

The Impacts of Flaming Gorge Dam on Avian Communities of the Green River

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ABSTRACT

The middle Green River is home to a diverse and distinct assemblage of birds. The relatively new presence of Flaming Gorge Dam as a discontinuity in the river continuum has caused major changes to the riparian vegetation that may have in turn affected the avian community. The invasion of tamarisk favors ground-dwelling and shrub-nesting species, while the simultaneous decline in native cottonwoods and willows threatens those species that nest or roost in these communities. Other factors also come into play to affect the avifaunal composition and abundance, including the direct impacts of flow regulation on avian food sources such as fish. As predicted by the Serial Discontinuity Concept, the indirect effects of the dam on the avian community should dampen downstream as a more natural flow regime takes over.

INTRODUCTION

River regulation through dam construction is a worldwide phenomenon. Studies on the impacts of regulated flow on animal communities have largely focused on fish and invertebrates (e.g., Ward and Stanford 1979). Effects on the local avifauna are far less well studied (Nilsson and Dynesius 1994). A recent study by Stevens and others (1997) demonstrates the potential importance of the effects of dams on avifauna with the conclusion that Glen Canyon Dam's regulation of the Colorado River has a greater influence on seasonal waterfowl distribution than the natural channel geomorphology of the river.

The present review focuses on the birds of the middle Green River and the associated impacts of Flaming Gorge Dam on the avifauna. The area of study begins in northeastern Utah just below Flaming Gorge Dam, winds its way eastward to Colorado, runs southwest back into Utah, and ends at Split Mountain Canyon below the confluence of the Green River and the unregulated Yampa River (see Figure 1).

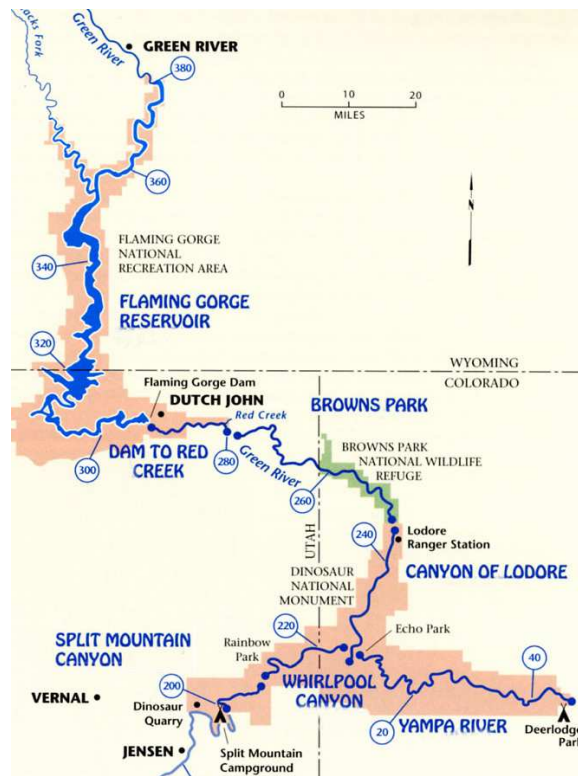


Figure 1. Map of the middle Green River. This study focuses on the stretch from Flaming Gorge Dam to Split Mountain Canyon, which is located past the confluence with the Yampa River, near the town of Jensen. (Belknap and Belknap Evans 2006.)

REGIONAL AVIFAUNAL DIVERSITY AND THE IMPORTANCE OF RIPARIAN HABITAT

The state of Utah is home to 311 species of birds that are present regularly and in considerable numbers (Behle 1985). Of those 311 species, 95 are permanent residents, 139 are summer residents, 27 are winter residents, and 50 are transients (Behle 1985). The state of Utah can be divided into three distinct avifaunal areas: the Mohavian region, the Southern Rocky Mountains, and the Great Basin. The portion of the Green River focused on here is located in the Great Basin region. While the Great Basin avifauna does not have any endemic species, it is nonetheless comprised of a distinct assemblage of birds (Behle 1985).

The riparian habitat of the greater Green River supports hundreds of bird species. Riparian habitat can be defined as transitional areas regularly influenced by fresh water, extending from the edge of a water body to the edge of the upland community (Naiman et al. 2005). The importance of riparian habitat to wildlife in general and birds in particular is a well-

documented phenomenon. A study by Stevens and others (1977) showed that riparian habitats contained up to 10 times as many migrant passerines (songbirds) per hectare compared to adjacent, nonriparian habitats. Riparian habitat is especially important to insectivores (Stevens et al. 1977), because flowing water is required for many insects' life cycles and streams are highly productive. Riparian habitat is also critical to breeding birds. Less than one percent of the western United States landscape consists of riparian vegetation; however, this vegetation provides habitat for many more breeding birds than do surrounding uplands (Knopf et al. 1988). According to Johnson and others (1977), 51% of all breeding avian species in the southwestern United States are completely dependent on riparian vegetation. The loss of all southwestern riparian vegetation could result in a loss of 78 of the 166 bird species that breed in that area (Johnson et al. 1977).

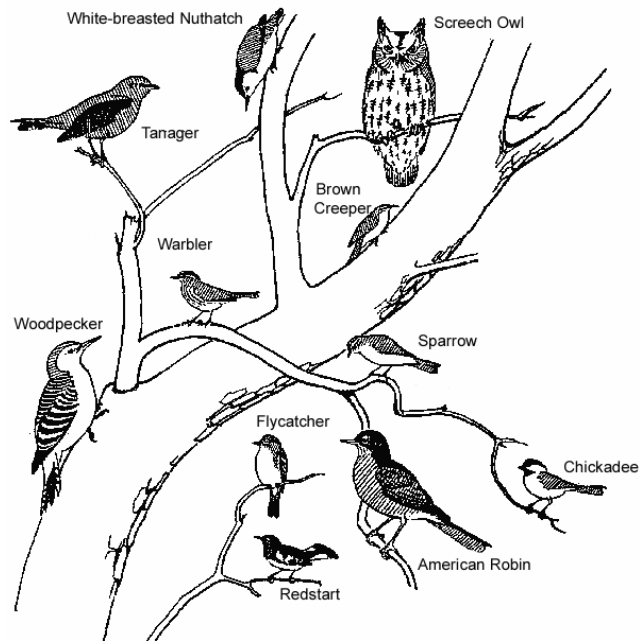


Figure 2. This diagram depicts a typical riparian bird assemblage, similar to that seen in the Green River area: nuthatches, tanagers, warblers, woodpeckers, sparrows, flycatchers, chickadees, and robins are common residents of the area. Image courtesy of Math/Science Nucleus (<http://www.msnuclus.org/watersheds/biological/birdenv.html>).

