INTRODUCTION AND SCOPE

Prior to 1980, wildlife biologists and managers relied primarily upon the literature, personal knowledge, and experience for information about wildlife-habitat relationships in California. This approach to management has a number of obvious limitations in light of emphasis recently placed on ecosystem management. Moreover, because of growing human pressures on natural landscapes, management decisions must be made with full recognition of the cumulative effects of multiple-resource decisions. Therefore, to address these conditions, broad-based, biologically defensible strategies must be developed. To be successful in this endeavor, new concepts and tools are needed. These must include organized, community-level information that not only provides the macroview of species-habitat interactions, but also life history information about individual species. Finally, tools such as this must be microcomputer based, providing flexibility, easy access, and user-friendly interfaces. Recently, a tool or "system" that meets these criteria has been developed for California.

The California Wildlife-Habitat Relationships (WHR) System is the most extensive compilation of such information in California today. It represents a state-of-the-art tool for wildlife-habitat management and research. The goal of the system is to provide credibility to wildlife analyses and resource management decisions.

Currently, the WHR System is composed of: (1) a wildlife species list; (2) species notes (a summary of the status, distribution, habitat requirements, and life history of each vertebrate species that regularly occurs in California); (3) species' distribution maps, (4) computer data base (species-habitat relationships models); and (5) habitat classification and vegetation descriptions (found within this *Guide*). These components can be used separately or in combination. However, to address wildlife responses to changes in habitat, all components should be used collectively, as no single component contains the breadth of information needed for a comprehensive analysis.

This *Guide* describes the various wildlife habitats that constitute the WHR classification system. The classification system was developed for WHR by the California Interagency Wildlife Task Group. Its goal is to identify and classify existing vegetation types important to wildlife. In addition, habitats and structural classes have been designed to accommodate or directly link to commonly collected inventory data (e.g., forest inventory information, USDA Forest Service). The system was not intended to provide the final word on vegetation classification. Rather, it was developed to recognize and logically categorize major vegetative complexes at a scale sufficient to predict wildlife-habitat relationships.

In a hierarchical sense, the WHR habitat classification approximates the association level of a vegetation classification. It is intended to provide an umbrella classification for other more detailed vegetation-classification systems. Confusion commonly exists among different vegetation/habitat-type classifications, as many times one system cannot be linked or compared to another. This is true not only in California, but also throughout the nation, creating significant problems for resource managers, as ancillary resource information (e.g., timber volumes, area estimates by type, wildlife responses, etc.) may not be easily usable because the information was based upon a unique classification. Thus, one objective of the WHR System is to address this problem by providing a framework that diverse resource interests can use to effectively bridge among various disciplines (e.g., wildlife, forestry, and range).

How to Use the Guide

The *Guide* is designed to provide information needed to classify wildlife habitats identified by the WHR System. This can be done either from standard field methods and measurements or by translating between other vegetation-classification systems. Furthermore, the habitats are grouped according to vegetative dominance or unique characteristics to which wildlife are thought to respond. Thus, the following major habitat subdivisions are recognized: Tree-Dominated, Shrub-Dominated, Herbaceous-Dominated, Aquatic, and Developed Habitats. The structural components and section headings are unique to each subdivision and standardized for comparison.

The following provides a step-by-step approach to identifying and describing habitats. First, the user should refer to the section called "Classification Crosswalk." Here an easy reference is provided to the other major vegetation-classification systems used in California. If the user is familiar with a particular system and its specific vegetation types, it will provide initial insight into the composition and structure of WHR habitats. In addition to becoming familiar with the WHR habitats, the user must properly identify appropriate habitats under investigation. This can be accomplished by referring to the following section entitled "How to Classify Habitats," where specific criteria are provided which are necessary for classifying a particular vegetation assemblage into a WHR habitat. Once the habitat of interest has been determined, its description can be found in the guide by referring to the table of contents or appropriate major habitat subdivision depicted by a unique color and logo in the upper portion of each page. The individual habitat descriptions will thus provide specific technical information about each habitat.

Habitat descriptions provide detailed information necessary to recognize the habitat in the field or technically describe it for reports or publications. Each habitat description provides information on structure, composition, habitat stages, biological setting, physical

setting and distribution. A distribution map and color photograph are also provided to further assist in correctly identifying each habitat. Descriptions of seral stages and special habitat components or elements are also provided. Special attention should be given to these elements, as they often dictate whether certain wildlife species may be expected to use a particular habitat.

