# 5.0 SYNTHESIS AND INTERPRETATION

Comparing existing conditions to reference conditions allows an evaluation and interpretation of changes in specified (as per Section 3.0) physical and biological processes and interactions in the watershed. The causal mechanisms attributed to departures from reference or natural conditions are identified, as are the effects on related factors or processes. Interpreting these provides background for assessing natural and human-related disturbances influencing or altering the Lower Siuslaw River watershed, and its ability to function within a natural range of conditions. These natural conditions frame management objectives set by agency directives, such as the Northwest Forest Plan. Implications of conditions and interactions not meeting management objectives provide the basis for recommendations and opportunities. Information in this step is organized by core topics as identified in Section 3.0.

## 5.1 ISSUE #1 THE CAPABILITY OF THE WATERSHED TO MAINTAIN AND SUPPORT AQUATIC SPECIES AND HABITAT

### 5.1.1 Differences Between Reference and Current Conditions

- Reduction in natural coho salmon runs can be attributed to past overharvesting in commercial ocean and Siuslaw River fisheries. Commercial harvest data (1889-1956) showed an annual harvest of about 60,000 coho salmon from 1892 to 1914 from the Siuslaw River (BLM, 1996). After 1914, coho salmon harvests decreased to about 10,000 fish annually, never exceeding 50,000 fish up to the 1950s (ODFW, 1995).

- Based on historic coho salmon harvest levels and current peak coho salmon counts in the Lower Siuslaw watershed, aquatic habitat may be producing only about 2 percent of its historic capability. Selected reference values for functioning habitat (adopted from the North Fork Siuslaw Watershed Analysis; Table 30) were compared to conditions quantified by USFS R6 inventories. All stream reaches were found to be far below reference amounts of LWD and few had sufficient deep-pool area (greater than 1 meter). Comparing inventoried habitat components to the NMFS "Pathway Indicators of Stream Habitat for Coastal Oregon" (NMFS, 1996) suggests most streams would rate non-functional (poor) for LWD, substrate, pool frequency and quality, and off-channel habitat indicators. Historic habitat conditions are perceived as having been of a much higher quality.

**Table 30. Reference Values of Selected Aquatic Habitat Variables for the Lower Siuslaw Watershed**

| Habitat Variable | Good (Functioning) | Fair (Partially Functioning) | Poor (Non-Functional) |
|---|---|---|---|
| Large woody debris (pcs/mile) | 80 | 40-79 | <40 |
| % pools (0-2% gradient) | >55 | 40-55 | <40 |
| % pools (3-5% gradient) | >40 | 30-40 | <30 |
| % pools (>5% gradient) | >30 | 20-30 | <20 |
| % deep pools | >20 | 10-20 | <10 |

Note: values derived from the North Fork Siuslaw Watershed Analysis

- Reference (Pre-Euro-American settlement) temperature regimes for streams in the Lower Siuslaw watershed are unknown. However, in 1996 most stream reaches in the Lower Siuslaw watershed had a 7-day average maximum water temperature during salmonid rearing periods above 62° F, which, according to NMFS, is above optimal rearing conditions. Furthermore, all of the monitoring sites recorded water temperatures above 64° F, indicating a non-functional condition (NMFS 1996) for stream shade and rearing of salmonids in the watershed.

- An additional comparison notes that 3 of the 23 subwatersheds in the Lower Siuslaw River area (Berkshire, upper Knowles, and Brush creeks) have high amounts of mature conifer occupying riparian zones. However, logging of mature conifer in riparian zones along many streams in the remaining 20 subwatersheds has converted vegetation either to a younger seral stage, or a deciduous seral stage, thus altering the vegetative influences that play a role in maintaining natural water temperature regimes. Since high stream temperatures have been recorded and riparian vegetation has been altered in much of the watershed, it is inferred that the historic water temperature regime also has been altered.

- Based on relative changes in conditions, or impacts from human disturbances such as roads and logging, the mainstem Siuslaw River, Sweet and Knowles Creeks and their tributaries, and Divide, Hadsall, Meadow, Munsel, and Walker Creeks have conditions substantially below reference or natural conditions. Watersheds with minimal changes in natural conditions are Brush, Petersen, Saunders, Nielson, and Waite Creeks (Table 31).