In Utah, approximately 75% of birds use riparian habitat at some point in their lives, although riparian habitat represents less than 1% of the state's land cover (Parrish et al. 2002). In the last 150 years, somewhere between 80-95% of Utah's riparian habitat has been altered or

destroyed (Parrish et al. 2002), illustrating the importance of the riparian habitat that does remain. The Green River, its tributaries, and associated vegetation provide nesting and roosting habitat, offer cover and thermal refugia, and serve as food sources for a great number and diversity of local avifauna. Browns Park National Wildlife Refuge, through which the Green River runs, is specifically managed to provide high quality nesting habitat for migratory waterfowl and birds. Other reaches of the river, such as Lodore Canyon, offer suitable nesting and/or roosting habitat for flagship species such as the bald and golden eagles. Bird watching and photography is an important regional attraction. Birding is also economically important, generating 32 billion dollars in retail sales and 85 billion in overall economic output nationwide in 2001 (U. S. Fish and Wildlife Service 2001a).

IMPACTS OF FLAMING GORGE DAM ON BIRD HABITAT AND PREY

Despite the fact that the vast majority of the world's rivers are now regulated by mankind, the impacts of river regulation on birds have not been very well studied, and are often based on unpublished observations and speculation (Nilsson and Dynesius 1994). In general, the two most important documented effects of dams relative to potential impacts on birds are the inundation of valley floors (as with reservoir creation) and the disruption of the river's seasonal flood regime (Nilsson and Dynesius 1994). In this discussion, we are concerned only with the latter (downstream) effect of dams.

Prior to the construction of Flaming Gorge Dam, the Green River exhibited a hydrograph typical of many northern hemisphere rivers: relatively low discharge in the winter months and high discharge in the spring and summer months, corresponding to periods of snowmelt. Because of the unregulated nature of the river, scouring flash floods swept through with large winter and spring storm events. The completion of Flaming Gorge Dam in 1963 led to a very different annual hydrograph. In the post-dam era, middle Green River flows correspond to the maximum power plant capacity for most of the year, and are almost entirely devoid of large flooding events. This disruption of the natural flow regime significantly altered the downstream ecology of the Green River. For local avifauna, the two most important impacts of this disruption are the changes to riparian habitat and prey abundance.

One of the most visible changes effected by the dam is the change in riparian vegetation composition and abundance. Before the construction of Flaming Gorge Dam, the vegetation

along the Green River was dominated by native cottonwoods (*Populus* spp.) and willows (*Salix* spp.). However, the altered, more stable flow regime set into place by the dam favored the establishment of tamarisk (*Tamarix* spp.) along the historically unoccupied floodplain of the river (Bowen 2006, this volume). Tamarisk, also known as saltcedar, is an invasive species that was introduced to the Green River area in the 1930s. In the absence of scouring floods, it is able to rapidly spread through riparian communities via wind-dispersed seeds, outcompeting the natives and replacing vast stands of old-growth cottonwoods (see Figure 3). The establishment of tamarisk ultimately led to an overall increase in vegetation in affected areas, with a corresponding decrease in vegetation diversity (Bowen 2006, this volume).

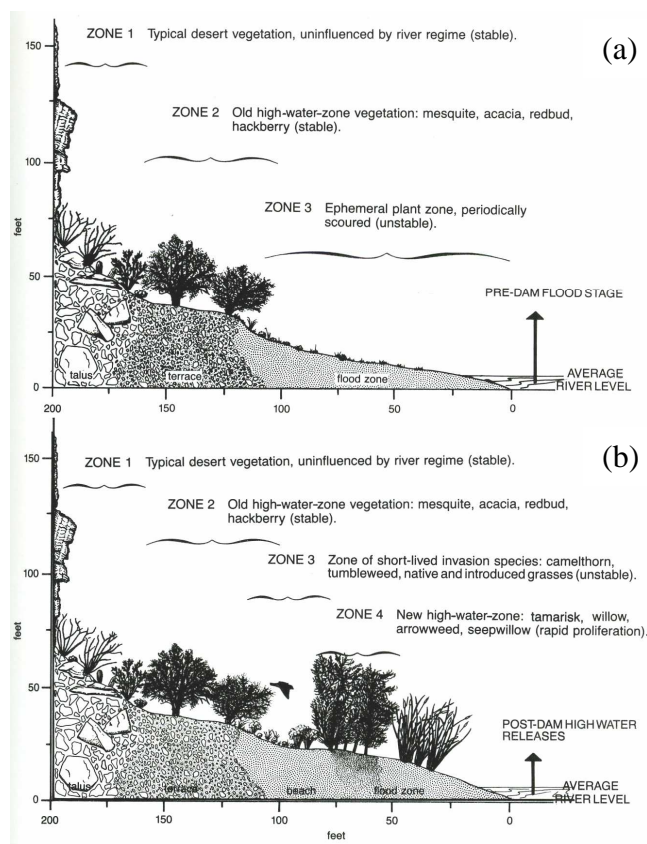


Figure 3. (a) This diagram shows the riparian vegetation distribution in the Grand Canyon prior to Glen Canyon Dam. (b) Post-dam, the regulated flow regime allows tamarisk and other species to colonize the previously unstable floodplain. (from Brown et al. 1987.)

On the middle Green River, the increase in tamarisk and marsh vegetation caused by flow regulation benefits riparian habitat generalists, or species that can readily utilize most to all types of riparian vegetation. To avian riparian habitat generalists, an increase in total vegetation

represents an increase in available nesting and roosting habitat (and sometimes food supply). Evidence from nearly all studies examining bird-tamarisk interactions suggests that while some bird species benefit from increases in tamarisk, other species are hurt by the corresponding loss of native vegetation (e.g., Hunter et al. 1985, Hunter et al. 1988, Ellis 1995). These species are known as native riparian habitat specialists: species that require cottonwoods and willows for nesting and perching.

The construction of Flaming Gorge Dam has also led to a decrease in natural marshlands and an increase in artificial marshlands. Before its regulation, the Green River flooded each spring, creating excellent marsh habitat for migrating and breeding waterbird species. The stable flows instituted by the dam in the early 1960s did not afford the same marsh habitat quality or acreage. As mitigation, the Migratory Bird Conservation Commission acquired Browns Park National Wildlife Refuge in 1963 to develop and manage suitable waterfowl habitat in Colorado. Today, water is pumped from the Green River and smaller tributaries to inundate portions of the refuge each spring and fall, creating artificial wetlands that attract tens of thousands of waterfowl each year (U. S. Fish and Wildlife Service 1999). The autumn flooding creates lucrative wetland habitat for fall migrants that did not exist prior to the dam. Additionally, natural marsh vegetation on river sand bars has increased in the wake of Flaming Gorge Dam. The lower, more stable flow levels have allowed marsh vegetation such as the common reed (*Phragmites* spp.), rush (*Juncus* spp.), and cattail (*Typha* spp.) to colonize and persist on previously bare sand bars (Bowen 2006, this volume), where it now serves as habitat to breeding waterfowl.

