Effects of Land Use Practices on Western Riparian Ecosystems

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Abstract — Riparian ecosystems are among the rarest and most sensitive habitat types in the western United States. Riparian habitat is critical for up to 80% of terrestrial vertebrate species, and is especially important in the arid West. Estimates have placed riparian habitat loss at greater than 95% in most western states. Impacts to riparian ecosystems are reviewed along with mitigation and conservation recommendations for resource managers.

INTRODUCTION

Riparian refers to the vegetation, habitats and ecosystems associated with bodies of water (streams, springs or lakes) or dependent on the existence of perennial, intermittent, or ephemeral surface or subsurface water drainage (Arizona Riparian Council 1988). This habitat is exceptionally important in the western United States due to presence of water and lush vegetation typically surrounded by harsher, drier, less productive environments (Chaney et al 1990). Western riparian systems differ significantly from eastern riparian systems primarily due to availability of water and resultant vegetative competition (Johnson and Lowe 1985). Whereas many eastern hardwood forests average between 35 and 50 inches of precipitation annually, most western systems receive 20 inches or less annually but pan evaporation rates can exceed 100 inches (Johnson and Lowe 1985). Johnson and Lowe (1985) state that eastern forest vegetation primarily competes for space and light whereas in the West competition is predominately for underground water. Riparian areas slow flood flows, filter out sediments, reduce erosion, buffer soil chemistry, enhance biodiversity, protect hydrologic systems from temperature extremes and evaporative loss, and slowly release retained water which extends quality and quantity of water for a variety of consumptive and non-consumptive uses (Carothers 1977, Hubbard 1977, Sands and Howe 1977, Chaney et al. 1990).

DISCUSSION

It is estimated that wetlands and riparian areas comprise less than 1% of the total land area in the western U. S., yet they support a tremendous number and diversity of aquatic and terrestrial wildlife (Chaney et al 1990). In portions of southeastern Oregon and southeastern Wyoming, more than 75% of terrestrial wildlife species are dependent upon riparian areas for at least a portion of their life cycle (Chaney et al 1990). In Arizona and New Mexico, at least 80% of all animals use riparian areas at some stage of their lives, with more than half of these species considered to be riparian obligates (Chaney et al. 1990). Studies in the southwest United States show that riparian areas support a higher breeding diversity of birds than all other western habitats combined (Anderson and Ohmart 1977, Johnson et al. 1977, Johnson and Haight 1985). Western riparian habitat also harbor the highest non-colonial avian breeding densities in North America (Johnson et al. 1977).

Over 60% of the species which ***Partners In Flight*** have identified as neotropical migratory birds use riparian areas in the West as stopover areas during migration or for breeding habitat (Bent 1919-1968, Ehrlich et al. 1988, Appendix 1). Riparian zones have been shown to be extremely important for migratory species by providing cover, food, and water in many areas of the West which are surrounded by habitats deficient in these critical elements (Wauer 1977). Stevens et al. (1977) reported that western riparian areas contained up to 10 times the number of migrants per hectare than adjacent non-riparian habitats. They also found at least twice as many breeding individuals and species occurring in riparian zones relative to non-riparian zones. Gori (1992) attributes this disparity to three factors: the presence of water attracts large numbers of predators and prey alike; plant growth and vegetative biomass are very high which leads to multi-storied vegetation and greater food production; and vegetation is deciduous in these habitats, so plants do not invest in chemical compounds to protect leaves from insect herbivores as do coniferous trees, thereby allowing abundant insect prey for avian consumption.

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Due to the value and productivity of western riparian areas, human activities have been concentrated in these habitats. As a result, riparian areas are among the most modified habitat types in the West. Habitat alterations include river flow management and diversions (dams, reservoirs, canals, rip-rapping, channelization and dredging), agricultural clearing, firewood collecting, sand and gravel extraction, urbanization and development, recreation, grazing, groundwater pumping, pollution and effluent discharge, fire, flooding, erosion and soil deposition, and exotic plant invasion. The most threatened forest habitat of the 106 identified types in North America is western cottonwood/willow riparian (D. Campbell 1988 pers. comm.). Once extensive stands of riparian habitat throughout the West now exist only as cleared agricultural fields, dry riverine habitat, and urban development. California has lost approximately 98.5% of its historic riparian habitat (Dillinger 1989). Arizona has lost 90% of its historic gallery cottonwood/willow forests (Lofgren et al. 1990). For example, the Colorado River from Fort Mohave to Fort Yuma had 400,000 to 450,000 acres of riparian habitat at the turn of the century, but as of 1986, only 768 acres of pure cottonwood/willow riparian habitat remained (Ohmart et al. 1977, Ohmart et al. 1988). Fremont cottonwood habitat for the entire state of Arizona totals 6,000-8,000 acres (Barger and Ffolliott 1971). In many western states figures may not be as dramatic, but the trend is similar.