## Table 31. Comparison of Relative Changes on Streams in the Lower Siuslaw River Watershed

| Streams | Roads Conditions | Human Disturbance on Unstable Slopes | Channel Integrity | Riparian Seral Stages | Aquatic Habitat Condition | LWD Recruitment Potential | Fish Status | Land Use Practices | Water Temperature | Sediment | Change in Condition (compared to Reference) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mainstem Siuslaw River | H | H | L | E-M | F | L | D | AG/GR, L, RD/RR, DK/TG | P | ? | H |
| South Inlet | M | H | ? | E | F | L | D | ? | ? | ? | M |
| Demming | M | L | ? | E-L | F | L | D | AG/GR, RD/RR | ? | ? | M |
| Lawson | M | L | L | E | F | L | D | AG/GR, RD/RR, DK/TG | ? | ? | M |
| Karnowsky | M | L | L | E | P | L | D | AG/GR, L, RD/RR, DK/TG | ? | ? | M |
| Peterson | L | L | ? | E | ? | L | ? | ? | ? | ? | L |
| Hoffman | L | L | ? | E | P | L | D | AG/GR, L | P | ? | H |
| Mason | L | M | ? | E | ? | L | ? | ? | ? | ? | M |
| Sweet and tributaries | H | L | L | E | P, F | L | D | AG/GR, L, RD/RR | P | F | H |
| Marlin | H | L | ? | E | ? | L | ? | ? | ? | ? | M |
| Hadsall | H | H | L | E | F, P | L | D | L, RD/RR | ? | ? | H |
| Knowles and tributaries | H | H | L | E-L | P, F, G | L-H | D | L, RD/RR | P | ? | H |
| Old Man | L | M | L | E | F | L | D | ? | ? | ? | M |
| Brush | L | L | L | L | G | H | D | ? | ? | ? | L |
| Barber | L | M | M | E | P, F | L | D | ? | ? | ? | H |
| Turner | H | L | L | E | F | L | D | L, RD/RR | ? | ? | M |
| Waite | L | M | ? | E-L | F, G | L | D | L | ? | ? | M |
| Rock | L | L | ? | E | F | M | D | RD/RR | ? | ? | M |
| Meadow | L | H | L | E-L | P | M | D | RD/RR | ? | ? | L |
| Smith | L | H | ? | E-L | F | M | D | RD/RR | ? | ? | M |
| San Antone | H | M | ? | E | G | L | D | RD/RR | ? | ? | M |
| Beech | L | L | ? | E | F | L | D | RD/RR | ? | ? | M |
| Pat | L | H | ? | E | F | L | D | RD/RR | ? | ? | M |
| Tilden | L | L | L | E | F, P | M | D | ? | ? | ? | M |
| Cleveland | L | M | ? | E-L | P | L | D | L | ? | ? | M |
| Thompson | H | M | ? | M-L | P, G | H | D | L, RD/RR | ? | F | M |
| Shoemaker | L | M | L | E-L | F | L | D | L, RD/RR | ? | ? | M |
| Walker | L | M | L | E-L | P | M | D | AG/GR, L, RD/RR | P | P | H |
| Berkshire | L | H | L | L | F | L | D | L, WD, DK/TG | ? | ? | M |
| Hollenbeck | L | H | L | E | F | L | D | ? | ? | ? | H |
| Saunders | L | L | ? | E-L | F | L | D | ? | ? | ? | M |
| Neilson | L | L | ? | E-L | ? | L | ? | ? | ? | ? | L |
| Divide | L | L | L | E-L | P, F, G | M | D | L, RD/RR | P | F | H |
| Hanson | L | L | ? | E-L | F | L | D | ? | ? | ? | M |
| Schoolhouse | L | L | L | E | F | L | D | L | ? | ? | M |
| Munsel | L | L | ? | E | F | L | D | ? | ? | ? | L |

* For column definitions see the following key. Question (?) marks indicate that there is no information to make a qualitative call

## Key to Table 31

Roads condition includes problem culverts, unstable road sections, and roads rated as unstable by Berkeley, L=low number of problem sites, M=moderate number of problems, H=high number of problem sites.