Because lists of typical plants and animals common to each habitat are a major part of the habitat descriptions, common names are used in the text. DeGarmo (1980) and Munz and Keck (1973) provided the standards for common names. A complete list of species' common and scientific names is included as a separate section of the *Guide*.

It is important to note that this *Guide* describes more habitats than are currently included in the WHR computer data base. Because the *Guide* was written subsequent to completing the data base, additional habitats were included to more fully recognize and describe the major habitats of California. As habitat descriptions were developed, it became obvious that it was nearly impossible to adequately describe habitats with considerable vegetative diversity and wide geographical distributions (e.g., Mixed Conifer, Valley Foothill Hardwood and Valley Foothill Hardwood-Conifer) without further refinement. Thus, we developed finer subdivisions of these habitats. In addition, the Eucalyptus habitat was conspicuously absent from the original habitat list. Hence, the habitat description was included. Some of these habitats may have unique wildlife habitat relationships, while others do not. Nevertheless, it is important to recognize their extensive distribution and unique floral characteristics. It is intended that wildlife information for most of these additional habitats will be added to the WHR computer data base ir the future.

Finally, because the Barren habitat needed little explanation or description, it was not included as a specific habitat in the *Guide*. Barren is defined as lands absent of vegetation measured by canopy closure. Habitats are considered barren at different levels of canopy closure. For example, most desert habitats are considered barren if they support less than 2 percent canopy closure, while tree and shrub habitats are barren if they support less than 10 percent crown closure.

As the WHR System evolves, additional habitats (e.g., dune and specific agricultural types) and species-habitat-relationships models will be added to the computer data base. Additional habitat descriptions will be developed and published as addenda to this publication.