In addition to the recent changes in riparian habitat, certain Green River bird species have also been impacted by increasing prey density. In the past few decades, the middle Green River has experienced significant changes to its fish populations. Historically, the middle Green River contained eight species of fish (sculpins, suckers, dace, chubs, and pikeminnows) that were adapted to warm spawning temperatures, turbid water, and a variable flow regime (Valdez and Muth 2005). In the 1960s, government officials in pursuit of a tailwater trout fishery took measures such as poisoning native fish and stocking the river with brown trout, rainbow trout, and Yellowstone cutthroat. The colder, less turbid river conditions put into place by the dam favored the non-native fishes, and quickly led to an overabundance of trout from Flaming Gorge Dam to Browns Park (Valdez and Muth 2005). Today, non-native fish stocking is regulated to

maintain 8,000 – 14,000 fish per mile in this particular stretch, serving as a bountiful food source for local piscivorous birds.

The Serial Discontinuity Concept (SDC; Stanford and Ward 2001) recognizes the physical and ecological impacts of interruptions such as dams to the river continuum, while also recognizing restoring factors such as tributaries. The SDC predicts that the impacts are most severe just below the discontinuity, and that their severity gradually lessens as a function of downstream distance. According to the SDC, the Green River should gradually ‘reset’ itself ecologically as the distance from Flaming Gorge Dam increases. Thus tamarisk and marsh vegetation should decrease in abundance and/or density as a function of the distance downstream from the dam, as unregulated creeks and rivers help to reestablish a more natural flooding regime. Non-native trout should also decline in density downstream from the dam. In turn, these changes should affect the local avian communities. Below is discussion of specific responses to the dam predicted or observed for major groups of Green River birds by habitat type.

DESCRIPTION AND RESPONSE OF BIRDS BY HABITAT

There are five main types of habitat available to birds along the middle Green River, according to Hayward (1967): (1) pinyon-juniper woodlands, (2) desert shrubs, (3) canyonlands, (4) marshes, and (5) cottonwood-willow-tamarisk communities. The first three habitats occur beyond the pre-dam high water zone, and hence have not been affected by river regulation. Any changes in bird populations that inhabit these areas are due to changes in prey abundance or other factors mentioned only briefly here. The latter two habitats have been drastically impacted by Flaming Gorge Dam, and the bird populations that occur in these habitats have been likewise affected.

Birds of the Pinyon-Juniper Woodlands

Pinyon-juniper woodland communities are well represented in the Uinta Mountains, around which the Green River meanders. This habitat type is typically found on foothills or low plateaus. Avifaunal diversity in these areas is relatively low, due primarily to the desert-like conditions and the uniform vegetation (Hayward 1967). The pinyon jay and scrub jay are characteristic of this habitat type, passing through and stopping to eat from the trees or ground

(Hayward 1967). Other bird types that characterize this woodland community include the black-throated gray warbler, blue-gray gnatcatcher, Bewick's wren, gray flycatcher, ash-throated flycatcher, gray vireo, white-breasted nuthatch, and hairy woodpecker (Hayward 1967).

Black-throated Gray Warbler



Above is a picture of a breeding male black-throated gray warbler. Image courtesy of Mike Danzenbaker (<http://www.avesphoto.com/website/NA/species/WARBGY-1.htm>).

The black-throated gray warbler is a neotropical migrant (a bird that nests in temperate regions and winters in tropical regions) listed in the Utah Partners in Flight Avian Conservation Strategy as a priority species for conservation (Parrish et al. 2002). The species, which feeds mainly on insects, utilizes pinyon-juniper woodlands in Utah as its primary breeding habitat from March to August. North American Breeding Bird Survey (BBS) data indicate nearly significant ($p=0.07$), decreasing black-throated gray warbler population trends for the state of Utah from 1968-2003 (Sauer et al. 2005). Threats are thought to be primarily due to the human removal of over-story pinyon-juniper trees to enhance pasture land (Parrish et al. 2002).

Birds of the Desert Shrubs

The desert shrub communities of the Green River basin are dominated primarily by sagebrush. These communities are typical of higher elevations where rain and snow are the only sources of moisture. The shrubby vegetation can be found either on low foothills or plateaus or occupying the narrow ledges in deep canyons. The birds of the desert shrub are relatively low in

diversity. The most common birds of the sagebrush include the sage sparrow, lark sparrow, Brewer's sparrow, black-throated sparrow, and green-tailed towhee. The horned lark, loggerhead shrike, white-crowned sparrow, and dark-eyed junco are more examples of species characteristic of the desert shrubs (Hayward 1967).

Sage Sparrow



Above is a picture of a sage sparrow perching on a tree branch. Image courtesy of Bill Schmoker (www.schmoker.org/BirdPics/Sparrows.html).

Sage sparrows are found in desert shrub habitats in Utah during the breeding season, and are sometimes seen in southern Utah over the winter. Their diet consists primarily of seeds, and of insects to a lesser extent. Although BBS data shows nonsignificant but increasing recent trends for sage sparrows in Browns Park, Dinosaur National Monument, and Jensen (Sauer et al. 2005), human-mediated habitat degradation (shrub removal to improve rangelands) has caused declines in sage sparrow populations statewide (Parrish et al. 2002). It is currently also listed as a priority species in the Utah Partners in Flight Avian Conservation Strategy (Parrish et al. 2002), with management suggestions including the conservation of sagesteppe habitats.

Birds of the Canyonlands

The Green River canyonlands consist of sheer cliff faces, rock piles, and spires, all of which provide nesting and lookout sites for a unique group of birds. Hawks and eagles typically use the cliffs and spires of the canyons; common species of the area include the golden eagle,

American kestrel, red-tailed hawk, and prairie falcon (Hayward 1967). The common raven, cliff swallow, and white-throated swift have also been known to nest in the canyon crevices and ledges, while the rock wren and canyon wren often make use of rock piles in the canyonlands (Hayward 1967). Other species that have been observed nesting on cliffs include the house finch and broad-tailed hummingbird (Hayward 1967).

Peregrine Falcon



Above is a picture of a peregrine falcon perching on a cliffside. Image courtesy of Steve Maslowski (http://www.audubon.org/centennial/images/species/Peregrine_Falcon_lg2.jpg).