1. Roads and clearcuts located on slopes rated unstable or out-of-range by Berkeley Prognosis. H=high, M=moderate, L=low
2. Channel Integrity is a qualitative rating of the degree of in-stream human impacts from stream cleaning, splash dams, bank stability from livestock grazing, tide gates, and parallel roads and dikes with riparian zones, L=low, M=moderate, H=high.
3. Rating of the dominant vegetative seral stage in riparian areas. E=early, M=mid, L=late
4. Functionality, G=good (functioning), F=fair (at risk), P=poor (non-functioning)
5. LWD Recruitment Potential, L=no or little potential, M=some current potential, H=high potential currently
6. Fish status includes current compared to reference spawner and juvenile numbers, D=depressed, S=strong.
7. Major human use impacts that are causal mechanisms in the watershed, AG/GR= agriculture/grazing, L=past logging activities, RD/RR= roads/railroads, WD = water diversion, DK/TG = dikes/tidegates
8. Water quality includes impacts to temperatures and fine sediment, P=poor, F=fair, G=good.
10. Overall relative change in condition from reference, L= no or minimal change, M= below reference, H=substantially below reference.

### 5.1.2 Interactions of Biological, Physical, and Human Processes on Aquatic Hotspots

- Most hotspots are currently located on private land and have not been inventoried (Map 17). Of the 151 (32.4 miles) identified hotspots, at least 50 have potentially unstable slopes (as identified by the Berkeley prognosis) either adjacent or just upstream, and are at risk of being affected by a landslide. Most (31 or 62 percent) of these at-risk hotspots are found in Knowles (5.4 miles), Sweet (8.1 miles), and Hadsall (1.8 miles) Creeks and their tributaries and South Inlet (1.3 miles), Demming (1.2 miles), and Waite (2.0 miles) creeks. In some smaller tributaries, such as Petersen, Pat, Cleveland, and Walker Creeks, the only identified hotspot is at risk from potential slope failure.

- The 1996 Flood Assessment inventoried landslides that deposited material either in or upstream from aquatic hotspots. The majority of slides depositing directly into Canyon, Deer, and Hadsall creek tributaries, and Hood, Knowles, Sulpher, Turner, and Waite creeks originated from roads or clearcuts, presumably contributing some degree of fine sediment to hotspots. The majority of slides originating from unmanaged stands likely contributed LWD to hotspots in upper Hadsall, Karnowsky, upper Knowles, Lawson, and Tilden creeks.

- Roads impinging on floodplains or constricting channels adjacent to hotspots occur in the upper mainstem Siuslaw River between Barber Creek and the watershed boundary, and along Beaver, Hadsall, Karnowsky, Knowles, Lawson, Thompson, Turner, and Sweet creeks (Map 27). Some of these road sections affect channel migration and off-channel habitat to some degree. In addition, they may isolate floodplains from the main channel, especially during high water events. Roads in these locations may be severely damaged in flood events, causing fine sediment to be deposited directly in hotspot reaches.

- Fourteen culverts barring fish passage to hotspot locations, as identified by ODFW, (Map 16) occur in Florence, Divide, Berkshire, Thompson, Meadow, Tilden, and lower Sweet subwatersheds. In addition, the Roads Condition Assessment evaluated culvert characteristics that would indicate a potential fish passage barrier. Culverts identified in this assessment exhibiting characteristics typical of a culvert barrier (ex. outlet drops > 6', culvert gradients > 8 percent, lengths > 200', plugged inlets) were not located on any stream reaches currently used by anadromous species.

- Hardwood-dominated areas in riparian areas may not naturally regenerate to conifers. These wet sub-environments (typified by salmonberry plant communities) could revert to shrub communities for long periods of time if conifers do not replace short-lived red alder. Large woody debris recruitment could be limited in such situations for a significant period of time. Hotspots along Barber, Beaver, Hadsall, Hood, Knowles, Karnowsky, Lawson, Meadow, Sweet, Sulpher, Turner, and Tilden creeks

have riparian zones dominated by hardwoods. Source LWD recruitment potential, either stream adjacent (within 150' of a stream, including unstable headwall zones) or on unstable slopes not adjacent to a stream, is currently lacking along hotspots(Map 18).

- Stream temperature monitoring data collected in a single year (1996) at nine sites recorded temperatures exceeding 64° F during the late summer months. Such data could be inferred as indicating an altered stream temperature regime. However, without any historical or base line data with which to compare, and considering that a single year of data is insufficient for determining annual ranges of variation, it is unknown if these temperatures indicate a departure from the range of natural variability. The shade model (Map 19) indicates that shade is inadequate at the precise location of five of the nine monitoring sites.

