4.10 Terrestrial Ecology

4.10.1 Introduction

Resource Issues

- Distribution and species composition of lowland plant communities
- Distribution and species composition of upland plant communities
- Diversity and abundance of associated wildlife communities
- Shorebirds and waterfowl

The terrestrial ecology of the Tennessee River Valley is unique in its diversity. Braun (1950) recognized four forest regions in the Valley: oak-chestnut, mixed mesophytic, western mesophytic, and oak-pine. Approximately 60 species of reptiles, 70 species of amphibians, 180 species of breeding birds, and 60 species of mammals occur in these forested regions and other habitats throughout the Valley (adapted from Ricketts et al. 1999).

The area of the Tennessee River system within 0.25 mile of reservoir shorelines was the study area for terrestrial ecology, since this zone contains several plant and animal communities that depend on or are otherwise associated with existing reservoir conditions. Vegetative communities of the Valley can be grouped into two broad categories: lowland and upland. Lowland communities are associated with creeks, streams, rivers, and reservoirs and are most likely to be influenced by changes in reservoir operations. Upland communities include all other communities lacking an aboveground hydrologic connection to a waterbody. These areas are typically situated at or above maximum summer pool levels.

Many plant communities, such as bottomland hardwood forest, scrub/shrub wetlands, and flats are widespread in the Valley. Changes in the elevation, duration, and timing of flooding of lowland communities may affect their distribution and species composition. Upland communities may be affected by loss of shoreline from erosion, conversion of land to residential development, and changes in groundwater levels.

Changes in the reservoir operations policy could affect the:

- Distribution and species composition of lowland communities;
- Distribution and species composition of upland communities;
- Diversity and abundance of associated wildlife communities; and,
- Shorebirds and waterfowl.

Throughout the Valley and surrounding region, the primary threats to plant and animal communities are loss of habitat and the introduction of invasive exotic species (Stein et al. 2000). As human populations and associated development have increased throughout the region, many communities have become increasingly rare. More than 30 percent of all ecological communities throughout the Southeast are considered imperiled or critically imperiled on a global scale (Stein et al. 2000). Globally imperiled wetland plant

communities that are known from or with potential to occur in the study area are listed in Tables 4.10-01 and 4.10-02, respectively.

Wildlife dependent on flats, wetlands, or other lowland community types would potentially be affected by the proposed changes in reservoir operations. These groups of wildlife contain a variety of migratory waterfowl, wading birds, shorebirds, songbirds, and other non-game animals—including reptiles, amphibians, and small mammals. (See Section 4.14, Managed Areas and Ecologically Significant Sites, for discussions about bird-watching.)

4.10.2 Regulatory Programs and TVA Management Activities

Regulatory Programs

Federal legal authorities that apply to the terrestrial ecology on TVA lands and reservoirs include the Migratory Bird Treaty Act of 1918 and Executive Order 13186—Responsibilities of Federal Agencies to Protect Migratory Birds. The Migratory Bird Treaty Act decreed that all migratory birds and their parts (including eggs, nests, and feathers) are fully protected. Executive Order 13186 requires federal agencies implementing or planning actions that could affect migratory birds and their habitats to "support the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions." The executive order requires federal agencies whose actions may negatively affect migratory birds to develop memoranda of understanding with the USFWS to promote migratory bird conservation.

Generally, these legal authorities establish policies for the conservation of all native birds of the United States, except species that are managed by the states, such as northern bobwhite (*Colinus virginianus*) and wild turkey (*Meleagris gallopavo*). Furthermore, state and federal agencies provide for planned management activities designed to protect and enhance natural resources along the reservoir system (see Section 4.14, Managed Areas and Ecologically Significant Sites).

TVA Management Activities

TVA uses a variety of land management activities to identify and protect natural resources on TVA lands. TVA's Regional Natural Heritage Program maintains a database to track populations of rare and protected plants and animals and significant natural areas throughout the TVA Power Service Area. Once significant populations of protected species are identified on TVA lands, TVA actively monitors these populations of rare plants and animals and takes actions to conserve them.

