Chapter 2:

SCIENTIFIC FRAMEWORK

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2.1 INTRODUCTION

This chapter presents a set of scientific concepts and principles, or a scientific framework, that supplies the context for determining the "best available science" as defined by WAC 365-195-900 to 925 and discussed in the critical area chapters that follow. This framework guides and informs the use and interpretation of the scientific information that is the basis for King County's approach to environmental management. This framework is most applicable to critical areas that protect wildlife, wetland, and aquatic areas. Critical areas that are protected primarily for public safety, property, and health, such as flood hazard areas, channel migration zones, landslide hazard zones, or critical aquifer recharge areas, may directly or indirectly provide a secondary benefit to aquatic or terrestrial ecosystems.

The framework is derived from the current scientifically accepted view of conservation[1] and is the context within which hypotheses are formed, data is collected and interpreted, and conclusions are drawn. The framework also establishes the basis for many other King County management programs and projects that are directed toward the protection and conservation of the County's critical areas and natural resources. Please note that a primary purpose of the proposed critical areas, clearing and grading, and stormwater regulations is to protect the existing functions and values of critical areas. These regulations are not intended to accomplish conservation completely, but they do play an important role in King County's overall efforts to protect and conserve resources.

King County's scientific framework is guided by the principles of conservation, context, connectivity, and complexity. Each of these is described briefly below.

Conservation

Conservation is the act of protecting, recovering, and managing an ecosystem, habitat, biological community, or species for its ecological, scientific, economic, or cultural value. Conservation encompasses actions taken to protect ecosystems, habitats, and fish and wildlife species from further harm and actions taken to preserve future options for recovery. In the face of uncertainty about the workings of ecosystems and the effects of human actions, the potential for harm should be anticipated and human actions should err on the side of caution. In this precautionary context, absence of adequate scientific data should not be used to justify a delay in taking conservation actions.

The scientific framework for conservation has changed dramatically over the last few decades. Historically, the prevailing scientific view focused on habitat and species as the central units of conservation, and nature was presumed stable and in equilibrium. This view is neatly summed up in the phrase "the balance of nature" that is so much a part of discussions about the natural world.

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[1] Conservation is defined as "the protection, recovery, and management of native ecosystems, habitats, and species for their ecologic, scientific, social, cultural, spiritual, aesthetic, and economic values."

However, observations of natural systems over the last three or four decades have led to the questioning of these ideas. Generally, the view of nature that has emerged is one of change at many scales of time and space and of non-equilibrium. It is this dynamic and variable state of nature that results in diversified and healthy ecosystems and biological communities. Natural environments are best and most efficiently maintained and restored if this dynamic characteristic is incorporated into their management. Moreover, because change occurs over long time periods and large areas, natural resource management must include a comprehensive context of analysis for resource protection.

Context

All natural resource protection occurs within an ecologically defined context. The watershed is one such context and is an appropriate scale for planning for many ecosystems. A systems approach to watershed conservation includes consideration of how all of the components of a site function together within the site and surrounding land uses. The arrangement of habitats and ecosystems across the watershed shapes local conditions and responses. Local changes, in turn, have broad-scale impacts over the landscape. Therefore, it is critical to examine context both at the site-specific and the larger scale. Humans and aquatic species are embedded in this context. Another context is regional planning, which is appropriate for many wildlife species that have ranges across watershed boundaries.

Complexity

As natural systems mature and evolve, the resultant structural patterns and linkages among the physical, chemical, and biological elements of a system most often become more complex. The extent and degree of this complexity is formed and driven by the changing patterns that systems undergo through time and the processes controlling those patterns. These patterns contribute to productivity, diversity, richness, and sustainability and thus are critical characteristics of a system. The contemporary view of ecology emphasizes these processes and the behavior of systems rather than static endpoints or stability.

Connectivity

Natural systems are open to the movement of materials and energy including species from outside the system; exchanges with other systems are common. An ecosystem’s structure and dynamics are also influenced by adjacent habitats and ecosystems. This linkage of one system to another is called connectivity. To protect connectivity, human intervention in the ecosystem should follow this hierarchy:

1. Maintain the magnitude and rates of natural processes—both physical and biological (e.g., hydrology, sedimentation, beach erosion, and channel migration as examples of physical processes, and plant succession, wildlife reproduction cycles, and source-sink dynamics as biological processes);

2. Maintain structural complexity (e.g., hydraulic and biological diversity);

3. Maintain function (e.g., soils permeability, plant evapotranspiration, fish or amphibian spawning, rearing, migration, and refuge); and

4. Maintain particular ecosystem attributes, habitats (e.g., pools, spawning riffles, nest tree), and critical species (e.g., chinook salmon, bull trout, western toad, red-legged frog, and native freshwater mussels).

This principle directs human intervention to follow the ecological hierarchy of first identifying and restoring process, then structure, then function. Only where actions to address this hierarchy fail, or are not feasible, should actions be taken to maintain particular ecosystem attributes, habitats, and critical species. The presumption is that at the fourth level of the hierarchy, actions are unsustainable in the long-term.