- However, shade upstream of the Hoffman and upper Knowles monitoring sites, where high stream temperatures were recorded, is adequate. Data recorded at two of the monitoring sites on middle and lower Knowles Creek indicate that stream temperatures exceeded 64° F for more than 30 days (non-consecutive), despite adequate shade along most of the mainstem stream and along tributaries on private industrial timberlands that are predominantly stocked with mixed conifer. This could be attributed to several factors. The bedrock dominated channel, thought to have been created by log drives and splash dams, and a lack of deep pool area, may lend to a greater preponderance for solar radiation to heat up the water. Furthermore, a disconnection between the mainstem channel and its floodplain likely has lowered the water table, thereby decreasing summertime base flows, and increasing the capacity for solar radiation to influence water temperature. Consequently, it is thought that shade is not the major contributing factor of high stream temperatures recorded on Knowles Creek.

- In addition, shade is determined to be predominantly adequate in the Hoffman subwatershed. Yet stream temperatures exceeding 64° F for 55 consecutive days were recorded at the monitoring site at the stream mouth. Tidal influences and site location may be more of a factor influencing elevated stream temperatures at this location than riparian vegetation.

- Topographical influences provide shade during certain daylight periods. Therefore, some shade provided by the mountains and ridges in the watershed, likely offset the effects of inadequate shade provided by vegetation along riparian zones in mid and late summer, especially streams with a north-south orientation. In contrast, drainages with more east-west orientations, likely receive the longest duration of exposure to the sun, such as Turner and Walker Creeks, and the mainstem Siuslaw River. Consequently, stream temperatures there may be influenced by solar radiation despite adequate riparian shade.

- Non-forest habitat (grass/forb) along aquatic hotspots in South Inlet, Duncan Slough, and the lower reaches of Lawson, Karnowsky, and Sweet Creeks have the greatest potential for elevated stream temperatures resulting from an increase of solar radiation due to a lack of shade. Non-forest habitat along these reaches has been converted predominantly by agricultural practices from forest or brush dominated riparian vegetation to grass/forb plant communities. Currently, there are no stream temperature monitoring sites along any of these reaches.

- Stream temperature monitoring data does not conclusively indicate, nor refute, that the condition of riparian vegetation is a primary contributing factor to elevated stream temperatures during mid and late summer. It is possible that stream temperatures exceeding 64° F at certain times of the day, or for a certain duration, is within the natural range of variability. Consequently, shade is not perceived to be a limiting factor along forested riparian plant communities, however, it may be limiting along non-forest riparian plant communities.

## 5.2 ISSUE #2 CONDITIONS OF THE EXISTING ROAD SYSTEM.

### 5.2.1 Alterations to Reference Watershed Conditions from Roads

- Many roads from which slides have originated, have existing problem sites as identified by the Roads Conditions Assessment (RCA) and the District Road Manager. These roads are located on landforms shaped by infrequent and seasonal, large storm events, implying that roads have affected several ecosystem processes in the watershed. Road segments in the watershed are thought to have increased slide frequency and sediment production and delivery. They are also thought to have limited the routing of LWD through the watershed, to some degree.

- Many road segments exist on unstable slopes, making them prone to landslides. In addition, many unstable road fills occur on slopes that are themselves only moderately stable, increasing the risk of failure on slopes where landslides may have been less frequent historically. Consequently, it appears that the natural regime of slide disturbances in the watershed has been expanded, possibly spatially and temporally. Furthermore, road-related slides are often comprised primarily of fill material, implying that fine sediment contributions to streams likely have been elevated. Roads are also thought to have increased surface erosion potential through the exposure of bare soil by prism components, such as cut banks and road treads, on many routes. However, whether those contributions actually exceed the range of natural variability is unknown. Nonetheless, roads are thought to have altered somewhat the inherent sediment regime across the landscape.

- Many road segments in the watershed closely parallel steam courses, often impinging on floodplains or stream banks. Roads in these locations are very prone to damage from floods and landslide deposits since they occur in lower drainage locations where cumulative flood stages are manifested. Roads occurring in valley bottoms and on floodplain landforms may also obstruct LWD transport to stream channels from

upslope sources (Map 18). Where road segments in valley bottoms cross tributary confluences, fill material and the associated culvert may not allow for passage of LWD to third- and fourth-order streams.

- Transport of at least 20 percent of LWD to hotspots from potential source sites is blocked by arterial roads in Cedar, Hand, Hood, Knowles, San Antonio, and Lower Sweet subwatersheds. State highways 36 and 126, as well as County Road 5020, block LWD sources along the mainstem Siuslaw River and Knowles Creek.

- Most of the roads and road segments that appear to affect the landslide, sediment, and LWD transport regimes are primary arterial travel routes in the watershed (including ATM roads). The secondary roads in the watershed, such as system and non-system spurs, do not appear to affect the watershed as much. Moreover, the RCA identified fewer problem sites on these roads than on primary arterial routes.

