to a lesser degree, the encroachment of upland shrublands, coniferous forests and woodlands, and exotics. However, there were 10 subbasins in which the upland herbland community exceeded its historical range. Most (80 percent) of these subbasins were generally wild to semi-wild, minimally to moderately roaded, and had cold to moist forest settings. Nine of ten of these subbasins were also in areas where we observed the early-seral subalpine forest community type to be well above its historical range. Consequently, the observed increase in upland herbland communities within these subbasins was likely attributable to timber harvest activities and some relatively recent, large-scale wild fires. These activities probably converted some areas into grass/forb communities which were misclassified as an upland herbland type instead of an early-seral forest type. In addition, the historical model run may have underestimated the amount of disturbance which would have resulted in higher abundances of the upland herbland type.

Of the subbasins that had a substantial composition of the upland shrubland community type, 61 percent had areas of this community below its historical range. Conversions to agriculture, and to a lesser degree upland herbland, upland woodland, exotics, and lower montane forest communities, were responsible for these declines. Conversely, 21 subbasins had areas of the upland shrubland community that exceeded its historical range. Most (57 percent) of the subbasins in which we observed substantial increases in upland shrublands were also classified as having moderate to high rangeland integrity (see Quigley and others, 1996). However, nearly 30 percent of the subbasins in which upland shrublands increased were classified as having low rangeland integrity.

Nearly 40 percent of the subbasins that had a substantial component of the upland woodland community type, contained that community at a level below its historical range. Most of the upland woodland community within these subbasins (located predominantly in the Blue Mountains, Central Idaho Mountains, Upper Clark Fork, and Snake Headwaters ERUs) was converted into the upland herbland community type (Jones and Hann 1996). Conversely, conifer and juniper expansion into shrubland habitats was the predominant factor responsible within 46 percent of the subbasins in which the upland woodland community type occurred above its historical range. More specifically, the expansion of western juniper is responsible for the substantial increase of the upland woodland community type within two clusters of nine subbasins centered around the southern portions of the Columbia Plateau and Upper Klamath ERUs. Expansions of mixed-conifer and limber pine woodlands was largely responsible for all other subbasins in which the upland woodland community exceeded its historical range.

We recognize that the individual fitness and the population persistence of few species are closely correlated to the areal extent of only one community type. Instead, many species rely upon the availability and spatial juxtaposition of several communities. Consequently, a multi-community departure approach (i.e., similarity index) of indexing vegetation change may be a more powerful tool for predicting the population response of those species having more general habitat requirements.

We are undoubtedly faced with a significant deficiency of information pertaining to the broadscale habitat relationships and population responses to habitat change for most species residing in the Interior Columbia River Basin. Furthermore, there is little likelihood that the information void will ever be satisfactorily filled for the majority of flora and fauna within any time soon. We believe that our coarse-filter approach of quantifying broadscale habitat change, and providing some spacial context of those changes, creates a useful data set for predicting the population responses of those species for which we know very little.

SUMMARY

The vegetation composition and structure within the ICRB has changed substantially from the predicted historical conditions. Most of the ICRB is dominated by subbasins where the areal extent of most communities occur below their historical ranges. The areas where a community type occurs within its historical ranges are highly fragmented into relatively small and isolated patches. Similarly, we observed extensive fragmentation of individual habitats which we would expect to support productive populations of those species whose fitness is strongly correlated with the areal extent of that particular habitat. Although typically small and isolated, these patches may act as important source areas for those subbasins having higher probabilities of local population extirpation. Consequently, the patches of subbasins in which a community type occurred within or above its historical range may prove to serve as important building blocks for conservation and restoration strategies.

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Figure Captions

Figure 1--Relationship between current areal extent of terrestrial community types and their respective historial ranges.

Figure 2--Broadscale habitat departure of the early-seral lower montane forest terrestrial community type.

Figure 3--Broadscale habitat departure of the mid-seral lower montane forest terrestrial community type.

Figure 4--Broadscale habitat departure of the late-seral lower montane forest terrestrial community type.

Figure 5--Broadscale habitat departure of the early-seral montane forest terrestrial community type.