The formerly endangered peregrine falcon is presently a summertime resident of the Green River canyonlands. Within the past three decades, the number of peregrine falcon nests observed in Dinosaur National Monument has increased from 2 active nests in 1976 to 8 active nests in 1992 to 12 active nests in 2005 (U. S. Department of the Interior 2005). Peregrine falcons are usually only found in the Green River area during their breeding season, March-October.

Nationwide, declines in peregrine falcon populations in the 1950s and 1960s were attributed to DDT (an organochlorine insecticide) poisoning and correlated eggshell thinning that led to low nesting success. The banning of DDT in 1972, along with a captive breeding program implemented by The Peregrine Fund, led to increases in population numbers and a successful

delisting of the species in 1999. In the Green River area, peregrine falcon populations have also been bolstered by an increase in available prey (U. S. Department of the Interior 2005). Peregrine falcons typically feed on bats, ducks, swallows, and passerines. In the post-dam era, these groups of animals have increased due to the increases in insect prey corresponding to the overall increase in riparian vegetation (U. S. Department of the Interior 2005). Thus, through a trophic cascade, riparian vegetation increases have indirectly contributed to the recent success of the peregrine falcon in Dinosaur National Monument.

Birds of the Water and Marsh

Waterbirds, including ducks, geese, and shorebirds, are the main avian species found in the Green River marsh habitat, and also utilize the river itself for swimming, feeding, and courtship rituals. Areas of different flow serve as habitat to different types of waterbirds. In fairly level country such as Browns Park, the channel is generally wide and the flow rate is relatively slow. In canyonlands, the river channel often narrows and the flow rate quickens. Waterfowl commonly seen in slow-moving reaches of the Green River include the Canada goose, red-breasted merganser, common merganser, and common goldeneye (Hayward 1967). Other types of waterbirds seen along the shore or amongst the vegetation include the mallard, northern pintail, cinnamon teal, American coot, great blue heron, killdeer, and spotted sandpiper (Hayward 1967). One of the only birds that inhabits the fast-moving reaches is the American dipper (Hayward 1967).

Unlike the woodlands, desert shrubs, and canyonlands, which have not been directly impacted by the construction of Flaming Gorge Dam, marsh habitats lie well within the pre-dam high water zone, and hence have been affected by the river's regulation. While flow regulation on the Green River has led to a decrease in natural marshlands, human mitigation efforts have led to the successful creation and management of alternative wetland and marsh habitat, such as Browns Park National Wildlife Refuge. Additionally, the more stable flow regime brought about by Flaming Gorge Dam has allowed marsh vegetation to colonize river sand bars, creating even more usable breeding habitat for waterbirds. According to the SDC, these changes would be expected to decrease in magnitude downstream of the dam, especially beyond the confluence of the Yampa River. As tributary input gradually restores the Green River to a more natural,

scouring hydrograph, the sandbar marsh vegetation should decrease, and so should waterfowl populations using that vegetation.

Canada Goose



Above is a picture of a Canada Goose incubating a nest in the marsh vegetation alongside a river. Image courtesy of David Sanger (<http://www.davidsanger.com/images/bay/5-200-24.canadagoose.y.jpg>).

The Canada goose is one of the most abundant waterbirds seen on the Green River, and one of only six waterfowl species that breed on the river (U. S. Department of the Interior 2005). Canada geese feed almost exclusively on plant matter, with a small portion of their diet comprised of aquatic invertebrates. They breed from mid-March to mid-May, and prefer to nest in low, grassy vegetation found on wetlands or on river islands and sandbars. The construction of Flaming Gorge Dam has likely bolstered their nesting success by requiring the establishment of wildlife refuges specifically designed for waterfowl, and by stabilizing the Green River hydrograph and permitting sandbar vegetation colonization. Additionally, sandbar and island nesting has become a good deal safer than pre-Flaming Gorge Dam, as large pre-dam springtime floods undoubtedly scoured out not only the sandbar vegetation but also the waterfowl nests in them. In theory, Canada goose numbers should thus decline downstream from Flaming Gorge Dam, as tributaries such as the Yampa provide more scouring events.

Birds of the Cottonwood-Willow-Tamarisk Communities

The cottonwood-willow-tamarisk communities support the greatest number of birds of the five habitats described by Hayward (1967). As a result of the availability of both cover and food, this vegetation composition supports large numbers of breeding birds, migrating birds, and wintering birds (Hayward 1967). Based on their habitat use, these birds can be divided into two categories, which are affected by Flaming Gorge Dam in very different ways: riparian habitat generalists and native riparian habitat specialists.

Riparian Habitat Generalists

Avian riparian habitat generalists are species that can utilize most to all types of riparian vegetation. These generalists have not been harmed by the recent proliferation of tamarisk vegetation and decrease in native vegetation because they are able to use the tamarisk for cover. On the Green River, riparian habitat generalists consist mainly of ground dwellers and shrub nesters. Neither of these groups is likely to be adversely affected by the river regulation put into place by Flaming Gorge Dam.

On the middle Green River, ground-dwellers or residents of pastures or open fields sometimes use riparian shrubs and trees for roosting or temporary cover, while typically foraging and nesting on the ground. Examples of such birds include the California quail, western meadowlark, white-crowned sparrow, dark-eyed junco and Savannah sparrow (Hayward 1967). Since neither their nesting nor their feeding are dependent on cottonwoods or tamarisk, this group of birds is unlikely to be affected by Flaming Gorge Dam.

Other bird species do nest in the riparian shrubs found growing amongst the larger trees on the historic Green River floodplain. These shrubs include tamarisk, willows, alder, birch, squawberry, and hawthorn. Most of the birds that nest in these shrubs feed in part from the shrubs themselves, and in part from the ground. The most common bird found in this habitat is the song sparrow. Other birds include the yellow-breasted chat, gray catbird, green-tailed towhee, Brewer's blackbird, and black-chinned hummingbird (Hayward 1967). Studies from the Grand Canyon show that shrub nesting birds increased in numbers due to the overall increase in riparian vegetation associated with the tamarisk invasion along the Colorado River (Brown et al. 1987). Because additional shrub vegetation serves as more nesting habitat for these birds, the same results can be expected along the Green River. As distance downstream from Flaming

Gorge Dam increases, one would expect a gradual decline in populations of riparian habitat generalists.

Yellow-breasted Chat



Above is a picture of a yellow-breasted chat. Image courtesy of Tam Stuart (www.tamstuart.com/Birds%20Song/birdssong_001.htm).