Table 4.10-01 Globally Imperiled Wetland Plant Communities Known to Occur in the Study Area

Common Name	Global Rank[1]
Appalachian montane alluvial forest: sycamore–tuliptree–(yellow birch, sweet birch)/smooth alder–mountain doghobble forest	G2U
Beech-mixed hardwood floodplain forest: American beech–oak species–red maple–black walnut forest	G2G3
Eastern Highland Rim rich floodplain terrace forest: sweetgum–swamp chestnut oak–kingnut hickory/American beech–(yellow buckeye) forest	G2G3Q
Maple-hickory mesic floodplain forest: sugar maple–bitternut hickory/common pawpaw floodplain forest	G2
Swamp forest-bog complex (typic type): eastern hemlock–red maple–(tuliptree, blackgum)/great rhododendron/peatmoss species forest	G2
Floodplain canebrake: giant cane shrubland	G2U
Cumberland Plateau rockhouse: cave alumroot–rockhouse meadowrue–(rockhouse white snakeroot, rockhouse goldenrod) herbaceous vegetation	G2
Cumberland Plateau wet sandstone cliff: cinnamon fern–northern beaksedge–rockhouse meadowrue Cumberland seepage cliff herbaceous vegetation	G1G2Q
Cumberland River limestone seep cliff: southern maidenhair–false nettle–great blue lobelia herbaceous vegetation	G2G3
Duck River scour prairie: big bluestem–river-oats–willowleaf bluestar herbaceous vegetation	G2G3
Hiwassee/Ocoee bedrock scour vegetation: little bluestem–chairmaker's bulrush–grassleaf rush–late thoroughwort herbaceous vegetation	G2
Limestone seep glade: flat spikerush–yellow sunnybell–crawe's sedge–nodding onion herbaceous vegetation	G2U
Limestone glade streamside meadow: leafy prairie-clover–axil-flower–caribbean miterwort herbaceous vegetation	G2U

[1] Global rank definitions:

G1 = Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction or elimination.

G3 = Vulnerable globally either because very rare and local throughout its range, found only in restricted range (even abundant in some locations), or because of other factors making it vulnerable to extinction or elimination.

Qualifiers:

U = Unranked (current rank is tentative, global rank not yet assessed).

Q = Questionable taxonomy that may reduce conservation priority.

Source: NatureServe Explorer 2001.

Table 4.10-02 Globally Imperiled Wetland Plant Communities not Known but with Potential to Occur in the Study Area

Common Name	Scientific Name	Global Rank[1]	Distribution in United States[2]	Expected Distribution in Study Area	
				Associated Habitat	Physiographic Region
Forests					
Interior forested acid seep: Carolina red maple–blackgum/wild azalea–southern wild raisin/netted chainfern forest	*Acer rubrum* var. *trilobum–Nyssa sylvatica/ Rhododendron canescens–Viburnum nudum* var. *nudum*/ *Woodwardia areolata*	G2G3	IL*, KY, TN	Floodplains, seeps	Coastal Plain
Montane floodplain slough forest: Carolina red maple–green ash/fringed sedge–green arrow-arum forest	*Acer rubrum* var. *trilobum–Fraxinus pennsylvanica/Carex crinita–Peltandra virginica*	G1	NC	Floodplains	Blue Ridge
Pin oak – post oak lowland flatwoods: pin oak–(post oak)–cherrybark oak/ quillwort species forest	*Quercus palustris*–(*Quercus stellata*)–*Quercus pagoda/ Isoetes* spp.	G2G3	AR*, IL, IN, KY*, MO, TN*	Floodplains	Highland Rim, Coastal Plain
Upland sweetgum – red maple pond: sweetgum–red maple/sedge species–peatmoss species forest	*Liquidambar styraciflua–Acer rubrum*/*Carex* spp.–*Sphagnum* spp.	G2Q	AL, GA, NC, TN	Upland depressions, floodplains, seeps	Blue Ridge
Water tupelo sinkhole pond swamp: water tupelo/ buttonbush pond forest	*Nyssa aquatica/ Cephalanthus occidentalis*	G1U	AR, MO, TN*	Upland depressions	Highland Rim
White oak sandstone ridgetop depression forest: white oak–blackgum sandstone ridgetop depression forest	*Quercus alba–Nyssa sylvatica*	G2U	AL, TN*	Upland depressions, vernal pools	Cumberland Plateau
Scrub/Shrub Vegetation					
Southern Appalachian bog (rhododendron type): great rhododendron/ peatmoss species shrubland	*Rhododendron maximum*/*Sphagnum* spp.	G2G3Q	NC, TN, VA	Seeps, floodplains of small streams	Blue Ridge

Table 4.10-02 Globally Imperiled Wetland Plant Communities not Known but with Potential to Occur in the Study Area (continued)