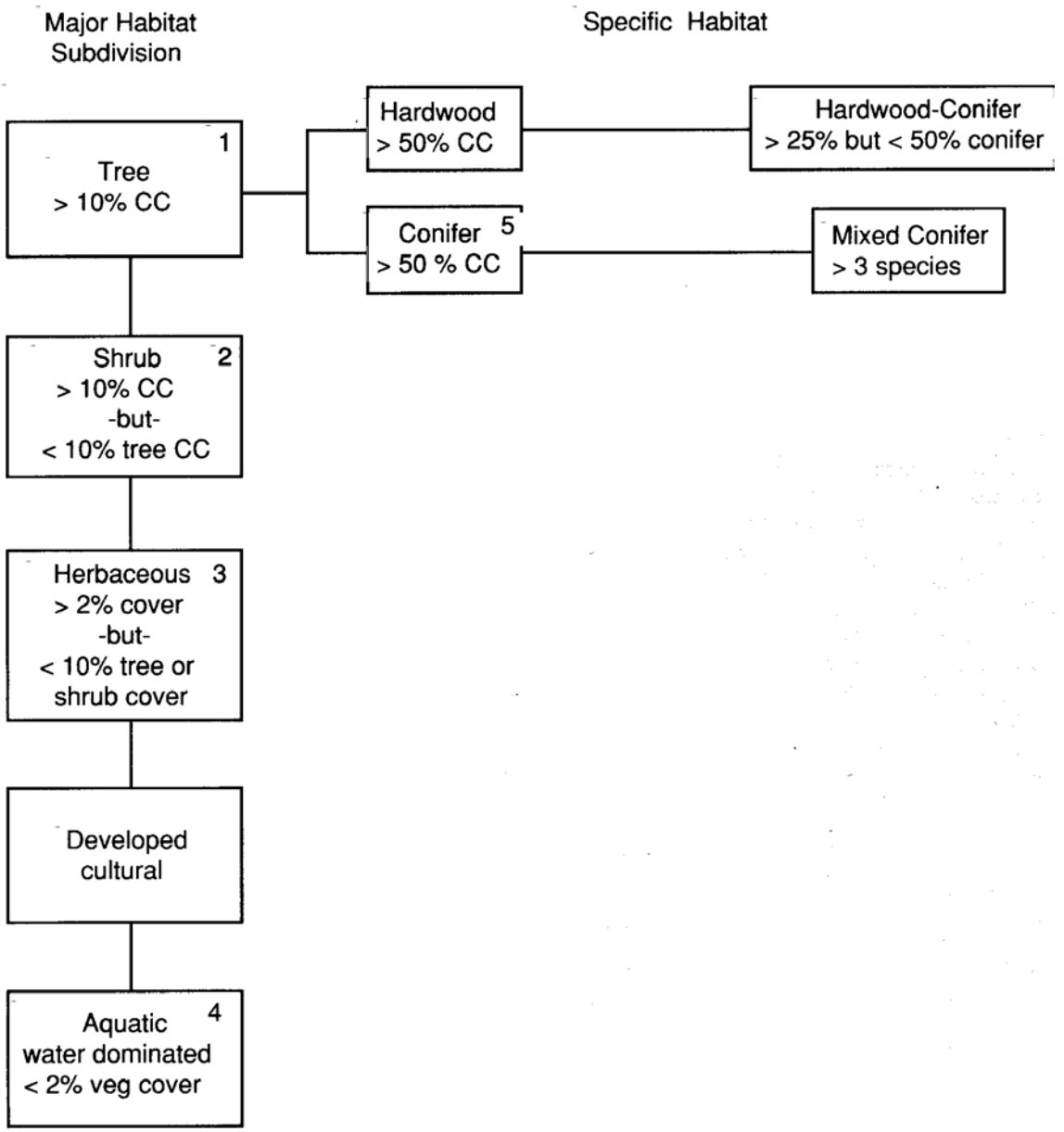
How to Classify Habitats

Before actually attempting to classify a parcel of land (or site) into a WHR habitat, some preliminary work and planning is needed. Ideally, the project area should be delineated on a standard United States Geological Survey (USGS) or USDA Forest Service map base. Information such as slope, aspect, elevation, and so on can thus be determined. Next, existing information, such as inventory data (vegetation or wildlife) or aerial photographs, should be obtained for making final determinations on appropriate habitat classification and in the interpretation of species habitat relationships. The rules for placing a vegetative assemblage into a major habitat subdivision, and ultimately identifying the appropriate habitat, are problematic for any classification system. Nevertheless, arbitrary rules must be established to guide the classification, recognizing that human constructs do not always accommodate natural phenomena. Therefore, the goal of a classification system is to select categories that allow for natural variation, while allowing users to recognize all units in the system. The WHR classification is designed to accomplish this goal. Hence, habitats are based on dominant existing vegetation. Dominance is based on: (1) amount (crown closure) or (2) a unique indicator of specific environmental conditions (i.e., Closed-cone Pine Cypress).

The first step in using the WHR habitat classification is to determine the major habitat subdivision from the following: Tree-Dominated, Shrub-Dominated, Herbaceous-Dominated, Aquatic, and Developed. The latter two are easily identified, as water or cultural (man influenced) are the controlling factors. However, to separate the major habitat subdivisions—Tree-, Shrub-, or Herbaceous-Dominated—the following general rules apply (see Figure 1):

—Tree-Dominated:	Tree canopy exceeds 10 percent crown closure, or young tree density indicates imminent tree dominance.
—Shrub-Dominated:	Shrub canopy closure exceeds 10 percent. However, tree crown closure never exceeds more than 10 percent of the site.
—Herbaceous-Dominated:	Herbaceous cover exceeds 2 percent. Trees and shrubs do not exceed 10 percent cover. If less than 2 percent of the site is covered with herbaceous species, the site is considered barren.

Figure 1. Decision rules for wildlife habitat relationships (WHR) classification hierarchy.



1 = When trees are mixed with shrubs and/or herbaceous species, trees take precedent if their canopy closure accounts for > 10 percent of the total cover (except desert types).

2 = When trees are absent or comprise < 10 percent of the total canopy closure on the site and shrubs exceed 10 percent total canopy closure on the site, shrubs take precedent (except desert types).

3 = When less than 2 percent of the site is covered with herbaceous species and/or tree or shrub canopy closure is < 10 percent of the site, the site is considered barren.

4 = Open water comprises > 98 percent of the surface.

5 = When sites are composed of two conifer species the habitat is determined by the species with the largest percentage canopy closure.

Once a site has been classified into its appropriate major habitat subdivision, the specific habitat can be determined. The general rules for identifying these habitats are illustrated in Figure 1.

The most direct and logical approach to selecting the appropriate habitat is to use deductive reasoning. For example, habitats should be eliminated from consideration by evaluating physiographic criteria, such as elevation, soil, and general distribution. If the site of interest is beyond the range of the major species that compose the habitat (e.g., Coastal Oak Woodland is not found east of the Coast Range) or it is at an elevation that limits certain species (e.g., Mixed Chaparral species do not generally grow above 1,067 meters [3,500 feet] elevation), the array of possible habitats from which to choose is significantly reduced. Similarly, if a habitat is widely distributed throughout the state, composition will be unique to the particular location (considering the range of the individual species).