Impacts of riparian habitat loss on riparian obligates, many of which are neotropical migratory birds, have been severe. The western race of the yellow-billed cuckoo (*Coccyzus americanus occidentalis*) was once common in all riparian systems throughout the West (Grinnell and Miller 1986, Bent 1940). It's population is now estimated at 475-675 pairs primarily due to habitat loss or modification (Laymon and Halterman 1987). The southwest willow flycatcher (*Empidonax traillii extimus*), Least Bell's vireo (*Vireo bellii pusillus*) and yellow warbler (*Dendroica petechia*) have experienced precipitous population and range declines in western states (Franzreb 1987, Harris et al. 1987, Hunter et al. 1987, Laymon and Halterman 1989, Sanders and Flett 1989).

Johnson et al (1977) reported that of 166 species of nesting birds in the arid southwest, 127 (77%) were dependent on water associated habitats and 51% were completely dependent upon riparian habitat. They predict that if water dependent habitats were completely destroyed in the southwest, 47% of the lowland nesting birds would be extirpated. With continued riparian habitat loss, avian numbers will continue to decline. Once a species population deteriorates to the point where it becomes federally listed as threatened or endangered, a great deal of effort and money are required for protection and recovery. In 1989, the cost for attempted recovery of five avian species averaged more than $700,000 each (McClure et al. 1991). Preventing population declines of avian species will save significant funds which can better be used for funding recovery programs for other seriously threatened species or for implementing habitat conservation or improvement efforts.

The U.S.D.A. Forest Service (U.S.F.S), the U.S.D.I. Bureau of Land Management (B.L.M.), and various private sector companies administer lands in a multiple use manner which attempts to balance many different consumptive and non-consumptive activities (Fox 1977, Buckhouse 1985, Sweep et al. 1985, Vanderheyden 1985). This philosophy often affects one resource at the expense of another. Productive habitats which are especially rich in resources challenge the manager to balance competing demands from various special interest groups and the public at large (Hubbard 1977, Zube and Simcox 1987). In years past, riparian habitat protection and management were inadequate to maintain viable or productive systems in many western areas. Recently, riparian ecosystem awareness has increased in both public, private and scientific sectors. For public and private land managers to mitigate riparian loss and to reverse the trend of riparian habitat alteration and destruction, progressive management measures must be initiated.

Following are examples of current management practices with recommendations and citations providing information needed to administer western riparian habitats.

Grazing

One of the most significant adverse impacts within western riparian systems has been perpetuation of improper grazing practices (Hastings and Turner 1965, Ames 1977, Davis 1977, Glinski 1977, Marlow and Pogacnik 1985). Chaney et al (1990) noted that initial deterioration of western riparian systems began with severe overgrazing in the late nineteenth century. Native perennial grasses were replaced with annual or non-native grass species, salt cedar, juniper, mesquite, rabbitbrush, and other shallow-rooted vegetation less adapted for soil stabilization. Wind and water erosion stripped productive topsoil and began down-cutting and entrenchment of riparian systems. This resulted in lowered water tables and caused perennial watercourses to become ephemeral or dry. Chaney et al. (1990) estimate that resultant desertification reduced arable land of the West by 225 million acres (90 million hectares). Although management has greatly improved riparian habitat in some areas, field data compiled in the last decade showed that riparian areas throughout much of the West were in the worst condition in history due mainly to complications initiated by improper grazing management techniques (Chaney et al. 1990).