The yellow-breasted chat is a neotropical migrant, feeding on insects and fruit during the Utah summer. It readily utilizes tamarisk for cover and nesting habitat (Brown et al. 1987). BBS data shows that yellow-breasted chat populations have been increasing since 1968 in both Colorado and Utah, although the results were not statistically significant in Utah (Sauer et al. 2005). Surveys conducted from 1992-2005 on Sheep Creek, near Flaming Gorge Dam, show that the yellow-breasted chat is one of the most abundant bird species observed on the creek (Utah Division of Wildlife Resources, unpublished data). While it seems that a correlation might exist between tamarisk abundance and yellow-breasted chat numbers, more information is needed before causation is justified. If yellow-breasted chat populations are indeed responding to increased riparian vegetation on the middle Green River, then the number of chats should gradually decline downstream of Flaming Gorge Dam, as the tamarisk density decreases.

Native Riparian Habitat Specialists

In contrast to generalists, native riparian habitat specialists are limited in the vegetation that they can utilize. The invasion of exotic tamarisk and depletion of cottonwood-willow stands has had the potential to negatively impact many specialist birds in the Green River area. While

specific research is lacking in this area, it is possible to make predictions about species and groups of species based on their habitat requirements. There are two major groups of native riparian habitat specialists for which predictions can be formulated: cavity nesters and tree branch dwellers.

Cottonwoods and other large trees along the Green River provide important habitat for cavity nesters. Cavity-nesting birds breed in holes in either living or dead trees; these holes can be pre-existing (through rot or lightning, for example) or created by the bird itself. Some of the common cavity-nesting species found on the Green River floodplain are the downy woodpecker, red-headed woodpecker, Lewis' woodpecker, hairy woodpecker, yellow-bellied sapsucker, black-capped chickadee, white-breasted nuthatch, red-breasted nuthatch, and house wren (Hayward 1967). All of these bird species also feed on the tree foliage. Other cavity nesters do not feed directly on the trees in which they reside. Examples of these types of birds are the European starling, tree swallow, mountain bluebird, and American kestrel, which also nests in canyon ledges (Hayward 1967).

Cavity nesters might be expected to decline in numbers in response to the tamarisk invasion. Most of the cavity nesters of the Green River, with the major exception of the European starling, are native to the area, and thus co-evolved with the native cottonwood riparian vegetation. In the Bosque del Apache National Wildlife Refuge in the Middle Rio Grande Valley, a study by Ellis (1995) showed that most cavity nesters did not utilize tamarisk as breeding habitat, with the exception of the downy woodpecker. Although the exact mechanism remains unclear, the majority of cavity nesters do appear to be tied to the native vegetation. The difference between the two habitats may have to do with tree size: mature Fremont cottonwoods are typically 20 to 110 feet tall (6 to 34 m) and 20 inches to 5 feet (0.5 to 1.5 m) in diameter, while tamarisk shrubs only reach 5 to 20 feet (1.5 to 6 m) in height and 4 inches (10 cm) in diameter.

Another major bird group of the Green River riparian community consists of birds that utilize tree branches for nesting, perching, and roosting. Several of the Green River hawk species are known for using large riparian trees as nesting sites. These include species such as the red-tailed hawk, Cooper's hawk, and sharp-shinned hawk (Hayward 1967). The western yellow-billed cuckoo, western and eastern kingbirds, western wood pewee, American crow, and American robin also utilize riparian trees in this manner (Hayward 1967). Other species, such as

the bald eagle, use the tree branches for perching and roosting in the winter, and migrate elsewhere to breed in the summer.

These bird species typically will not or cannot substitute tamarisk shrub for native riparian habitat. Although the mechanism behind this varies by location and bird species, there seem to be two general rules. First, large raptors require tall, mature cottonwoods because tamarisk shrub is simply too small or short for their use. Breeding raptors, such as the red-tailed hawk, would not be able to efficiently nest in a small tamarisk shrub. Non-breeders, such as the bald eagle, require tall trees as perching sites so that they can see their prey more easily. The second rule is that for certain smaller bird species, tamarisk shrubs do not provide sufficient thermal refugia from the desert heat (Hunter et al. 1985, Rosenberg et al. 1991). Tamarisk leaves are small and scale-like, while cottonwood leaves are broad and flat, providing a great deal more shade. For breeding birds, temperature is of utmost importance, and cannot exceed 108 degrees Fahrenheit for many bird species without fatal effects to embryos (Walsberg and Voss-Roberts 1983). These native riparian habitat specialists have thus likely been negatively impacted by Flaming Gorge Dam and the proliferation of tamarisk. Populations of these birds will be expected to increase downstream of Flaming Gorge Dam, especially once past the unregulated Yampa River confluence, as the native cottonwood abundance increases.

Lewis' Woodpecker



Above is a photo of an adult male Lewis' woodpecker. Image courtesy of Peter LaTourrette (<http://www.stanford.edu/~petelat1/photos/lewo-1.jpg>).

Lewis' woodpecker is a migratory, cavity-nesting species that feeds primarily on insects during the breeding season. Its primary breeding habitat is Ponderosa pine, with its secondary breeding habitat being lowland riparian trees. Breeding pairs excavate a nesting cavity together, preferably in Ponderosa pine or cottonwood trees (Parrish et al. 2002). BBS data indicates that Lewis' woodpecker populations are declining (Parrish et al. 2002), which is particularly important because of its relatively small, highly fragmented distribution (Figure 4). The Utah Partners in Flight Avian Conservation Strategy lists the Lewis' woodpecker as its highest priority species for conservation (Parrish et al. 2002). Current conservation recommendations include riparian habitat restoration, management, and protection. In the Green River area, Lewis' woodpecker would certainly benefit from increases in native cottonwood abundance, as it cannot utilize tamarisk or other shrubs for nesting.

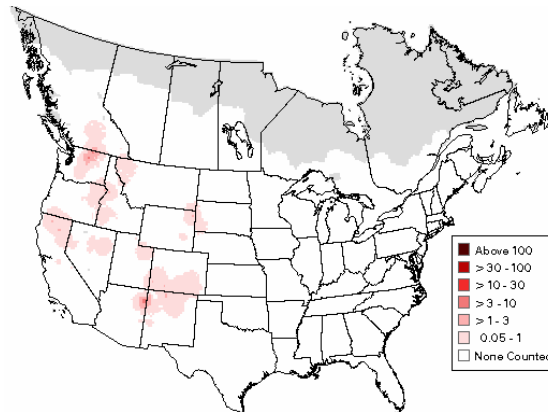


Figure 4. Breeding Bird Survey summer distribution map for Lewis' woodpecker, 1994 – 2003. (Sauer et al. 2005.)

Bald Eagle



Above is a picture of a bald eagle preying upon a small fish, a familiar scene on the middle Green River in winter. Image courtesy of Greg Downing (www.naturescapes.net).