Scale is another important consideration when classifying habitats. As a general rule, 16 ha (40 ac) is the minimum mapping unit when using 1:24,000 or larger aerial photography. While it is important to make the distinction between mapping and classification, this can be used as a general rule for the WHR classification. Thus, the 16 ha or 40 ac minimum mapping unit can be used as a guide for delineating areas to be classified. However, there are two important exceptions to this general rule: (1) When habitats or habitat patches are rare or restricted to specific site conditions (e.g., wet meadow or riparian), the classification should be based on the unique vegetation or site; (2) The home ranges of certain wildlife species must be considered. If, for example, the goal of a project is to identify habitat for the red tree vole or Siskiyou mountain salamander, the small home range and habitat requirements of the species must be considered when selecting the scale at which to classify habitats. Conversely, if the species of interest is spotted owl, mule deer, or mountain lion, all of which have relatively large home ranges, appropriate considerations must be given. Information on life history, such as home range, can be found in Zeiner et al. (in press).

Once a vegetative complex has been classified to the correct habitat, field measurements must be taken to describe the habitat's structural condition or seral stages. Tables 1-5 provide the technical criteria for structural conditions of all habitats treated in this *Guide*. Standards for these criteria are unique to the major habitat subdivision. For example, stages for Tree-Dominated habitats (Table 1) are based on conifer or hardwood crown diameter (measured in feet), diameter at breast height (dbh is measured as quadratic mean diameter [QMD]) and canopy closure (measured as percent). These stages can be determined using standard forestry-measurement techniques. Similarly, aquatic habitat stages (Table 5) have been recognized. However, these are based on aquatic zones and substrates unique to marine, estuarine, lacustrine, and riverine environments.

Special Habitat Elements

Once a habitat has been identified and appropriately classified, the user may wish to determine the associated wildlife community. This may be accomplished by referring to the WHR computer data base as previously mentioned. It is important to recognize that these predictions are for large scale projects or for quick analyses where a "general" degree of accuracy is sufficient. Indeed, analyses such as this provide valuable community level information. However, when predictions are used to guide management decisions on the ground, a greater degree of accuracy is required. Therefore, additional dimensions of a habitat must be considered.

It has long been argued that habitat and niche are closely aligned, or as many believe, one in the same. Fundamental niche, as described by Hutchinson (1978), lays the theoretical basis for identifying and describing important habitat elements, in addition to floristic and structural parameters, that are essential for a species' existence within a habitat. These special habitat elements must therefore be included into a habitat inventory and used as an integral part of the WHR computer projections for more precise evaluations. A user is encouraged to collect information about these habitat elements during the normal course of classifying habitats. Special habitat elements are specific physical and biological attributes of the landscape (e.g., ponds and snags) without which, certain species are not expected to be present, or if present, are at relatively low population numbers. At relatively large scales (e.g., county level) one can assume that many of the special habitat elements are present, and therefore, it is not necessary to query the data base for specific elements to improve the accuracy of predictions. However, for site specific projects (e.g., development of a housing tract or timber sale) reasonable accuracy of predictions is assured only when special habitat elements are considered.

Special habitat elements in the WHR system are grouped into eight major categories and associated subclasses. Elements may be environmental diversity (e.g., dead vegetation elements such as snags or physical elements such as friable soils) or food items (e.g., vegetative or diet elements). We make no pretense that the elements identified in the WHR data base are exhaustive. Rather, the elements included are a first approximation (initially most important), and will thus be expanded upon as more biological information becomes available. The definition of the special habitat elements are as follows:

Live Vegetation Elements

TREE LAYER: Subcanopy trees greater than 10 percent cover.

SHRUB LAYER: Subcanopy shrubs greater than 10 percent cover.

HERBACEOUS LAYER: Subcanopy herbaceous vegetation greater than 10 percent cover.

TREES, HARDWOOD: Hardwood trees with diameter breast high (dbh) greater than 280 mm (11 in).

TREES, PINE: Trees of the genus *Pinus* with dbh greater than 280 mm (11 in).

TREES, FIR: Trees of the genus *Abies* with dbh greater than 280 mm (11 in).

TREES, LIVE WITH BROKEN TOP: Trees with dbh greater than 280 mm (11 in) which have a broken top.

TREES, WITH LOOSE BARK: Trees possessing loose bark.

TREES WITH CAVITIES: Trees possessing one or more cavities.