Proper management of riparian habitat requires that managers understand dynamics of grazing strategies and hydrologic processes of the affected watershed before attempting riparian restoration (Elmore 1989). It has been demonstrated that riparian habitat can be restored and protected if grazing interests and land managers join together and determine appropriate grazing systems. One method involves a strictly seasonal grazing system, where livestock may utilize the riparian zone during the

non-growing season (Bryant, L. 1985, Krueger and Anderson 1985, Spear 1985). Cattle may utilize riparian areas after grasses have dispersed annual seed stock. Grazing within the riparian zone may be used to remove dense annual growth which may endanger the ecosystem due to high fuel loads during fire season. Complete exclusion of cattle from the riparian zone by fencing and establishing waters in neighboring habitat is another option and may be necessary to rehabilitate severely over-utilized habitat (Smith 1989, Swanson 1989, Szaro 1989). Neotropical migratory birds can benefit by excluding cattle from riparian areas, as evidenced within the San Pedro Riparian National Conservation Area in Arizona. Within 4 years after cattle removal, understory vegetation increased significantly (Figure 1). Avian understory obligates such as common yellowthroat (*Geothlypis trichas*), song sparrow (*Melospiza melodia*), and yellow-breasted chat (*Icteria virens*) responded with significant population increases (Table 1).

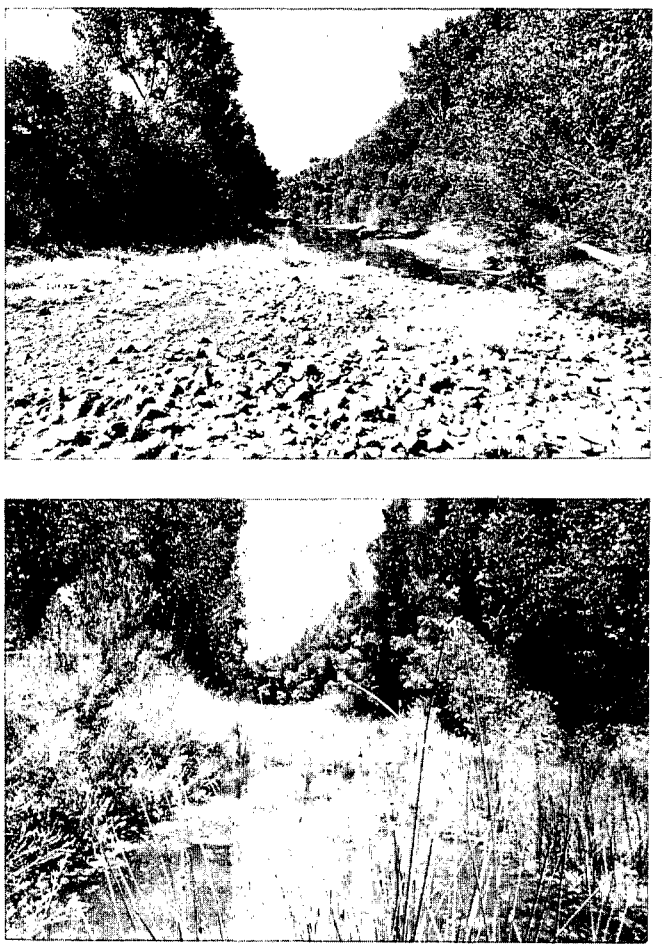

Figure 1. — Riparian vegetation within the San Pedro Riparian National Conservation area before (June 1987) and four years after (June 1991) livestock exclusion. Note changes in understory vegetation and total ground cover.

Table 1. — Neotropical migratory bird population response to retirement of grazing in riparian habitat, (beginning 1987), San Pedro Riparian National Conservation Area, AZ. Densities are number of individuals per 40 ha (100 acres) of habitat.

	YEAR					
Species	86	87	88	89	90	91
Yellow-billed cuckoo (*Coccyzus americanus*)	6	10	8	8	13	*
Western wood-pewee (*Contopus sordidus*)	8	16	22	38	28	29
Brown-crested flycatcher (*Myiarchus tyrannulus*)	21	33	27	36	26	26
Bell's vireo (*Vireo bellii*)	7	11	7	12	15	16
Yellow warbler (*Dendroica petechia*)	29	84	99	227	131	176
Common yellowthroat (*Geothlypis trichas*)	7	24	39	115	110	149
Yellow-breasted chat (*Icteria virens*)	26	44	47	95	100	110
Summer tanager (*Piranga rubra*)	44	84	73	167	94	108
Song sparrow (*Melospiza melodia*)	0	11	14	38	36	61
Northern oriole (*Icterus galbula*)	28	35	28	34	21	32