Figure 6--Broadscale habitat departure of the mid-seral montane forest terrestrial community type.

Figure 7--Broadscale habitat departure of the late-seral montane forest terrestrial community type.

Figure 8--Broadscale habitat departure of the early-seral subalpine forest terrestrial community type.

Figure 9--Broadscale habitat departure of the mid-seral montane forest

terrestrial community type.

Figure 10--Broadscale habitat departure of the late-seral montane forest terrestrial community type.

Figure 11--Broadscale habitat departure of the upland herbland terrestrial community type.

Figure 12--Broadscale habitat departure of the upland shrubland terrestrial community type.

Figure 13--Broadscale habitat departure of the upland woodland terrestrial community type.

Table Captions

Table 1--Terrestrial community types used for estimating habitat departures within subbasins of the Interior Columbia River Basin

Table 2--Terrestrial community group departure classes.

Table 3--Summary of subbasin frequency distribution (percent) by current terrestrial community group departures .

Table 4--Fragmentation indices of terrestrial community groups occurring

within subbasins at a level within their historical ranges.

Table 5--Fragmentation indices of terrestrial community groups occurring within subbasins at a level within or above their historical ranges.

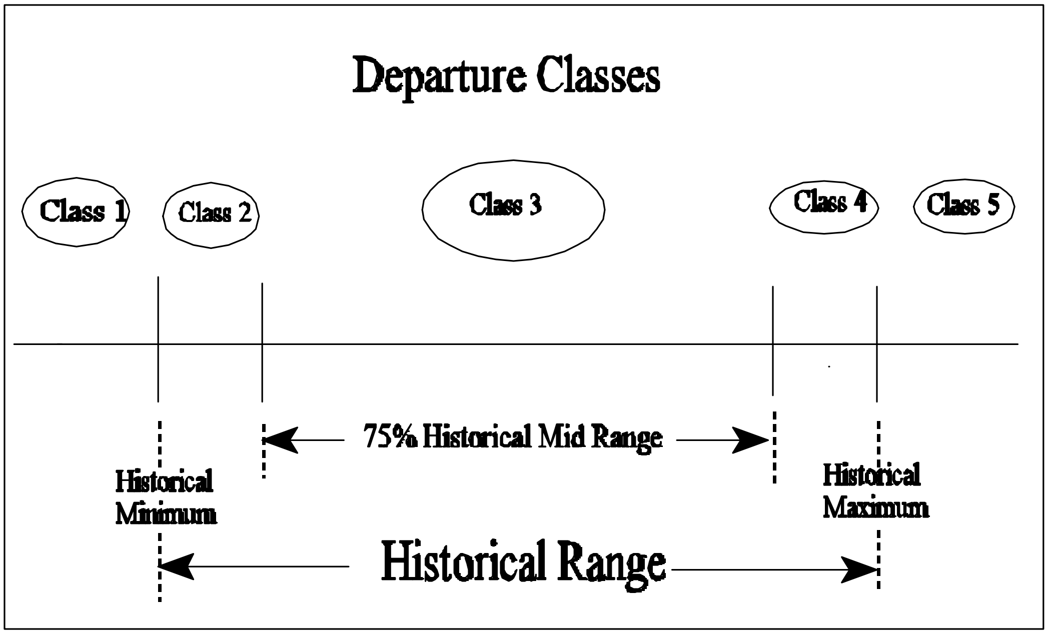

Figure 1. Relationship between current areal extent of terrestrial community types and their respective historial ranges.

Figures 2 through 13 are not available

Table 1--Terrestrial community types used for estimating habitat departures within subbasins of the Interior Columbia River Basin.

Forest habitats

- Lower montane forest community types
  - Early-seral
  - Mid-seral
  - Late-seral
- Montane forest community types
  - Early-seral
  - Mid-seral
  - Late-seral
- Subalpine forest community types
  - Early-seral
  - Mid-seral
  - Late-seral

Non-forest habitats

- Upland herbland
- Upland shrubland
- Upland woodland

Table 2--Terrestrial community group departure classes.