RIPARIAN INCLUSION: Small (not mapable) stand of vegetation which is associated with permanent water, includes seeps.

AQUATICS, SUBMERGED: Rooted vascular plants which do not emerge above the water surface.

AQUATICS, EMERGENT: Rooted vascular plants which emerge above the water surface.

Dead or Decadent Vegetation Elements

Snags are standing dead or mostly dead trees with the following decay classes:

Sound—Top intact, bark on, wood sound, or

Rotten—Top broken, bark sloughing off, wood decaying and falling apart.

SNAG, SMALL: Diameter breast high less than 380 mm (15 in).

SNAG, MEDIUM: Diameter breast high between 380 mm and 760 mm (15 and 30 in).

SNAG, LARGE: Diameter breast high greater than 760 mm (30 in).

STUMP: Any snag less than 3 m (10 ft) in height.

Vegetation Residues

Residues are all dead and decaying vegetation, from duff to down logs on the ground, with decay classes for large slash, and all sizes of logs as follows:

Sound—Wood sound.

Rotten—Wood rotting, falling apart.

Hollow—Center of log is hollow.

DUFF: Non-structured decaying matter.

LITTER: Residue less than 25 mm (1 in) in diameter.

SLASH, SMALL: Residue 25-76 mm (1-3 in) in diameter.

SLASH, LARGE: Residue 76-254 mm (3-10 in) in diameter.

LOG, MEDIUM: Residue 254-508 mm (10-20 in) in diameter.

LOG, LARGE: Residue greater than 508 mm (20 in) in diameter.

BRUSH PILE: Slash that has been moved into a pile at least 1 m (3 ft) in height and covering an area of at least 15 m^2 (160 ft^2).

Habitat Edge Elements

TREE/SHRUB: Transition between any stand of trees, size class 3, 4, 5, or 6, and tree size class 2, or shrub classes 2, 3, or 4.

TREE/GRASS: Transition between any stand of trees size class 3, 4, 5, or 6, and tree or shrub classes 1, or any herbaceous stand.

TREE/WATER: Transition between any stand of trees size class 3, 4, 5, or 6, and any wetland or aquatic type.

TREE/AGRICULTURE: Transition between any wildland tree stand of size class 3, 4, 5, or 6, and any agricultural cover type.

SHRUB/GRASS: Transition between any stand of trees size class 2 or any stand of shrubs classes 2, 3, or 4, and any herbaceous stand, or any stand of trees or shrubs class 1.

SHRUB/WATER: Transition between any stand of shrubs, classes 2, 3, or 4, and any wetland or aquatic type.

SHRUB/AGRICULTURE: Transition between any stand of shrubs size class 2, 3, or 4, and any agricultural cover type. GRASS/WATER: Transition between any herbaceous stand, or any stand of shrubs or trees size class 1, and any wetland or aquatic habitat.

GRASS/AGRICULTURE: Transition between any herbaceous site, or any site with shrubs or trees of size class 1, and any agricultural cover type.

WATER/AGRICULTURAL: Transition between any wetland or aquatic habitat and any agricultural cover type.

Physical Elements

Soils:

SOIL, FRIABLE: Easily crumbled or pulverized soil.

SOIL, ORGANIC: Soil which contains greater than 20 percent of organic matter by weight.

SOIL, GRAVELY: Soil dominated by gravel size grains 2 to 75 mm (.08 to 3.0 in) in diameter.

SOIL, SANDY: Soil dominated by sand size grain .05 to 2 mm (.002 to .08 in) in diameter.

SOIL, AERATED: Soil that is well-drained and aerated.

SOIL, SALINE: Soils which are saline or alkaline, supporting vegetation which is salt tolerant (e.g., pickleweed, salt grass, shadscale, iodine bush).

Geologic:

BARREN: Areas within a vegetation dominated habitat that are devoid of vegetation.

BANK: The rising ground bordering a body of water or forming the edge of a cut or hollow.

SAND DUNE: A hill or ridge of sand piled up by the wind.

BURROW: A hole or excavation in the ground made by an animal.

CAVE: A natural underground chamber open to the surface.

CLIFF: A steep, vertical or over-hanging face of rock or earth.

LITHIC: A scatter of rocks less than 254 mm (10 in) in diameter on the ground.

ROCK: An outcrop of rocks greater than 254 mm (10 in) diameter.

TALUS: A slope formed by an accumulation of rock debris, often at the base of a cliff.

STEEP SLOPE: Slopes greater than 50 percent.