The bald eagle is a large bird of prey that, as the symbol of our nation, constitutes an important flagship species, a charismatic species that serves as a rallying point for conservation awareness and action. Bald eagles, which are endemic to North America, often overwinter in the lower 48 states and breed in more northerly regions. Utah is home to one of the largest state populations of wintering bald eagles; approximately 25-30% of western eagles (eagles that spend the winter west of the Rocky Mountains) reside in Utah (Project WILD 2005). Around 50 bald eagles spend the winter in the middle Green River area each year, and are most often seen in open valley areas such as Browns Park and Island Park (Huffman 1992, as cited in U. S. Department of the Interior 2005). Eagles perch in large cottonwood trees near the river, while watching for fish and waterfowl to take as prey. Their primary food source is non-native trout. Flaming Gorge Dam thus serves as a mixed blessing for bald eagles. The decrease in cottonwoods associated with the post-dam tamarisk invasion directly decreases available eagle perching and roosting habitat, jeopardizing wintering populations (Project WILD 2005). However, the benefits afforded by the dam to trout populations directly increase their food supply, and probably outweigh the negative impacts of cottonwood declines.

Yellow-Billed Cuckoo



Above is a picture of a yellow-billed cuckoo perching on a tree branch. Image courtesy of AJ Hand (www.manomet.org/news/archives/).

The western yellow-billed cuckoo is a migratory species that breeds in Utah on rare occasion. When present, the cuckoo arrives in late May and leaves in late August, during which time it feeds almost exclusively on large insects. Historically, western cuckoos were probably relatively common summer residents in Utah (Hayward et al. 1976). Today, the western cuckoo is a candidate species for listing under the Endangered Species Act, and is described as a sensitive species in the state of Utah. While extremely rare, the species has been observed on the middle Green River near Ouray (U. S. Department of the Interior 2005). Western cuckoos have faced severe population declines due in part to the loss or degradation of riparian habitat (U.S. Fish and Wildlife Service 2001b). Yellow-billed cuckoos have very specific habitat requirements: mature cottonwood forests with a dense understory. Studies indicate that they will only nest in tamarisk 2.5% of the time (Hunter et al. 1988). Hence, while their population declines are not necessarily due to the post-dam riparian habitat changes, such changes have probably prevented the species from reestablishing itself. The species would clearly benefit from a more natural riparian vegetation composition (U. S. Department of the Interior 2005).

MANAGEMENT RECOMMENDATIONS

Under the present management system, tamarisk shrubs are likely to continue to proliferate and cottonwood stands decline in the Green River area (Bowen 2006, this volume). While tamarisk stands differ structurally from mature cottonwood stands, tamarisk still meets the habitat requirements of many migrating and breeding birds. As this review suggests, these habitat generalists will be able to successfully undergo the transition from native to exotic vegetation, and may even benefit from such habitat changes. However, the changing vegetation will also undoubtedly cause declines in the abundance of native riparian habitat specialists. Birds such as Lewis' woodpecker may be excluded from the middle Green River, and the area may never serve as suitable habitat for the rare western yellow-billed cuckoo.

While complete removal of tamarisk is probably impossible, and maybe even undesirable from the point of view of certain birds, restoration efforts to replace and maintain patches of native cottonwoods and willows will undoubtedly benefit avian riparian habitat specialists

without harming the generalists. Conservationists can initiate the planting of cottonwoods in areas where the pre-determined probability of sapling survival is high. When coupled with the proposed new Flaming Gorge Dam flow regime that better mimics natural scouring events (U. S. Department of the Interior 2005), these restoration efforts may lead to increased cottonwood recruitment. Additional habitat restoration efforts can include planting native tree species in large stands of tamarisk. A study by Anderson and others (1977) noted that the addition of one or more native tree species, even in small numbers, greatly enhanced the overall attractiveness of an area to breeding birds. Such restoration efforts would certainly benefit native avian riparian habitat specialists on the middle Green River.

APPENDIX: A LIST OF THE BIRDS OF THE GREEN RIVER

(primarily derived from World Wildlife Fund 2006 and Sauer et al. 2005)

Common Name	Scientific Name	Notes
American Coot	<i>Fulica americana</i>	
American Crow	<i>Corvus brachyrhynchos</i>	
American Dipper	<i>Cinclus mexicanus</i>	utilizes swift streams of steeper canyons (Hayward et al. 1976)
American Goldfinch	<i>Carduelis tristis</i>	common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
American Kestrel	<i>Falco sparverius</i>	uses holes in cotton-willow-tamarisk woodland for nesting and roosting; also nests in canyon ledges (Hayward 1967); AKA Sparrow Hawk
American Robin	<i>Turdus migratorius</i>	utilizes cottonwood and box elder riparian woodland (Hayward et al. 1976); very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
American White Pelican	<i>Pelecanus erythrorhynchos</i>	
American Wigeon	<i>Anas americana</i>	
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	
Bald Eagle	<i>Haliaeetus leucocephalus</i>	uses canyon ledges and cliffs as lookout points (Hayward 1967)
Bank Swallow	<i>Riparia riparia</i>	
Barn Swallow	<i>Hirundo rustica</i>	
Belted Kingfisher	<i>Ceryle alcyon</i>	utilizes swift streams of steeper canyons and small valley streams (Hayward et al. 1976)
Bewick's Wren	<i>Thryomanes bewickii</i>	
Black-and-white Warbler	<i>Mniotilta varia</i>	
Black-billed Magpie	<i>Pica hudsonia</i>	very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Black-capped Chickadee	<i>Poecile atricapillus</i>	found along Green River and tributaries (Hayward 1967); common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	uses shrubby floodplain vegetation as habitat; feeds at least in part from the ground (Hayward 1967)
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	utilizes cottonwood and box elder riparian woodland (Hayward et al. 1976); uses the trees to nest and obtain food (Hayward 1967); common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Black-throated Gray Warbler	<i>Dendroica nigrescens</i>	
Black-throated Sparrow	<i>Amphispiza bilineata</i>	
Blue Grosbeak	<i>Passerina caerulea</i>	uses shrubby floodplain vegetation as habitat; feeds at least in part from the ground (Hayward 1967)
Blue-gray Gnatcatcher	<i>Poliophtila caerulea</i>	
Blue-winged Teal	<i>Anas discors</i>	
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	uses shrubby floodplain vegetation as habitat; feeds at least in part from the ground (Hayward 1967); uses