- Road density within the watershed may adversely affect late-successional wildlife and big-game species. Twenty of the 23 watersheds have road densities greater than 2 miles per square mile. Road densities greater than this have a substantial impact on habitat utilization by deer and elk (Thomas, 1979; Brown et al., 1985). Roads may assist the invasion of non-native plants, increase access for edge predators, and increase human activity in the LSRs, potentially increasing the likelihood of direct disturbance to late successional species from noise, poaching, vandalism, or human caused wildfire. Roads also may limit movement of some small and/or less mobile species, reducing available habitat and limiting dispersal and migration.

### 5.2.2 Proficiency of the Current Road System to Meet Current Management Objectives

- A predominance of the main arterial roads in the watershed maintained in perpetuity by the ATM plan, including county roads and state highways, have drainage or stability problems (Map 12). Consequently, it appears that many sections of the main arterial and access roads in the watershed do not meet Aquatic Conservation Strategy objectives, since they directly impact riparian and aquatic resources at many locations, especially in Beaver, Hadsall, Lawson, Karnowsky, Knowles, Sweet, and Turner creeks, as well as the mainstem Siuslaw river.

- Many of these roads are in valley bottoms, directly in riparian zones. They contribute sediment to aquatic habitat from heavy traffic, cut-bank erosion, ditch erosion, and tread erosion. In addition, many of the arterial roads in riparian zones impinge on floodplains and channels, and are constructed of "sidecast" technique. These valley bottom roads also often disrupt natural hydrologic flow paths. Arterial roads on ridgetops, and mid-slope roads connecting valley-bottom travel routes with ridge routes, are of "sidecast" construction and occur on steep, unstable slopes. Slides have originated from these roads, transporting fine sediment downhill to streams. Impacts

of this nature are not considered to meet ACS objectives for protecting aquatic habitat and anadromous fisheries from road related impacts. Aquatic hotspots, specifically those in the aforementioned streams, are being affected by roads.

- Secondary travel routes and spur roads, not identified as primary travel routes, comprise about 40 percent of the entire road system in the watershed. These roads, most of which are ridgetop roads, appear to affect aquatic and riparian habitat the least of all roads in the watershed (Map 30). Nonetheless, there are sections of these roads that impact aquatic habitat, thereby failing to meet ACS objectives. These kinds of roads are thought to be necessary for near-term access (Map 30a) where there are stands ripe for thinning activities. In addition, these secondary roads access younger plantations, thus being necessary in a more distant future to access thinning opportunities.

## 5.3 ISSUE #3 THE CAPABILITY OF THE LATE-SUCCESSIONAL RESERVE TO FUNCTION AS A LATE SUCCESSIONAL ECOSYSTEM AND SUPPORT RELATED WILDLIFE SPECIES

### 5.3.1 Differences Between Reference and Current Late-Successional Habitat Characteristics and Distribution

**Disturbance Processes**

- Timber harvest has replaced fire as the dominant disturbance, resulting in decreased late-successional patch size, increased fragmentation, reductions in biological legacy material (remnant green trees, snags, coarse woody debris, etc) and reductions in remnant late-successional patches within disturbance areas.

- Many areas within the watershed are predominantly in the stem-exclusion phase. The majority of these stands are the result of same-age, single-species plantation management. Unlike stands developing following a natural disturbance, these stands lack tree species diversity and structural heterogeneity created by remnant material, variable regeneration rates, and natural thinning from wind, fire, disease, or other environmental stress.

- Logging on unstable slopes likely has increased landslide frequency there to some degree. As a result, a greater percentage of the unstable slopes in the watershed may be in a pioneer, deciduous seral phase than historically occurred. These areas are likely to remain in this condition for a significant period of time.

- Patch sizes have decreased significantly compared to patch sizes in natural conditions. Average late successional conifer patch size has decreased from very large (greater than 1,000 acres) to 102 acres, with a corresponding increase in the number of patches.

- Roads and harvest units have fragmented the watershed, resulting in a change from large, connected patches having high within patch vegetation species and structural heterogeneity, to numerous small, isolated patches with low species and structural heterogeneity.

- The amount and distribution of biological legacy material (remnant green trees, snags, coarse woody debris, etc.) typically present following disturbance has been reduced by timber management activities.