Common Name	Scientific Name	Global Rank[1]	Distribution in United States[2]	Expected Distribution in Study Area	
				Associated Habitat	Physiographic Region
Herbaceous Vegetation					
Cumberland sandstone flatrock glade: elf orpine–smooth sandwort sandstone herbaceous vegetation	*Diamorpha smallii–Minuartia glabra*	G2G3	AL*, GA*, TN	Glades (sandstone)	Nashville Basin
Floodplain pool: green arrow-arum–lizard's-tail–fringed sedge/tree moss herbaceous vegetation	*Peltandra virginica–Saururus cernuus–Carex crinita/ Climacium americanum*	G2U	DE*, MD*, NC, NJ*, TN*, VA	Floodplains, seeps	Blue Ridge
Kentucky prairie cordgrass marsh: prairie cordgrass western Kentucky herbaceous vegetation	*Spartina pectinata*	G1Q	KY, TN*	Seeps, wet prairies	Highland Rim
Midwest acid seep: fringed sedge–royal fern species/peatmoss species herbaceous vegetation	*Carex crinita–Osmunda* spp./ *Sphagnum* spp.	G2G3	AR, IL, IN, KY*, MO, OH*, TN	Seeps, headwaters of small ravines	Highland Rim, Coastal Plain
Southern Appalachian acid seep: fowl mannagrass–mountain fringed sedge–white turtlehead–purple-stem aster/peatmoss species herbaceous vegetation	*Glyceria striata–Carex gynandra–Chelone glabra–Symphyotrichum puniceum/Sphagnum* spp.	G2G3	AL*, GA, NC, SC*, TN	Seeps	Blue Ridge

[1] Global rank definitions:

G1 = Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction.
G2 = Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction or elimination.
G3 = Vulnerable globally either because very rare and local throughout its range, found only in restricted range (even abundant in some locations), or because of other factors making it vulnerable to extinction or elimination.

Qualifiers:

U = Unranked (current rank is tentative, global rank not yet assessed).
Q = Questionable taxonomy that may reduce conservation priority.

[2] Distribution as reported by NatureServe. Asterisks (*) indicate that the presence of this community type is unconfirmed in that state.

Source: NatureServe Explorer 2001.

4.10.3 Lowland Plant Communities

Existing Conditions

Tables 4.10-01 and 4.10-02 present the names, global ranks, and distribution of the imperiled lowland communities known to occur or with potential to occur in the study area. Although specific locations have not been identified in the study area for some imperiled wetland plant communities, Table 4.10-02 provides information on the expected distribution of these communities, including the associated habitat and physiographic region.

Bottomland hardwood forests occur in floodplains as well as along terraces, natural levees, and back-lying sloughs associated with reservoirs. Representative tree species found in these forests are listed in Table 4.10-03. Five globally imperiled floodplain forest communities are known from the study area. Four other globally imperiled floodplain or riparian communities are not known from the study area but could occur there. More detailed information on lowland plant communities can be found in Appendix D5, Terrestrial Ecology.

Table 4.10-03 Representative Tree Species Found in Bottomland Hardwood Forests

Common Name	Scientific Name
Bald cypress	*Taxodium distichum*
Black gum	*Nyssa sylvatica*
Black willow	*Salix nigra*
Box elder	*Acer negundo*
Cottonwood	*Populus deltoides*
Green ash	*Fraxinus pennsylvanica*
Hackberry	*Celtis occidentalis*
Red maple	*Acer rubrum*
River birch	*Betula nigra*
Silver maple	*Acer saccharinum*
Sugarberry	*Celtis laevigata*
Sweet gum	*Liquidambar styraciflua*
Sycamore	*Platanus occidentalis*
Water oak	*Quercus nigra*
Water tupelo	*Nyssa aquatica*
White oak	*Quercus alba*
Willow oak	*Quercus phellos*

Scrub/shrub and herbaceous communities also occur in floodplains, terraces, and other saturated to temporarily flooded riparian habitats. Tree and shrub species commonly occurring in these habitats are listed in Table 4.10-04. Three globally imperiled riparian plant communities occur in the study area. A globally imperiled herbaceous community (the floodplain pool) potentially occurs in the Blue Ridge Physiographic Region.