Departure Class	Relationship of current area to historical ranges
1	A_c[1] < Historical Minimum
2	Historical Minimum $\leq A_c$ <-75% Historical mid range
3	A_c is within 75% historical mid range
4	75% Historical mid range < $A_c \leq$ Historical Maximum
5	A_c > Historical Maximum

[1]A_c = Current area.

Table 3--Summary of subbasin frequency distribution (percent) by current terrestrial community group departures .

Terrestrial Community Group	No. of Subbasins[1]	Departure Class[2]				
		1	2	3	4	5
Early-seral Lower Montane Forest	117	79	15	4	1	2
Mid-seral Lower Montane Forest	125	23	5	10	3	58
Late-seral Lower Montane Forest	125	78	8	7	0	6
Early-seral Montane Forest	136	44	7	18	4	28
Mid-seral Montane Forest	133	19	3	19	2	57
Late-seral Montane Forest	127	59	4	9	1	27
Early-seral Subalpine Forest	75	21	3	20	0	56
Mid-seral Subalpine Forest	90	38	9	20	3	30
Late-seral Subalpine Forest	91	63	9	12	0	16
Upland Herbland	145	66	15	12	0	7
Upland Shrubland	129	47	14	22	8	9
Upland Woodland	104	34	7	13	6	40
Average	--	47.6	8.3	13.8	2.3	28.0

[1]Subbasins (4th field HUCs) having at least 1 percent composition of the terrestrial community group during historical or current periods.
[2]See text, Table l, and Figure 1 for descriptions of departure classes: 1) #!100% of historical range; 2) >!100% to <!75% historical range; 3) within 75% historical range; 4) >75% to <100% historical range; 5)$100% historical range.
[3]Average subbasin frequency distribution across 12 terrestrial community group departure classes.

Table 4--Fragmentation indices of terrestrial community groups occurring within subbasins at a level within their historical ranges[1].

Terrestrial community group	Frequency of subbasins[2] (%)	No. of patches	Median patch size[3]	Maximum patch size
Early-seral Lower Montane Forest	4	5	1.0	1
Mid-seral Lower Montane Forest	10	9	1.0	3
Late-seral Lower Montane Forest	7	3	2.0	6
Early-seral Montane Forest	18	17	1.0	5
Mid-seral Montane Forest	19	14	1.0	7
Late-seral Montane Forest	9	7	2.0	3
Early-seral Subalpine Forest	20	6	1.5	5
Mid-seral Subalpine Forest	20	10	1.5	5
Late-seral Subalpine Forest	12	4	1.5	7
Upland Herblands	12	13	1.0	4
Upland Shrublands	22	9	2.0	11
Upland Woodlands	13	9	1.0	4

[1]Summation of departure class 3.
[2]Frequency of subbasins = the percentage of those subbasins having at least a one percent historical or current composition of a terrestrial community group in which that community group occurs within its historical range.
[3]Patch size = count of subbasins within a patch.

Table 5--Fragmentation indices of terrestrial community groups occurring within subbasins at a level within or above their historical ranges[1].

Terrestrial community group	Frequency of subbasins[2] (%)	No. of patches	Median patch size[3]	Maximum patch size
Early-seral Lower Montane Forest	7	5	1.0	3
Mid-seral Lower Montane Forest	71	2	38.5	75
Late-seral Lower Montane Forest	13	3	2.0	14
Early-seral Montane Forest	50	12	3.5	34
Mid-seral Montane Forest	78	6	1.5	95
Late-seral Montane Forest	37	3	3.0	43
Early-seral Subalpine Forest	76	4	6.5	43
Mid-seral Subalpine Forest	53	5	3.0	39
Late-seral Subalpine Forest	28	2	13.5	21
Upland Herblands	19	11	1.0	11
Upland Shrublands	39	8	1.0	39
Upland Woodlands	59	4	2.5	58

[1]Summation of departure classes 3 through 5.
[2]Frequency of subbasins = the percentage of those subbasins having at least a one percent historical or current composition of a terrestrial community group in which that community group occurs within or above its historical range.
[3]Patch size = count of subbasins within a patch.