- Historic disturbance processes left individual or groups of trees, snags, and or down logs relatively unaffected. These remnant structures provide habitat for late-successional species within the regenerating stand significantly sooner than if all or most of the structure was removed. Generally, timber harvest removed the majority of trees and dead wood from a site, leaving little remnant material.

**Interior Habitat**

- Harvest distribution and rotation timing, road building, and conversion of forest lands to agriculture and development have substantially reduced the amount of interior habitat within the watershed. All remaining interior habitat is on federal land and widely spread across the watershed.

**Late-Successional Dependent Species (includes Threatened and Endangered)**

- Late-successional dependent species (including threatened and endangered species) habitat has generally declined over time as a result of human-related habitat loss. Most remaining late-successional habitat is on federal land.

- Anthropogenic effects (timber harvest, conversion to agriculture, etc.) have caused fragmentation and reduction in late-successional patch size reducing the amount and quality of habitat available for late-successional dependent species, including spotted owls and marbled murrelets. This human activity (sometimes combined with extensive eradication efforts) has resulted in local and/or regional extirpation of several species (gray wolf, wolverine, fisher), and federal listing (threatened) of several others (northern spotted owl, marbled murrelet, bald eagle). The grizzly bear, however, which formerly occupied the Coast Range, was last seen there in 1820, before substantial human alteration of the landscape (USDA and BLM, 1997). These human activities began at the turn of the century and continue today on private lands. They have been substantially curtailed on federal lands within the watershed through implementation of the Northwest Forest Plan and designation of the majority of the area as an LSR.

**Riparian Areas**

- Timber harvest, roads, and agriculture have fragmented riparian areas and historic vegetation communities along the substantial majority of streams in the watershed (only Brush Creek appears intact) (Map 24). Timber harvest frequently has resulted in conversion of riparian areas from conifer-dominated to deciduous-dominated.

- Historically, major disturbances processes had substantial influence on structure and vegetation of riparian areas. In all cases, legacy material and functioning refugia remained to support the recovery process. Timber harvest, splash dams/log drives, and/or stream clearing have resulted in increased spatial and temporal changes in riparian habitat structure and vegetation.

**Big Game**

- The spatial and temporal distribution of habitat types and seral stages created by timber harvest likely have increased the amount of suitable habitat for big game in the watershed.

### 5.3.2 Interactions of Biological, Physical, and Human Processes on Late-Successional Habitat Characteristics and Distribution

**Disturbance Processes**

- Current vegetation patterns in the watershed are not within the range of natural variability. Historically, natural disturbances resulted in vegetation patterns and physical structures that varied widely, both spatially and temporally. Although it is possible that, during some periods, historic conditions had similar quantities of vegetation in each seral stage present today, it is unlikely that current spatial distribution of vegetation patterns and within-patch structure (number of canopy layers, logs, snags, tree size) is similar to spatial distribution before management.

- Even-aged management has resulted in a relatively high proportion of stands in the stem exclusion phase, which has closed canopies and is structurally homogeneous. These areas provide little habitat for species, such as spotted owls and marbled murrelets, requiring certain structural attributes for nesting and foraging habitat. Left untreated, many of these overstocked stands could remain in the stem-exclusion stage for many decades, extending the time needed to develop late-successional characteristics.

- Human-induced increase in landslides (from roads and logging) has caused an increase in deciduous pioneer stands of alder that would not be expected to attain late-successional characteristics in the near future. It is unlikely that these areas will establish late-successional stands without significant intervention. On some slide sites, no amount of remediation would result in late-successional characteristics in the foreseeable future.

- As a result of decreases in average patch size, late-successional dependent species with large home ranges in the watershed must cross unsuitable areas and travel further to meet their life requirements. This exposes them and their young to increased predation risk and causes increased energy expenditure. Late-successional species with low mobility and small home ranges (amphibians, small rodents, insects, and others) become isolated and susceptible to stochastic and human caused disturbance events. Extirpation of these isolated populations reduces the sources available for recolonization of disturbed adjacent areas as they develop habitat conditions suitable for these species.

- Fragmentation has reduced the ability of some species to disperse successfully or migrate to new habitats. The small patch size and isolation of individual late-successional patches is particularly evident in the mosaic of private and state lands in the eastern portion of the watershed, but also is evident, although to a lesser extent, on federal lands in the central portion of the watershed (Hand, Cedar2, Lower Sweet, Hadsal, and Berkshire subwatersheds). Even the large blocks of late-successional forest in the Bailey Ridge, Bald Mountain, and southern portion of the Upper Knowles subwatershed have become isolated from adjacent late-successional patches. These large areas may be sufficient in size to maintain viable populations of some late-successional species, with sufficient reproduction and survival to provide excess populations that could colonize adjacent habitats. However, dispersing juveniles would have to cross large, unsuitable areas, potentially reducing dispersal success.