Reservoir flats occur in the drawdown zone between maximum summer and minimum winter pool elevations. These habitats tend to be dominated by plant species capable of completing their life cycle between the start of each annual winter drawdown and frost (Webb et al. 1988, Amundsen 1994). Table 4.10-05 lists representative plant species found on reservoir flats. No globally imperiled plant communities are known to be associated with reservoir flats in the study area.

Table 4.10-04 Representative Tree and Shrub Species Found in Scrub/Shrub Wetlands

Common Name	Scientific Name
Black willow	*Salix nigra*
Box elder	*Acer negundo*
Buttonbush	*Cephalanthus occidentalis*
Green ash	*Fraxinus pennsylvanica*
Red maple	*Acer rubrum*
Silky dogwood	*Cornus amomum*
Silver maple	*Acer saccharinum*
Smooth alder	*Alnus serrulata*
Swamp loosestrife	*Decodon verticillatus*
Swamp rose	*Rosa palustris*
Sycamore	*Platanus occidentalis*
Virginia willow	*Itea virginica*
Water hemlock	*Cicuta maculata*

Table 4.10-05 Representative Plant Species Found on TVA Reservoir Flats

Common Name	Scientific Name
Amazon sprangletop	*Leptochloa panicoides*[1]
Blunt spike rush	*Eleocharis obtuse*
Bosc's mille graines	*Oldenlandia boscii*[1]
Clustered mille graines	*O. uniflora* [1]
Grassleaf mudplantain	*Heteranthera dubia*[1]
Grasslike fimbry	*Fimbristylis miliacea*[1,2]
Lowland rotala	*Rotala ramosior*
Slender fimbry	*Fimbrystylis fallalis*
Smallflower halfchaff sedge	*Hemicarpha micrantha*
Teal love grass	*Eragrostis hypnoides*
Vahl's fimbry	*F. vahlii*[1]
Valley redstem	*Ammania coccinea*
Variable flatsedge	*Cyperus difformis*[1,2]
White-edge flatsedge	*Cyperus albomarginatus*[1]
Yellowseed false pimpernel	*Lindernia dubia*

[1] In the Tennessee Valley, the distribution of this species is essentially restricted to the TVA reservoir flats.
[2] This species is not native to the Tennessee Valley.

Source: Webb et al. 1988.

Seeps, springs, and temporary ponds are often characterized by herbaceous wetland vegetation. Although specific locations have not been identified in the study area, four globally imperiled plant communities associated with these habitats potentially occur in the study area.

Future Trends

Existing and future trends in lowland communities in the Valley mirror the existing and future trends of wetland systems because the lowland communities depend on the functioning of wetland systems (refer to Section 4.8, Wetlands).

4.10.4 Upland Plant Communities

Existing Conditions

Most land within 0.25 mile of reservoir shorelines is dominated by hardwood forest communities. Reservoir levels sufficiently influence adjacent groundwater to affect some upland plant communities near reservoirs. Needle-leaved forests occupy relatively small areas within 0.25 mile of the reservoirs in the system, and a substantial amount of this forestland type has been converted to agricultural use.

Glades and barrens are upland habitats that have been, in some cases, flooded or encroached on by reservoirs. Two globally imperiled wetland plant communities associated with glades are known to occur in the study area, and a third could occur in the study area. Seepage areas associated with rock shelters or bluffs also support uncommon plant communities. Three globally imperiled wetland plant communities are known to occur in association with such habitats in portions of the study area. More detailed information on the upland plant communities can be found in Appendix D5, Terrestrial Ecology.

Upland depressions, including those associated with seeps, springs, and vernal pools, can be connected to the reservoir system via groundwater systems. None of the globally imperiled wetland plant communities reported from the seven Valley states are currently known to occur in these habitats in the study area, but seven globally imperiled plant communities have potential to occur in these habitats in the study area.

Future Trends

The existing trend for the region is toward degradation or loss of natural plant communities. This trend is expected to continue because of two principal factors: increase in human population and increase in invasive exotic species. Increased human population results in corresponding increases in development (for example, housing, schools, hospitals, roads, and utility corridors). This development results in an overall loss of natural vegetation or conversion of these habitats into lawns, roadsides, and fences rows. Development also often results in the introduction and spread of invasive exotic species and the degradation or loss of species diversity in existing natural communities (see Section.4.11, Invasive Plants and Animals).