Aquatic Elements

WATER: Any source of free water.

VERNAL POOLS: Pools, ponds, or lakes that retain water during Spring, but dry up in Summer.

PONDS: Permanent water bodies of less than 2 surface ha (5 surface ac).

LAKES: Permanent lakes or reservoirs greater than 2 surface ha (5 surface ac).

STREAMS, INTERMITTENT: Intermittent lotic water courses (i.e., they dry up in part of the year).

STREAMS, PERMANENT: Permanent lotic water courses less than 6 m (20 ft) wide during the dry season.

RIVERS: Permanent lotic water courses greater than 6 m (20 f) wide during the dry season.

MUD FLATS: Expanses of mud contiguous to a water body often covered and exposed by tides.

SPRINGS: Freshwater springs or seeps.

MINERAL SPRINGS: Mineral springs or seeps.

BOGS: Low-lying and inadequately drained areas rich in plant residues.

HOT SPRINGS: Hot water springs.

TIDEPOOLS: Pools formed in potholes during the ebbing of a tide.

WATER, SLOW: Streams and rivers with low gradients and low water velocity less than 0.15 m/sec (0.5 ft/sec) with bottoms that are at least partially silted.

WATER, FAST: Streams and rivers with high gradients and high water velocities greater than 0.60 m/sec (2 ft/sec) with unsilted bottoms.

Vegetative Diet Elements

Lower Plants:

FUNGI: Saprophtic spore-forming, non-vascular plants such as mushrooms, molds, etc.

LICHENS: Algal-fungal symbiotic associations on solid surfaces.

MOSS: Bryophytic plants.

FERNS: Spore-forming vascular plants with leaf-like fronds.

KELP: Large, coarse, brown algae.

ALGAE: Any algae other than kelp.

Higher Plants:

GRAMINOIDS: Grasses and grass-like plants.

FORBS: Herbaceous dicotyledonous plants.

SHRUBS: Woody plants of smaller stature than trees when fully grown.

TREE LEAVES: The leaves (and/or new stem production) of trees.

SAP: The fluid part of a plant.

ROOTS: The underground parts of plants.

Fruits:

SEEDS: The ripened ovules of flowering plants, exclusive of seeds listed below.

ACORNS: Fruit of an oak.

GRAIN: A single, hard seed of a cereal grass.

BERRIES: Pulpy fruit of relatively small size.

FRUITS: Pulpy fruit reproductive body of a seed plant.

NUTS: Hard-shelled, dry fruit.

CONES: Ovule-bearing mass of scales or bracts of gymnosperm trees.

FLOWERS: Flowers.

NECTAR: The sweet fluids secreted by flowers.

Animal Diet Elements

Invertebrates:

INVERTEBRATES: Animals without backbones; in

this case, a more general term than the three immediately below.

INSECT, TERRESTRIAL: Insect fed upon while not on or under water or in the air.

INSECT, FLYING: Insect fed upon in the air.

AQUATIC INVERTEBRATES: Invertebrates fed upon on or below the surface of the water.

Vertebrates:

FISH: Fish.

AMPHIBIANS: Salamanders, frogs, toads.

REPTILES: Turtles, lizards, snakes.

BIRDS, SMALL: Birds that weigh less than 110 g (4 oz).

BIRDS, MEDIUM: Birds that weigh 110 to 450 g (4 oz to 1 lb).

BIRDS, LARGE: Birds that weigh greater than 450 g (1 lb).

MAMMALS, SMALL: Mammals that weigh less than 110 g (4 oz).

MAMMALS, MEDIUM: Mammals that weigh 110 to 2270 g (4 oz to 5 lb).

MAMMALS, LARGE: Mammals that weigh greater than 2270 g (5 lb).

CARRION: Any dead animal matter, first encountered while dead.

EGGS: Any eggs of birds or reptiles.

Man-made Elements

NEST ISLAND: An island constructed for bird nesting.

NEST BOX: A box constructed to provide secondary cavity nesters a nesting site.

NEST PLATFORM: An elevated platform constructed for large bird nesting site.

TRANSMISSION LINES: Above ground transmission lines (e.g., electricity, telephone) and their support towers.

BUILDINGS: Houses, sheds, etc.

FENCES: Any type of fence.

CAMPGROUNDS: Physical structures of campgrounds along with associated human use (refuge, food scraps, etc.).

PACK STATION: Pack stations along with associated human use.

WATER: Any artificial water catchment, storage, and distributing structure, e.g., pit, guzzler, well, etc.