- Removal of the majority of large green trees, snags, and down logs by human disturbance, such as timber harvest, will affect the ability of areas to provide or develop late-successional characteristics. Following natural disturbances this legacy material provides temporary refugia for late successional species, results in more rapid attainment of late -successional characteristics, and provides transient habitat and/or protective cover for late-successional species to use as they move between patches of suitable habitat (Franklin et. al., 1997).

- Logging and other land management activities have reduced the number of very old, structurally diverse stands. These areas are likely very rare in the watershed and limited to steep northeast slopes and riparian areas. Although sufficient information was not available to determine the location of biological hotspots in the watershed, the potential location of these areas is shown on Map 25. Where these areas exist, they may have special importance for this watershed as refugia for late-successional species, until habitat conditions within the LSRs become suitable for recolonization.

- The majority of federal lands within the watershed is designated as LSR. The resulting cessation of programmed harvest activity in most of these areas will, over time, either naturally or with restoration efforts, increase late-successional patch size and increase connectivity in the watershed.

- Most of the Matrix lands are isolated, and management of these areas for timber production or other allowable uses should have little effect on the function of the LSRs. Riparian Reserves dissect most of the Matrix lands. Current harvest practices on federal land have been designed to provide enough legacy material, so that harvest units should continue to allow movement of late-successional species across the landscape. Harvest in these areas primarily will provide habitat for early- to mid-seral associated species.

- Habitat on federal lands within the watershed is generally in recovery. However, some areas dominated by deciduous species and salmonberry may take many years, even with restoration efforts, to revert to pre-disturbance conditions. As these areas recover, they will begin to complement the existing older stands and provide travel corridors for many mobile and less mobile species existing, or potentially existing, in the watershed.

- Timber management within Matrix land in the Walker, Berkshire, and Thompson subwatersheds will add diversity in the LSR by providing young and mid-seral forest habitats adjacent to LSR, without compromising connectivity. Management of the remaining Matrix land should have little effect on LSR function.

- The area affected by recreation and matrix lands is small relative to LSR in the watershed. The likelihood of adverse effects from these activities is expected to be negligible.

- Recreational opportunities other than hunting are limited to water bodies (primarily the Siuslaw River), roads, and a few trails. These activities typically result in isolated, small areas of disturbance, and generally have minimal impacts on wildlife species.

**Interior Habitat**

- Interior-habitat-dependent species numbers are expected to correlate directly with the amount of interior habitat available. Reduction in average patch size, and the corresponding increase in fragmentation, limit the amount of interior habitat available. The limitation of available interior habitat results in altered vegetation communities and potential increases in predation, reduced reproductive success, and increased energy expenditure related to thermoregulation, caused by decreased mitigation of weather extremes.

- Some interior-dependent species, such as soil bacteria, fungi, and the species responsible for dispersing them (rodents) are integral to re-establishing functional late-successional habitat. The limited amount of interior habitat and the large distances between patches cause disturbance events affecting even small amounts of interior habitat potentially to have significant effects on long-term restoration of late-successional habitat

**Late-Successional Dependent Species (includes Threatened and Endangered)**

- Due to the current landscape pattern and human population, it is unlikely that any of the extirpated species will establish viable populations in the watershed without direct, extensive human intervention.

- The home-range circle of each known owl activity center in the watershed overlaps at least one other, possibly due to current forest alteration. Competition for the same resources may reduce the amount of habitat for some owl pairs, thus increasing energy expenditure for territorial defense. However, it is not known how individual pairs use available habitat, nor is the historic distribution of owls known. Therefore, this overlapping may be a natural occurrence for this watershed.

- Despite the level of fragmentation, owls and murrelets occur throughout the watershed, and are concentrated on federal lands. Home ranges that overlap private land have less suitable habitat than those entirely on federal lands. These owls may be at risk of reduced reproductive success and survival due to the combined effects of lower quality (or lack of sufficient) habitat within their home range and competition from other owls. Fragmentation and decreased interior habitat may increase murrelet nest predation by corvids and other edge species, by reducing the distance from edge to nest, thus making it easier for predators to find the nest in the stand.