* Represents data not available

Timber Harvest

Western forest management practices have long been at the forefront of news due to past harvest rates and perceived impacts on habitats which many avian and anadramous salmonid species depend. However, federal land managers have progressed tremendously during recent years in timber harvest and riparian protection practices (Ice et al. 1989). Resource Management Plans for western Oregon B.L.M. administered public lands are presently being formulated to apply the concept of biological diversity to the management of the landscape (E. Campbell, pers. comm. 1992). Both the U.S.F.S. and the B.L.M. have initiated innovative protective measures to insure that adequate habitat remains undisturbed around riparian areas. Mandatory buffer zones became common practice in the 1970's to provide stream channel protection. Activities within zones are allowed, but are modified based on soil type, slope of surrounding terrain, vegetation present, and other variables. Maintenance of quality of streambed, streambank stability, stream temperature, water quality, wildlife habitat, and surrounding vegetation are of utmost concern (Anderson 1985, Steinblums and Leven 1985).

Another example of riparian management involves removal of slash from riparian zones and streambeds after harvest. Although large woody debris is an important component of

riparian ecosystems, especially for rearing areas for juvenile salmonids (Bryant, M. 1985, O'Connor and Ziemer 1989), accumulated smaller slash in streams will block migratory fish passage. Judicious removal of slash accumulations and use of buffers strips greatly increases riparian protection. Each cutting unit may vary in the degree of protection, but timber harvest and land management plans are required for all timber sales and must involve an interdisciplinary team for their design and review.

Exotic Plant Invasion and Revegetation

Western riparian ecosystems have been adversely impacted by exotic plant invasions. One particularly prolific exotic, salt cedar (*Tamarisk chinensis*), has become established in almost all southwestern riparian systems, choking out or out-competing native vegetation and preventing natural vegetative succession (Horton 1977, Ohmart et al. 1977). Salt cedar root-sprouts faster than native vegetation after a fire, forms dense mats of fallen deciduous needles which increases fire threat, and exudes salt through evapotranspiration which increases soil salinity. Under these circumstances native plants cannot become established or compete. Some salt cedar roots have been documented over 100 feet below the ground surface, allowing it to survive in marginal habitats or in areas of scant rainfall (Ritzi et al. 1985). Loss of native riparian vegetation and spread of salt cedar has adversely affected native bird populations in the southwest (Carothers 1977). Anderson et al. (1977) reported that salt cedar habitat had lower value to birds than any other native tree community based on total avian density, number of species present, and bird species diversity along the lower Colorado River. Hunter (1984) identified nine avian species which were common along the lower Colorado River around the turn of the century but which now are approaching extirpation because they are riparian obligates and intolerant of salt cedar. Both aquatic and terrestrial flora and fauna can be severely affected by cumulative impacts of exotic vegetation establishment.

Methods to eradicate introduced vegetation has traditionally been costly and time-consuming, but some are effective. Managers attempting to eliminate noxious species and revegetate with native riparian vegetation need effective methods to achieve maximum success. These include application of chemical agents, prolonged inundation, plowing or clearing followed with root-ripping, and intensive hand removal (Anderson and Ohmart 1979, 1982, 1984, Kerpez and Smith 1987). Once removed, salt cedar can be controlled by replanting with native vegetation which prohibit salt cedar seedling establishment since salt cedar is not shade tolerant. It is critical to determine water table depth, soil and groundwater salinity, and soil type and structure for successful revegetation efforts. In areas of low water availability, planted seedlings must have access to water. In these areas, a system of irrigation may be required until roots reach free water. These methods have been employed with success along portions of the Colorado River (Anderson et al. 1977, Anderson and Ohmart 1982, 1984, 1985) and in New Mexico at Bosque del Apache National Wildlife Refuge (Kerpez and Smith 1987). These removal techniques can also be applied to other forms of exotic vegetation.

Other Riparian Impacts

Many human-induced influences have affected riparian ecosystems, significant among them being recreational disturbance. As human pressures multiply within finite western riparian systems, impacts will accelerate quickly. Hoover et al. (1985) found recreational visitors preferred environmental conditions which closely matched features which are found in healthy riparian ecosystems. Grazing, fishing, and excessive human contact were noted as detractants. Thus, the very nature of undisturbed riparian habitats acts as a major attractant for human use and recreational opportunities. As human populations increase in the West, riparian areas will continue to be affected. Managers must weigh recreational, wildlife, and purely aesthetic values against activities and other land use practices such as surface water use and pumping, grazing, mining, and urbanization (Johnson et al. 1977).