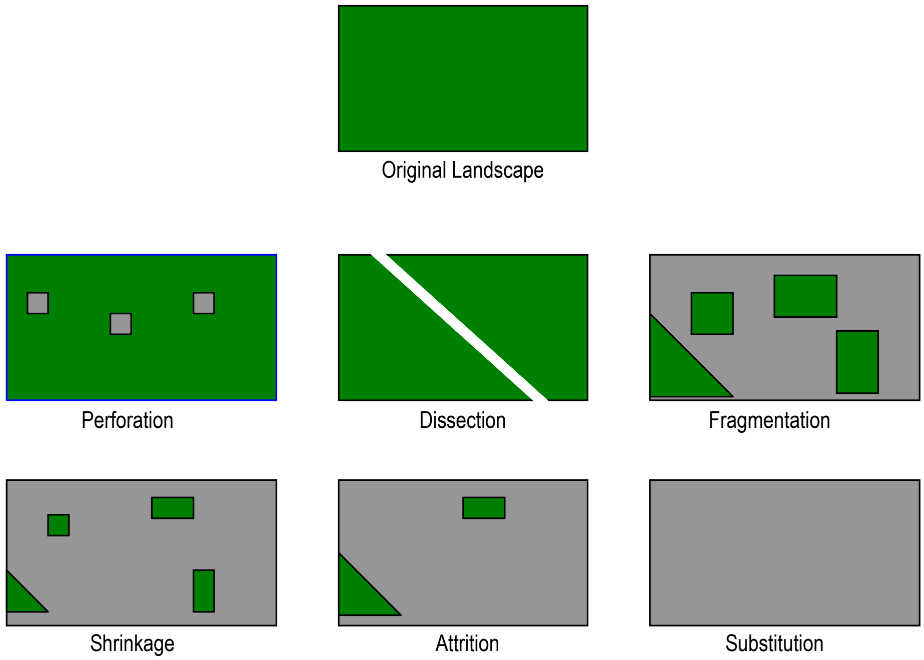
Ecosystems and habitats suitable for particular species are the outcome of various geologic, hydrologic, and biologic processes acting on structural characteristics of the system over time and space. These processes must be maintained at their natural rates and locations for ecosystems to be sustainable and for habitats and their species to be maintained. In general, the more variation from basic processes, the greater the severity and longevity of effects.

2.2 LANDSCAPE EFFECTS

As land is converted to tree farms, agricultural uses, or is urbanized, the area and continuity of native vegetation is transformed from the original composition and arrangement to alternative structures and functions (Figure 2.1). There are several processes associated with land transformation that have serious implications for wildlife and their habitats (Forman 1995). These processes generally represent stages in the transformation process from one type of landscape or patch to another.

The process usually begins with *perforation*—the creation of "holes" in an otherwise homogeneous land or habitat area. This perforation may result from carving out a small portion within the original landscape for a homestead or farm, or it may be the result of a blowdown or fire within a larger forested landscape. *Dissection* may occur simultaneously as a road or rail line splits the landscape into sections, and *fragmentation* occurs as the original landscape is further broken into unconnected pieces. *Shrinkage* is the decrease in size of any habitat or patch. *Attrition* is the disappearance of habitat or patch types and leads, ultimately, to the *substitution* of a new landscape for the original one. The first three processes (perforation, dissection, and fragmentation) are largely the result of transformations that began in the mid-nineteenth century in King County and reached their zenith around the turn of the twentieth century in most of our current agricultural areas. Although no longer the result of agricultural activity, these transformation processes continued through the twentieth century into the present as agricultural and forested landscapes continue to be transformed to suburban and urban ones.

Figure 2.1. Spatial Processes in Land Transformation



Each of the spatial processes described above and illustrated in Figure 1 has distinctive attributes, and each exerts significant effects on a range of ecological characteristics from habitat structure to biodiversity to erosion to water chemistry. Perforation, dissection, and fragmentation may affect the whole landscape or a patch within it; shrinkage and attrition apply mainly to a patch or corridor within the larger landscape. Substitution, the ultimate result of attrition, results in conversion from the original condition to a wholly new one, and it applies mainly to the landscape but is sometimes said of a habitat or patch as well. Table 1 shows the effects of each process on four landscape attributes important to wildlife survival. As each attribute of the landscape is altered, the relationship among habitats and the species that occupy them is likewise altered. Migration patterns, reproductive success, and exposure to invading species and predators are modified as populations are split and isolated. As habitats shrink, they are no longer capable of supporting populations large enough to maintain themselves; many are locally extirpated even though some attributes of the habitat remains.

Table 2.1. Effects of land transformation.

Major processes are listed in the first column and their effects on landscape attributes important to wildlife follow. "+" = increase; "–" = decrease; and a 0 = no change.

Spatial Process	Connectivity	Patch size	Habitat loss	Isolation
Perforation	–	0	+	+
Dissection	–	–	+	+
Fragmentation	–	–	+	+
Shrinkage	–	0	+	+
Attrition	+	0	+	+
Substitution	+/–/0	–	+	0

The survival of species and populations depends on (1) both scales of analysis and impact, (2) local phenomena embedded in the interactions among larger ecosystem, (3) landscape structure and function (Forman1995), and (4) related population dynamics (Merriam 1988a, 1988b, 1990).

2.3 CONCLUSION

Biological diversity, often referred to as biodiversity, is the basis for healthy environments. By protecting biodiversity, healthy and functioning ecosystems can be maintained and restored. Incorporating best available science into King County environmental regulations will contribute to natural resource protection, restoration, and conservation. Current scientific literature emphasizes several principles of natural systems that were not explained by the more static or classical view of nature. The principles of context, connectivity, and complexity are discussed further in Chapter 7 – Aquatic Areas, Chapter 8 – Wildlife Areas, and Chapter 9 – Wetlands.

2.4 REFERENCES

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