		open fields of the floodplains for feeding (Hayward 1967)
Brewer's Sparrow	<i>Spizella breweri</i>	
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	utilizes cottonwood and box elder riparian woodland (Hayward et al. 1976); can use canyon cliffs as nest sites (Hayward 1967)
Brown-headed Cowbird	<i>Molothrus ater</i>	common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Bufflehead	<i>Bucephala albeola</i>	utilizes streams in winter (Hayward et al. 1976)
Bullock's Oriole	<i>Icterus galbula</i>	
California Quail	<i>Callipepla californica</i>	wintering species; feeds on buds, fruits, and berries of both native and ornamental shrubs and trees; ground-dweller; uses floodplain vegetation as a temporary refuge (Hayward 1967)
Canada Goose	<i>Branta canadensis</i>	utilizes stream banks in summer (Hayward et al. 1976)
Canvasback	<i>Aythya valisineria</i>	
Canyon Wren	<i>Catherpes mexicanus</i>	uses rock piles in canyonlands (Hayward 1967)
Cassin's Finch	<i>Carpodacus cassinii</i>	common in NE montane habitats (Behle 1985)
Cedar Waxwing	<i>Bombycilla cedrorum</i>	wintering species; feeds on buds, fruits, and berries of both native and ornamental shrubs and trees (Hayward 1967)
Chipping Sparrow	<i>Spizella passerina</i>	
Cinnamon Teal	<i>Anas cyanoptera</i>	
Clark's Grebe	<i>Aechmophorus clarkii</i>	
Clark's Nutcracker	<i>Nucifraga columbiana</i>	common in NE montane habitats (Behle 1985)
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	nects in canyon ledges (Hayward 1967)
Common Bushtit	<i>Psaltiriparus minimus</i>	
Common Goldeneye	<i>Bucephala clangula</i>	utilizes streams in winter (Hayward et al. 1976)
Common Merganser	<i>Mergus merganser</i>	utilizes streams in winter (Hayward et al. 1976)
Common Nighthawk	<i>Chordeiles minor</i>	
Common Raven	<i>Corvus corax</i>	nects in canyon ledges (Hayward 1967)
Common Snipe	<i>Gallinago gallinago</i>	
Common Yellowthroat	<i>Geothlypis trichas</i>	
Cooper's Hawk	<i>Accipiter cooperii</i>	utilizes cottonwood and box elder riparian woodland (Hayward et al. 1976); uses tree branches to nest but obtains food elsewhere (Hayward 1967)
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	
Dark-eyed Junco	<i>Junco hyemalis</i>	uses shrubby floodplain vegetation as habitat during winter or migration (Hayward 1967)
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	
Downy Woodpecker	<i>Picoides pubescens</i>	found along Green River and tributaries (Hayward 1967)
Dusky Flycatcher	<i>Empidonax oberholseri</i>	common in NE montane habitats (Behle 1985)
Eared Grebe	<i>Podiceps nigricollis</i>	

Eastern Kingbird	<i>Tyrannus tyrannus</i>	uses tree branches to nest but obtains food elsewhere (Hayward 1967)
European Starling	<i>Sturnus vulgaris</i>	non-native; use holes in cotton-willow-tamerisk woodland for nesting and roosting (Hayward 1967); uses open fields of the floodplains for feeding (Hayward 1967); common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Ferruginous Hawk	<i>Buteo regalis</i>	
Fox Sparrow	<i>Passerella iliaca</i>	common in NE montane habitats (Behle 1985)
Gadwall	<i>Anas strepera</i>	
Golden Eagle	<i>Aquila chrysaetos</i>	uses canyon ledges and cliffs as lookout points (Hayward 1967)
Golden-crowned Kinglet	<i>Regulus satrapa</i>	
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	
Gray Catbird	<i>Dumetella carolinensis</i>	utilizes cottonwood and box elder riparian woodland (Hayward et al. 1976); uses shrubby floodplain vegetation as habitat; feeds at least in part from the ground (Hayward 1967)
Gray Flycatcher	<i>Empidonax wrightii</i>	
Gray Vireo	<i>Vireo vicinior</i>	
Great Blue Heron	<i>Ardea herodias</i>	common on White River (Steele and Vander Wall 1985)
Green-tailed Towhee	<i>Pipilo chlorurus</i>	uses shrubby floodplain vegetation as habitat; feeds at least in part from the ground (Hayward 1967)
Green-winged Teal	<i>Anas crecca</i>	common on White River (Steele and Vander Wall 1985)
Hairy Woodpecker	<i>Picoides villosus</i>	common in NE montane habitats (Behle 1985); found along Green River and tributaries (Hayward 1967)
Hermit Thrush	<i>Catharus guttatus</i>	common in NE montane habitats (Behle 1985); transient (Hayward 1967)
Horned Lark	<i>Eremophila alpestris</i>	
House Finch	<i>Carpodacus mexicanus</i>	utilizes cottonwood and box elder riparian woodland (Hayward et al. 1976); found along Green River and tributaries (Hayward 1967); can use canyon cliffs as nest sites (Hayward 1967)
House Sparrow	<i>Passer domesticus</i>	
House Wren	<i>Troglodytes aedon</i>	common in NE montane habitats (Behle 1985); very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Indigo Bunting	<i>Passerina cyanea</i>	
Juniper Titmouse	<i>Baeolophus ridgwayi</i>	
Killdeer	<i>Charadrius vociferus</i>	common on White River (Steele and Vander Wall 1985)
Lark Bunting	<i>Calamospiza melanocorys</i>	
Lark Sparrow	<i>Chondestes grammacus</i>	
Lazuli Bunting	<i>Passerina amoena</i>	very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Lesser Goldfinch	<i>Carduelis psaltria</i>	
Lesser Scaup	<i>Aythya affinis</i>	