DUMP: Sanitary landfills.

WHARF: Principally wooden structures extending into aquatic habitats.

JETTY: Rock or concrete structures extending into aquatic habitats.

SALT PONDS: Saline ponds used for salt extraction.

Value of Special Habitat Elements

The importance of these special habitat elements to different wildlife species varies from none to the element being essential to the continued persistence of the species in an area. The WHR system recognizes that the presence or absence of elements modifies the capability of a habitat to support the species. The system rates the value of the modification as four classes: *not rated*—if the species uses the element, but the element does not enhance the capability of the habitat for the species; *preferable*—the element is used by the species to a greater degree than what would be expected from its abundance, the element enhances the value of the habitat, but is not essential for the species presence; *secondarily essential*—an element must be present within the home range of the species for the species to be present unless it is compensated by the presence of another secondarily essential element that serves the same function to the species; and *essential*—the element must be present within the home range of a species for the species to be present.

And finally, an important element involved in determining species use is patch size. While the current WHR system does not include patch size as a part of the computer data base, the user is urged to consider patch size in the final analysis of the computer projections. Species life history information such as home range size must be considered in determining species presence or absence.

Table 1. Available Habitat Stages For Tree Dominated Habitats

Tree Habitat		Habitat Stage																	
		1	2S	2P	2M	2D	3S	3P	3M	3D	4S	4P	4M	4D	5S	5P	5M	5D	6
SCN	Subalpine Conifer	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
RFR	Red Fir	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
LPN	Lodgepole Pine	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
SMC	Sierran Mixed Conifer	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
WFR	White Fir	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
KMC	Klamath Mixed Conifer	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DFR	Douglas-Fir	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
JPN	Jeffrey Pine	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
PPN	Ponderosa Pine	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
EPN	Eastside Pine	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
RDW	Redwood	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
PJN	Pinyon-Juniper	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
JUN	Juniper	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
CPC	Closed-Cone Pine-Cypress	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
ASP	Aspen	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
MHC	Montane Hardwood-Conifer	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
MHW	Montane Hardwood	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
BOW	Blue Oak Woodland	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
BOP	Blue Oak—Digger Pine	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
VOW	Valley Oak Woodland	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
COW	Coastal Oak Woodland	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
MRI	Montane Riparian	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
VRI	Valley Foothill Riparian	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	

Standards For Tree Size

WHR	WHR Size Class	Conifer Crown Diameter	Hardwood Crown Diameter	dbh
1	Seedling Tree	n/a	n/a	<1"
2	Sapling Tree	n/a	<15"	1"–6"
3	Pole Tree	<12'	15'–30'	6"–11"
4	Small Tree	12'–24'	30'–45'	11"–24"
5	Medium/Large Tree	>24'	>45'	>24"
6	Multi-Layered Tree	Size class 5 trees over a distinct layer of size class 4 or 3 trees, total tree canopy exceeds 60% closure		

Standards For Canopy Closure

WHR	WHR Closure Class	Ground Cover (Canopy Closure)
S	Sparse Cover	10–24%
P	Open Cover	25–39%
M	Moderate Cover	40–59%
D	Dense Cover	60–100%

2. Available Habitat Stages For Shrub Dominated Habitats

Shrub Habitat	Habitat Stage												
	1	2S	2P	2M	2D	3S	3P	3M	3D	4S	4P	4M	4D
Alpine Dwarf Shrub	●	●	●	●		●	●	●		●	●	●	
Low Sagebrush	●	●	●	●		●	●	●		●	●	●	
Bitterbrush	●	●	●	●	●	●	●	●	●	●	●	●	●
Sagebrush	●	●	●	●	●	●	●	●	●	●	●	●	●
Montane Chaparral	●	●	●	●	●	●	●	●	●	●	●	●	●
Mixed Chaparral	●	●	●	●	●	●	●	●	●	●	●	●	●
Chamise-Redshank Chaparral	●	●	●	●	●	●	●	●	●	●	●	●	●
Coastal Scrub	●	●	●	●	●	●	●	●	●	●	●	●	●

Standards For Shrub Size

WHR Size Class	Crown Decadence
Seedling Shrub	(seedlings or sprouts <3 years)
Young Shrub	None
Mature Shrub	1–25%
Decadent Shrub	>25%

Standards For Canopy Closure

WHR	WHR Closure Class	Ground Cover (Canopy Closure)
S	Sparse Cover	10–24%
P	Open Cover	25–39%
M	Moderate Cover	40–59%
D	Dense Cover	60–100%