Other significant pressures on western riparian systems include oil and gas development, mining, urban development, flooding, groundwater pumping, and fire. Impacts by these activities are in direct proportion to the dimensions of local human populations. Resource strains by these varied but essential activities must be mitigated in a wide variety of ways, many of which are mentioned above. Lengthy specific management recommendations preclude listing here, but a wide variety of riparian literature is available. The manager is encouraged to consult with inter- and intra-agency specialists who have expertise for successful implementation of riparian initiatives.

CONCLUSION

Western riparian ecosystems are among the most productive habitats in North America, and among the rarest and most altered. Federal agencies, and many non-federal management agencies and private landowners, attempt to balance consumptive and non-consumptive land use practices in riparian areas and the watersheds on which they depend. This often results in sacrificing one resource for another. To properly administer riparian ecosystems, managers need to be aware of interrelationships between hydrological processes, vegetative communities, and wildlife populations (Heede 1985). If riparian values are to be conserved for future generations, management must exercise practices considered in terms of cumulative effects on biological and physical systems (Zube and Simcox 1987). Federal, state and private land managers and especially the general public need to address riparian management considering the following methods:

1) Involvement: Concerned citizens, environmental organizations, and public and private land managers must increase communication with state and federal agencies and elected officials to address riparian habitat issues. It is essential to strengthen environmental communication at both the local and national level. The public must get involved with the decision-making process and voice opinions and support of riparian area management.
2) Education: No other method will be more effective in preserving or expanding riparian habitats than education of private citizens and public land management officials. The public needs to become aware of the sensitivity and natural value of riparian ecosystems. Schools and other educational facilities need to begin to address issues such as riparian conservation, and concerned public officials need to get involved. Public land officials not aware of riparian concerns need to be informed and provided with tangible solutions to multiple use conflicts in riparian habitats by specialists and field personnel.
3) Partnerships: Private and public cost-sharing projects and encouragement of mutually beneficial partnerships, cooperative agreements, and conservation easements provide effective riparian protection measures. Many such successful partnerships have been established between private land owners and federal agencies and private conservation groups such as The Nature Conservancy and National Audubon Society. These partnerships must be expanded throughout the West.
4) Revegetation: Removal of exotic plants and reintroduction of extirpated species through revegetation efforts may be costly, but it provides a direct method of quickly re-establishing native riparian vegetation. Supplemental tree plantings in residential or "semi-artificial" habitats may help augment revegetation efforts and should be encouraged.
5) Grazing: Development of sound management practices for grazing systems in riparian areas may be the most important management tool available for riparian habitat conservation. Many riparian forests and wetlands have had their public values severely compromised through over-utilization (Brown et al. 1977). In habitats where little understory exists or where little or no vegetative regeneration is occurring, grazing should be limited or completely eliminated until proper seral stages are achieved. Once habitat recovers, grazing could be allowed under constraints and a managed rotational basis that meets riparian ecosystem objectives.
6) Inventory, Research and Monitoring: Long-term monitoring and evaluation efforts must accompany all riparian habitat management schemes to determine successes or failures. Statewide inventories, mapping projects and classification schemes need to be coordinated between federal, state and private agencies to prevent duplication and wasted effort. In addition, life history requirements and associations of floral and faunal riparian specialists, and studies of interrelationships of man and environment are required (Patton 1977).
7) Management: We must all encourage public land managers and private land owners to make riparian habitat improvement a desired end-product of stewardship of watersheds and ecosystems. Managers and specialists charged with development of land use plans must address potential riparian and watershed impacts before damage occurs. Administrators must cultivate interest, concern, and commitment beyond the agency's official mandate of multiple-use management for the benefit of riparian habitats. Managers have a very important responsibility to participate actively in educational programs which increase public knowledge of riparian values, potential threats to riparian ecosystems, and solutions to multiple use conflicts.

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Appendix 1. — Migrant landbirds for *Partners In Flight* Neotropical Migratory Bird Conservation Program (Gauthreaux 1992) which migrate, winter or breed in riparian-associated habitats west of the 100th meridian of the United States and Canada.