4.10.5 Wildlife Communities

Existing Conditions

The diversity of plant communities throughout the Valley results in comparably diverse wildlife communities. Distribution of habitats, food availability, surrounding land use, and other limiting factors also influence the diversity and abundance of these wildlife communities in the study area. More detailed information on wildlife communities can be found in Appendix D5, Terrestrial Ecology. In most cases, the highest diversity of wildlife occurs at the interface of high-quality wildlife habitats and a waterbody in the reservoir system. Potential changes in bottomland hardwood forests, scrub/shrub wetlands, emergent wetlands, aquatic vegetation, flats, and other communities potentially affected by reservoir levels affect terrestrial wildlife populations.

Historically, pesticide use, wildlife management activities, human development, and creation of the reservoir system have influenced the distribution of animal populations throughout the Valley. In general, gulls, wading birds, waterfowl, raptors, game birds, mammals, reptiles, and amphibians are exhibiting stable or increasing numbers throughout the Valley. However, many individual species in these groups are decreasing in number—along with some members of other animal groups like shorebirds and Neotropical songbirds.

Several habitat types in the Valley, including riparian forests, exposed flats, vernal pools, wetlands, and river islands, are essential to wildlife for foraging, migration, and reproduction. Migrating and resident waterfowl, shorebirds, gulls, and wading birds use these habitats year round. Riparian forests, primarily bottomland hardwoods, have been ranked among the highest priority of areas that provide optimal habitat for wildlife such as Neotropical songbirds (Hunter et al. 1993). Shallow water with emergent vegetation, overhanging banks, exposed sandbars, and rotting wood along the shoreline provide vital nesting and basking habitat for non-game animals such as turtles and snakes. Semi-aquatic mammals, such as muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), and river otter (*Lontra canadensis*), also use these habitats for foraging and shelter.

Shorebirds forage in moist drawdown zones along the reservoirs seasonally; concentrations are highest during fall migrations. Flats, isolated pools, and shallow water habitats are created by reservoir drawdowns. On many TVA reservoirs, these habitats are usually available in early August, and their availability often coincides with the peak of the fall migration. Flats are important to shorebirds as they forage in these areas to build fuel reserves necessary to migrate to their wintering grounds. The slowly receding waters result in large, open areas of shallow water and moist, exposed flats critical for foraging and resting. Kentucky and Douglas Reservoirs contain excellent examples of these habitats. Flats on Wheeler and Pickwick Reservoirs are also used by shorebirds but to a lesser extent as current operations on these reservoirs limit the availability of flats to the latter part of fall migration.

During fall and winter, a mixture of water depths, wetlands, riparian vegetation, aquatic macrophytes (aquatic plants that include aquatic vascular plants, a few mosses, and

macroscopic algae [see Section 4.9, Aquatic Plants]), shallow flooded overbanks, and agricultural fields provide valuable habitat to large aggregations of waterfowl on TVA reservoirs. Vegetated flats provide foraging habitat for geese and ducks on several reservoirs (most notably Kentucky and Pickwick) during winter. Therefore, summer drawdowns—which allow flats to be exposed for vegetation development before the end of the growing season—benefit waterfowl. The largest aggregations of waterfowl and shorebirds are most notable on mainstem reservoirs such as Kentucky, Wheeler, Guntersville, Chickamauga, and Watts Bar, and tributary reservoirs such as Douglas Reservoir. These reservoirs are surrounded by a variety of state and federal wildlife refuges that actively support migrating waterfowl and shorebirds. Many of these wildlife refuges operate dewatering projects, which provide resources that are important to these migratory birds.

During winter, large concentrations of gulls roost and forage in the vicinity of several TVA hydropower dams. These aggregations are most notable at Kentucky, Pickwick, and Wilson Dams. Flats on reservoirs are also important roost sites for gulls and other shorebirds. Overall, use of the reservoirs by migratory birds varies throughout the year and largely depends on weather patterns, dynamics of bird populations, and water levels.

Southern Appalachian forests support some of the richest diversity of birds in North America (Simons et al. 1998). Drier upland habitats often contain a lower diversity of wildlife species than lowland moist habitats like those found in the riparian zone along the Tennessee River. Several animal species associated with upland habitats rely on lowlands for food, refuge, reproduction habitat, and migration routes. Features important to birds and other wildlife that occur in upland habitats include bluffs, caves, and other rock-dominated areas.

Future Trends

Future trends in wildlife populations are expected to mirror existing trends. Adaptable species should continue to thrive, while species that depend on habitats susceptible to development and degradation are likely to continue to decline.