3. Available Habitat Stages For Herbaceous Dominated Habitats

Herbaceous Habitat	Habitat Stage							
	1S	1P	1M	1D	2S	2P	2M	2D
Annual Grassland	●	●	●	●	●	●	●	●
Perennial Grassland	●	●	●	●	●	●	●	●
Wet Meadow	●	●	●	●	●	●	●	●
Freshwater Emergent Wetland	●	●	●	●	●	●	●	●
Saline Emergent Wetland	●	●	●	●	●	●	●	●

Standards For Height Classes

WHR	WHR Height Class	Plant Height at Maturity
1	Short Herb	<12"
2	Tall Herb	>12"

Standards For Canopy Closure

WHR	WHR Closure Class	Ground Cover (Canopy Closure)
S	Sparse Cover	2–9%
P	Open Cover	10–39%
M	Moderate Cover	40–59%
D	Dense Cover	60–100%

Table 4. Available Habitat Stages For Desert Habitats

Tree/Shrub Habitat		Habitat Stage																	
		1	2S	2P	2M	2D	3S	3P	3M	3D	4S	4P	4M	4D					
DRI	Desert Riparian (Tree)	●	●	●	●	●	●	●	●	●	●	●	●	●					
POS	Palm Oasis (Tree)	●	●	●	●	●	●	●	●	●									
JST	Joshua Tree (Tree)	●	●	●	●		●	●	●										
DSW	Desert Wash (Shrub)	●	●	●	●	●	●	●	●	●	●	●	●	●					
DSS	Desert Succulent Shrub	●	●	●	●		●	●	●		●	●	●						
DSC	Desert Scrub	●	●	●	●		●	●	●		●	●	●						
ASC	Alkali Desert Scrub	●	●	●	●		●	●	●		●	●	●						

Standards For Tree Sizes In Palm Oasis and Joshua Tree Habitats

WHR	WHR Size Class	Base Diameter Above Bulge: Palm Oasis	Joshua Tree
1	Seedling	<1.5"	<1.5'
2	Small Tree	1.5–20"	1.5–6"
3	Large Tree	>20"	>6"

Standards For Tree/Shrub Heights In Desert Wash and Desert Riparian Habitats

WHR	WHR Closure Class	Ground Cover (Canopy Closure)
1	Seedling Tree/Shrub	<2'
2	Small Tree/Shrub	2–10'
3	Medium Tree/Shrub	10–20'
4	Large Tree	>20'

Standards For Canopy Closure

WHR	WHR Closure Class	Ground Cover (Canopy Closure)
S	Sparse Cover	2–9%
P	Open Cover	10–39%
M	Moderate Cover	40–59%
D	Dense Cover	60–100%

Table 5. Available Habitat Stages For Aquatic Habitats

Aquatic Types		Zones and Substrates																		
		1	2O	2M	2S	2G	2R	2B	3O	3M	3S	3G	3R	3B	4O	4M	4S	4G	4R	4B
MAR	Marine	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
EST	Estuarine	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
LAC	Lacustrine	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
RIV	Riverine	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Standards For Aquatic Zones

Aquatic Zone	Zone Number	Standard
Pelagic (1, 2) Limnetic (3) Open Water (4)	1	Open Waters, not closely associated with shoreline or bottom
Subitidal (1, 2) Submerged (3, 4)	2	Substrate continually submerged
Intertidal (1, 2) Periodically Flooded (3, 4)	3	Substrate flooded from time to time (includes tidal action and splash zone)
Shore (1, 2, 3, 4)	4	Substrate is continually exposed and not occupied by vegetation (less than 2% canopy closure)

1-Marine; 2-Estuarine; 3-Lacustrine; 4-Riverine

Standards For Aquatic Substrates

Substrate	Substrate Letter	Standard
Organic	O	Substrate is composed predominantly of organic material
Mud	M	Wet, soft earth (clays and silts; less than 0.074 mm (0.003 in) diameter covering at least 75% of the surface
Sand	S	Coarse grained mineral sediments 0.074 mm (0.003 in) to 2 mm (0.08 in) covering at least 75% of the surface
Gravel/Cobble	G	Rock fragments 2 mm (0.08 in) to 7.6 mm (3 in) covering at least 75% of the surface
Rubble/Boulders	R	Rock fragments greater than 7.6 mm (3 in) covering at least 75% of the surface
Bedrock	B	Bedrock covers at least 75% of the surface