Turkey vulture *(Cathartes aura)*
Mississippi kite *(Ictinia mississippiensis)*
Northern harrier *(Circus cyaneus)*
Sharp-shinned hawk *(Accipiter striatus)*
Cooper's hawk *(Accipiter cooperii)*
Common black-hawk *(Buteogallus anthracinus)*
Gray hawk *(Buteo nitidus)*
Red-shouldered hawk *(Buteo lineatus)*
Broad-winged hawk *(Buteo platypterus)*
Zone-tailed hawk *(Buteo albonotatus)*
Red-tailed hawk *(Buteo jamaicensis)*
Golden eagle *(Aquila chrysaetos)*
American kestrel *(Falco sparverius)*
Merlin *(Falco columbarius)*
Peregrine falcon *(Falco peregrinus)*
Prairie falcon *(Falco mexicanus)*
Killdeer *(Charadrius vociferus)*
Long-billed curlew *(Numenius americanus)*
White-winged dove *(Zenaida asiatica)*
Mourning dove *(Zenaida macroura)*
Black-billed cuckoo *(Coccyzus erythropthalmus)*
Yellow-billed cuckoo *(Coccyzus americanus)*
Elf owl *(Micrathene whitneyi)*
Long-eared owl *(Asio otus)*
Buff-collared nightjar *(Caprimulgus ridgwayi)*
Black swift *(Cypseloides niger)*
Chimney swift *(Chaetura pelagica)*
Vaux's swift *(Chaetura vauxi)*
Ruby-throated hummingbird *(Archilocus colubris)*
Broad-billed hummingbird *(Cynanthus latirostris)*
Violet-crowned hummingbird *(Amazilia violiceps)*
Blue-throated hummingbird *(Lampornis clemenciae)*
Magnificent hummingbird *(Eugenes fulgens)*
Black-chinned hummingbird *(Archilocus alexandri)*
Anna's hummingbird *(Calypte anna)*
Calliope hummingbird *(Stellula calliope)*
Broad-tailed hummingbird *(Selaphorus platycercus)*
Rufous hummingbird *(Selasphorus rufus)*
Allen's hummingbird (Selasphorus sasin)
Elegant trogon *(Trogon elegans)*
Belted kingfisher *(Ceryle alcyon)*
Green kingfisher *(Chloroceryle americana)*
Lewis' woodpecker *(Melanerpes lewis)*
Yellow-bellied sapsucker *(Sphyrapicus varius)*
Red-naped sapsucker *(Sphyrapicus nuchalis)*
Red-breasted sapsucker *(Sphyrapicus ruber)*
Williamson's sapsucker *(Sphyrapicus thyroideus)*
Northern flicker *(Colaptes auratus)*
Northern beardless-tyrannulet *(Camptostoma imberbe)*
Olive-sided flycatcher *(Contopus borealis)*
Greater pewee *(Contopus pertinax)*
Western wood-pewee *(Contopus sordidus)*
Yellow-bellied flycatcher *(Empidonax flaviventris)*
Alder flycatcher *(Empidonax alnorum)*
Willow flycatcher *(Empidonax traillii)*
Least flycatcher *(Empidonax minimus)*
Hammond's flycatcher *(Empidonax hammondii)*
Dusky flycatcher *(Empidonax oberholseri)*
Gray flycatcher *(Empidonax wrightii)*
Pacific-slope flycatcher *(Empidonax difficilis)*
Cordilleran flycatcher *(Empidonax occidentalis)*
Buff-breasted flycatcher *(Empidonax fulvifrons)*
Eastern phoebe *(Sayornis phoebe)*
Say's phoebe *(Sayornis saya)*
Vermilion flycatcher *(Pyrocephalus* rubinus)
Dusky-capped flycatcher *(Myiarchus tuberculifer)*
Ash-throated flycatcher *(Myiarchus cinerascens)*
Brown-crested flycatcher *(Myiarchus tyrannulus)*
Sulphur-bellied flycatcher *(Myiodynastes luteiventris)*
Tropical kingbird *(Tyrannus melancholicus)*
Cassin's kingbird *(Tyrannus vociferans)*
Thick-billed kingbird *(Tyrannus crassirostris)*
Western kingbird *(Tyrannus verticalis)*
Eastern kingbird *(Tyrannus tyrannus)*
Rose-throated becard *(Pachyramphus aglaiae)*
Purple martin *(Progne subis)*
Tree swallow *(Tachycineta bicolor)*
Violet-green swallow *(Tachycineta thalassina)*
N. Rough-winged swallow *(Stelgidopteryx serripennis)*
Bank swallow *(Riparia riparia)*
Cliff swallow *(Hirundo pyrrhonota)*
Cave swallow *(Hirundo fulva)*
Barn swallow *(Hirundo rustica)*
House wren *(Troglodytes aedon)*
Sedge wren *(Cistothorus platensis)*
Marsh wren *(Cistothorus palustris)*
Ruby-crowned kinglet *(Regulus calendula)*
Blue-gray gnatcatcher *(Polioptila caerulea)*
Veery *(Catharus fuscescens)*
Gray-cheeked thrush *(Catharus minimus)*
Swainson's thrush *(Catharus ustulatus)*
Hermit thrush *(Catharus guttatus)*
American robin *(Turdus migratorius)*
Gray catbird *(Dumetella carolinensis)*
American pipit *(Anthus spinoletta)*
Phainopepla *(Phanopepla nitens)*
Bell's vireo *(Vireo bellii)*
Black-capped vireo *(Vireo atricapillus)*
Gray vireo *(Vireo vicinior)*
Solitary vireo *(Vireo solitarius)*
Warbling vireo *(Vireo gilvus)*
Philadelphia vireo *(Vireo philadelphicus)*
Red-eyed vireo *(Vireo olivaceus)*
Tennessee warbler *(Vermivora peregrina)*
Orange-crowned warbler *(Vermivora celata)*
Nashville warbler *(Vermivora ruficapilla)*