- Human activity has decreased bald eagle habitat and the amount of potential forage within the watershed. The highest-quality remaining habitat is located along the Siuslaw River. However, this habitat is compromised by the proximity of roads, private development, and river traffic, and the lack of large trees suitable for nesting. Map 28 shows the location of the best potential bald eagle habitat within the watershed.

- Habitat within designated bald eagle management areas on Forest Service land is fragmented, and human disturbance may limit the use of some portions of all three management areas. However, present suitable nesting habitat and forage areas probably are sufficient to support the two existing bald eagle nest.

- Reductions in the number of large green trees and snags has decreased habitat for late-successional associated bat species. Certain types of bridges provide night roosting habitat for some species of bats, partially replacing the loss of large, old trees and snags.

- Management for LSR objectives and Riparian Reserves will increase suitable habitat for threatened and endangered species on federal lands. It is highly unlikely that most of the threatened and endangered species now extirpated in the watershed will recolonize the watershed even after suitable habitat increases.

- Management for LSR objectives will reduce big-game habitat within the LSR and concentrate those species on LSR/matrix and LSR/private land boundaries, resulting in less hunting traffic within the LSR and less likelihood of disturbance to late-successional species.

- The east-central portion of the watershed is dominated by privately-held commercial forest lands. It is assumed that harvest rotation will be 40 to 80 years. Management of these lands must meet Oregon State Forest Practices Act rules. Incorporation of these rules will provide maintenance and creation of some late-successional stand attributes within young seral-aged stands dominating private lands within the watershed. Private timberland, however, will likely continue to provide little structural diversity in the form of large green trees, late-successional interior habitat, snags, and downed logs. It will, however, continue to provide habitat for early and mid-seral species, and important habitat juxtaposition for species such as elk and deer.

**Riparian Areas**

- Deciduous-dominated portions of riparian areas may not regenerate naturally to conifers. Wet sub-environments (typified by salmonberry plant communities) could revert to shrub communities for long periods of time if conifers do not replace short-lived red alder.

- Unlike historic disturbances, human related disturbance is distributed throughout the watershed. Legacy material (large green trees, snags, logs) that would have remained in the system following most natural disturbances has been removed. The even distribution of disturbance across the landscape affected most stream systems during the same, relatively short, time period. Consequently, potential source populations of riparian-dependent species for recolonization that would have existed under historic disturbance regimes may frequently have been removed by human activity. The loss of, or significant reduction in, legacy material may alter biotic processes and affect recovery rates.

- Stand structural change and fragmentation have reduced the ability of riparian areas to provide the microclimate and other habitat conditions necessary for riparian-dependent species, and seriously hinders these species' ability to migrate or disperse throughout the watershed (Map 24). It also limits the Riparian Reserves ability to act as a conduit for movement and dispersal of other late-successional species, as intended in the NWP.

- Conversion of riparian areas to deciduous species or herbaceous species has created wider barriers to movement and removed physical structure (large logs, debris jams) that formerly allowed less mobile species to cross larger rivers and streams, adversely affecting these species' dispersal and movement capabilities.

- Timber harvest and agriculture have resulted in generally uniform disturbance from the edge of water bodies upslope, while valley-bottom roads have created a relatively narrow disruption of habitat continuity between riparian areas and upslope.

- Some species (primarily amphibians, some small mammals and birds) are dependent on the habitat conditions created in riparian areas. Fragmentation of these areas reduces habitat and these species' dispersal/migration success.

- Fragmentation of the riparian vegetation community is highest on private lands and along the larger streams in the watershed (Knowles and Sweet creek). Species dependent on late-successional riparian forest conditions will be rare in these areas, if present at all.

**Big Game**

- Management for LSR objectives and Riparian Reserves will, over time, alter the amount and distribution of big-game habitat. As federal lands transition to late-seral conditions, big-game forage habitat will be reduced, while thermal and hiding habitat will increase. Foraging likely will be concentrated on private timber lands and federal land designated as Matrix, if these lands are maintained in seral stages conducive to elk and deer foraging (e.g., young age class). Winter use will increase on federal lands as they transition to late-seral stages, providing thermal and hiding cover. Generally, the anticipated long-term changes in big-game habitat likely will cause a seasonal shift in the use of the watershed by deer and elk, and may result in an overall reduction in the number of these species within the watershed. The resulting pattern of use and population numbers may be similar to pre-European settlement, when these species typically were concentrated at the interfaces of disturbed areas and late-successional habitat, to take advantage of the readily-available forage in close proximity to cover.