Lewis's Woodpecker	<i>Melanerpes lewis</i>	common on Green River floodplains (Hayward 1967)
Lincoln's Sparrow	<i>Melospiza lincolnii</i>	common in NE montane habitats (Behle 1985)
Loggerhead Shrike	<i>Lanius ludovicianus</i>	
Lucy's Warbler	<i>Vermivora luciae</i>	
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	common in NE montane habitats (Behle 1985); common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Mallard	<i>Anas platyrhynchos</i>	common on White River (Steele and Vander Wall 1985)
Marsh Wren	<i>Cistothorus palustris</i>	
Montezuma Quail	<i>Cyrtonyx montezumae</i>	
Mountain Bluebird	<i>Sialia currucoides</i>	use holes in cotton-willow-tamerisk woodland for nesting and roosting (Hayward 1967)
Mourning Dove	<i>Zenaida macroura</i>	utilizes cottonwood and box elder riparian woodland (Hayward et al. 1976); ground-dweller; uses floodplain vegetation as a temporary refuge or nest site (Hayward 1967); common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Northern Flicker	<i>Colaptes auratus</i>	very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data); AKA Red-shafted Flicker
Northern Harrier	<i>Circus cyaneus</i>	
Northern Mockingbird	<i>Mimus polyglottos</i>	uses shrubby floodplain vegetation as habitat; feeds at least in part from the ground (Hayward 1967)
Northern Pintail	<i>Anas acuta</i>	present on White River (Steele and Vander Wall 1985)
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	
Northern Shoveler	<i>Anas clypeata</i>	
Northern Waterthrush	<i>Seiurus noveboracensis</i>	
Olive-sided Flycatcher	<i>Contopus cooperi</i>	common in NE montane habitats (Behle 1985)
Orange-crowned Warbler	<i>Vermivora celata</i>	common in NE montane habitats (Behle 1985)
Osprey	<i>Pandion haliaetus</i>	
Peregrine Falcon	<i>Falco peregrinus</i>	
Pied-billed Grebe	<i>Podilymbus podiceps</i>	
Pine Siskin	<i>Carduelis pinus</i>	
Pinyon Jay	<i>Gymnorhinus cyanocephalus</i>	
Plumbeous Vireo	<i>Vireo plumbeus</i>	utilizes swift streams of steeper canyons (Hayward et al. 1976)
Prairie Falcon	<i>Falco mexicanus</i>	uses canyon ledges and cliffs as lookout points (Hayward 1967)
Red Crossbill	<i>Loxia curvirostra</i>	common in NE montane habitats (Behle 1985)
Red-breasted Merganser	<i>Mergus serrator</i>	utilizes streams in winter (Hayward et al. 1976)
Red-breasted Nuthatch	<i>Sitta canadensis</i>	common in NE montane habitats (Behle 1985); found along Green River and tributaries (Hayward 1967)
Redhead	<i>Aythya americana</i>	

Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	found on Green River floodplains (Hayward 1967)
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>	
Red-tailed Hawk	<i>Buteo jamaicensis</i>	uses tree branches to nest but obtains food elsewhere (Hayward 1967); uses canyon ledges and cliffs as lookout points (Hayward 1967)
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	
Ring-necked Duck	<i>Aythya collaris</i>	
Rock Wren	<i>Salpinctes obsoletus</i>	uses rock piles in canyonlands (Hayward 1967)
Ruby-crowned Kinglet	<i>Regulus calendula</i>	common in NE montane habitats (Behle 1985)
Ruddy Duck	<i>Oxyura jamaicensis</i>	
Rufous Hummingbird	<i>Selasphorus rufus</i>	uses canyon ledges and cliffs as lookout points (Hayward 1967)
Sage Sparrow	<i>Amphispiza belli</i>	
Sage Thrasher	<i>Oreoscoptes montanus</i>	
Sandhill Crane	<i>Grus canadensis</i>	
Savannah Sparrow	<i>Passerculus sandwichensis</i>	uses open fields of the floodplains for feeding (Hayward 1967)
Say's Phoebe	<i>Sayornis saya</i>	
Scott's Oriole	<i>Icterus parisorum</i>	
Sharp-shinned Hawk	<i>Accipiter striatus</i>	utilizes cottonwood and box elder riparian woodland (Hayward et al. 1976); uses tree branches to nest but obtains food elsewhere (Hayward 1967)
Song Sparrow	<i>Melospiza melodia</i>	uses shrubby floodplain vegetation as habitat; feeds at least in part from the ground (Hayward 1967); very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Spotted Sandpiper	<i>Actitis macularia</i>	common on White River (Steele and Vander Wall 1985)
Spotted Towhee	<i>Pipilo maculatus</i>	very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Steller's Jay	<i>Cyanocitta stelleri</i>	common in NE montane habitats (Behle 1985)
Swainson's Hawk	<i>Buteo swainsoni</i>	
Townsend's Solitaire	<i>Myadestes townsendi</i>	wintering species; feeds on buds, fruits, and berries of both native and ornamental shrubs and trees (Hayward 1967); common in NE montane habitats (Behle 1985)
Tree Swallow	<i>Tachycineta bicolor</i>	common in NE montane habitats (Behle 1985); use holes in cotton-willow-tamerisk woodland for nesting and roosting (Hayward 1967)
Turkey Vulture	<i>Cathartes aura</i>	uses cotton-willow-tamerisk trees as lookouts (Hayward 1967)
Vesper Sparrow	<i>Poocetes gramineus</i>	
Violet-green Swallow	<i>Tachycineta thalassina</i>	very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Virginia Rail	<i>Rallus limicola</i>	
Virginia's Warbler	<i>Vermivora virginiae</i>	common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Warbling Vireo	<i>Vireo gilvus</i>	uses the trees to nest and obtain food (Hayward 1967); very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)

		Resources, unpublished data)
Western Bluebird	<i>Sialia mexicana</i>	
Western Kingbird	<i>Tyrannus verticalis</i>	uses tree branches to nest but obtains food elsewhere (Hayward 1967)
Western Meadowlark	<i>Sturnella neglecta</i>	uses open fields of the floodplains for nesting (Hayward 1967)
Western Scrub-Jay	<i>Aphelocoma californica</i>	uses shrubby floodplain vegetation as habitat; feeds at least in part from the ground (Hayward 1967)
Western Tanager	<i>Piranga ludoviciana</i>	common in NE montane habitats (Behle 1985); most frequently seen in spring and fall (Hayward 1967)
Western Wood-Pewee	<i>Contopus sordidulus</i>	utilizes cottonwood and box elder riparian woodland (Hayward et al. 1976); uses tree branches to nest but obtains food elsewhere (Hayward 1967)
White-breasted Nuthatch	<i>Sitta carolinensis</i>	common in NE montane habitats (Behle 1985); found along Green River and tributaries (Hayward 1967)
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	common in NE montane habitats (Behle 1985); uses shrubby floodplain vegetation as habitat during winter or migration (Hayward 1967)
White-throated Swift	<i>Aeronautes saxatalis</i>	nests in canyon ledges (Hayward 1967); very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Wild Turkey	<i>Meleagris gallopavo</i>	
Wilson's Warbler	<i>Wilsonia pusilla</i>	common in NE montane habitats (Behle 1985); most frequently seen in spring and fall (Hayward 1967)
Yellow Warbler	<i>Dendroica petechia</i>	utilizes cottonwood and box elder riparian woodland (Hayward et al. 1976); uses the trees to nest and obtain food (Hayward 1967); very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	very common in Green River woodlands (Hayward 1967)
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	
Yellow-breasted Chat	<i>Icteria virens</i>	utilizes cottonwood and box elder riparian woodland (Hayward et al. 1976); uses shrubby floodplain vegetation as habitat; feeds at least in part from the ground (Hayward 1967); very common on Sheep Creek (Utah Division of Wildlife Resources, unpublished data)
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	
Yellow-rumped Warbler	<i>Dendroica coronata</i>	common in NE montane habitats (Behle 1985)

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