Virginia's warbler *(Vermivora virginiae)*
Lucy's warbler *(Vermivora luciae)*
Yellow warbler *(Dendroica petechia)*
Magnolia warbler *(Dendroica magnolia)*
Cape May warbler *(Dendroica tigrina)*
Yellow-rumped warbler *(Dendroica coronata)*
Black-throated gray warbler *(Dendroica nigrescens)*
Townsend's warbler *(Dendroica townsendi)*
Hermit warbler *(Dendroica occidentalis)*
Golden-cheeked warbler *(Dendroica chrysoparia)*
Grace's warbler *(Dendroica graciae)*
Palm warbler *(Dendroica palmarum)*
Bay-breasted warbler *(Dendroica castanea)*
Blackpoll warbler *(Dendroica striata)*
American redstart *(Setaphaga ruticilla)*
Ovenbird *(Seiurus aurocapillus)*
Northern waterthrush *(Seiurus noveboracensis)*
Connecticut warbler *(Oporornis agilis)*
Mourning warbler *(Oporornis philadelphia)*
MacGillivray's warbler *(Oporornis tolmiei)*
Common yellowthroat *(Geothlypis trichas)*
Wilson's warbler *(Wilsonia pusilla)*
Red-faced warbler *(Cardellina rubrifrons)*
Painted redstart *(Myioborus pictus)*
Yellow-breasted chat *(Icteria virens)*
Hepatic tanager *(Piranga flava)*
Summer tanager *(Piranga rubra)*
Western tanager *(Piranga ludoviciana)*
Black-headed grosbeak *(Pheucticus melanocephalus)*
Blue grosbeak *(Guiraca caerulea)*
Lazuli bunting *(Passerina amoena)*
Indigo bunting *(Passerina cyanea)*
Painted bunting *(Passerina ciris)*
Green-tailed towhee *(Pipilo chlorurus)*
Rufous-sided towhee *(Pipilo erythrophthalmus)*
Vesper sparrow *(Pooecetes gramineus)*
Chipping sparrow *(Spizella passerina)*
Clay-colored sparrow *(Spizella pallida)*
Brewer's sparrow *(Spizella breweri)*
Black-chinned sparrow *(Spizella atrogularis)*
Fox sparrow *(Passerella iliaca)*
Song sparrow *(Melospiza melodia)*
Lincoln's sparrow *(Melospiza lincolnii)*
Swamp sparrow *(Melospiza georgiana)*
White-throated sparrow *(Zonotrichia albicollis)*
White-crowned sparrow *(Zonotrichia leucophrys)*
Dark-eyed junco *(Junco hyemalis)*
Red-winged blackbird *(Agelaius phoeniceus)*
Yellow-headed blackbird *(Xanthocephalus xanthocephalus)*
Brewer's blackbird *(Euphagus cyanocephalus)*
Brown-headed cowbird *(Molothrus ater)*
Hooded oriole *(Icterus cucullatus)*
Northern oriole *(Icterus galbula)*
Scott's oriole *(Icterus parisorum)*
Purple finch *(Carpodacus purpureus)*
Cassin's finch *(Carpodacus cassinii)*
Pine siskin *(Carduelis pinus)*
Lesser goldfinch *(Carduelis psaltria)*
Lawrence's goldfinch *(Carduelis lawrencei)*
American goldfinch *(Carduelis tristis)*