Yellowstone National Park
Montana, Wyoming, Idaho

National Park Service
U.S. Department of the Interior

Yellowstone National Park
Bird Program Annual Report

2015

Observing birds at Promontory Point, along the southern shore of Yellowstone Lake. Photo © S. Rebinski

Cover photo: Sandhill cranes. Photo © D. & L. Dzurisin

Suggested Citation: Smith, D.W., L. Baril, B. Cassidy, D. Haines, L. Strait, and K. Duffy. 2016. Yellowstone National Park Bird Program 2015 Annual Report. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyoming, YCR-2016-02.

Yellowstone National Park Bird Program Annual Report 2015

Douglas W. Smith
Senior Wildlife Biologist

Lisa Baril
Raptor Biologist

Lisa Strait
Biological Science Technician

David Haines
Raptor Biologist

Brenna Cassidy
Biological Science Technician

Katy Duffy
Interpretive Planner (retired)

National Park Service
Yellowstone National Park
Post Office Box 168
Yellowstone National Park, Wyoming, USA 82190

www.nps.gov/ycr

Executive Summary

During 2015, Yellowstone National Park (YNP) continued its long-term core bird monitoring program for the 32nd year and completed the fifth and final year of the Yellowstone Raptor Initiative, a five-year project focusing on the role of aerial predators (hawks, eagles, falcons, and owls).

Raptors: YNP supports at least 36 peregrine falcon territories, many of which are occupied annually (23 confirmed in 2015). Although nesting success has remained at or below the 27-year average in six of the last ten years, the peregrine population in YNP remains stable. In contrast, the nesting success of bald eagles and ospreys has been at or above the long-term averages for both species during the last several years. There are 50 historic bald eagle territories in YNP, one-half of which are occupied by a mated pair each year. Thirteen of 19 (68%) bald eagle nests were successful in 2015. We monitored 30 osprey nests, which represents a sample of the total population, and 15 (50%) were successful. Three pairs nested on Yellowstone Lake, but only one pair was successful.

Two new golden eagle territories were discovered, bringing the total known territories to 28. All territories are occupied every year, but breeding attempts and nesting success vary among years. Only 5 of 19 pairs successfully fledged young in 2015. In the monitored red-tailed hawk territories, only 12 of 30 (41%) successfully fledged young. Although greater than during 2014, nesting success was much lower than during 2011-2013 (80-90%). Fifteen Swainson's hawk territories were occupied, and 2 of 3 monitored nests produced young. Since 2010, there have been at least 90 American kestrel sightings, mostly in northern Yellowstone. Both prairie falcon sites monitored were occupied, but successful nesting was confirmed at only one site.

During autumn, 1,248 raptors across 17 species were documented migrating through Hayden Valley. The most abundant species observed were red-tailed hawk (32%), northern harrier (10%), golden eagle (8%), and American kestrel (8%). During winter/spring owl surveys, observers detected individuals of five owl species: great horned owl, northern pygmy owl, long-eared owl, boreal owl, and northern saw-whet owl.

Staff of the Yellowstone Bird Program searching for birds in the rolling hills above Lamar Valley. NPS Photo-D. Smith

We participated in several public outreach events and classes, focused around raptor identification and ecology, led by retired Interpretive Ranger Katy Duffy. Additionally, we hosted a mid-winter bald and golden eagle survey in January, accomplished through a volunteer effort. These programs served to foster enthusiasm and public appreciation for raptors and other avian communities in YNP.

Trumpeter Swans: Two pairs nested in 2015. The Grebe Lake pair successfully fledged two cygnets, while the Riddle lake pair fledged one cygnet. In partnership with Wyoming Wetlands Society, three cygnets raised in captivity were released on the Yellowstone River in the Hayden Valley to augment the population and establish more breeding pairs. One hundred and sixty-eight swans were observed in the park during the winter survey in late February, while 29 swans were observed during the autumn survey in late September.

Molly Islands Colonial Nesting Birds: American white pelicans fledged 291 young, while double-crested cormorants fledged 9 young. None of the 19 California gull nest attempts were successful. Although no Caspian terns nested on the islands, there were three individuals observed in aerial photos. The number of pelicans, cormorants, and gulls fledged from the Molly Islands has declined since the early 1990s, and Caspian terns have not nested there since 2005.

Common Loons: Two pairs fledged a total of four young, while four other pairs nest unsuccessfully. Another 14 adults were observed in the park. The Biodiversity Research Institute (BRI) is working with park biologists to learn more about the Wyoming population since it is isolated by more than 200 miles from the nearest breeding population in northwestern Montana. The park supports the majority of loons in Wyoming and, as a result, is extremely important for the persistence of this isolated population.

Songbirds: Three methods were used to monitor songbirds: point counts in willow stands, point counts in recently burned forests, and the international breeding bird survey. Twenty-four songbird species were recorded among three willow growth types. Species richness and diversity of songbirds increased along a gradient from height-suppressed willows to tall, dense willows. Taller willows support willow specialists, such as the Wilson's warbler and willow flycatcher. The forest burn surveys assess the responses of woodpeckers and songbirds to fires by comparing recently burned plots to older burned plots. Observers recorded 24 bird species in these forest types. The most abundant species in these burns were the tree swallow, American robin, dark-eyed junco, and yellow-rumped warbler. The breeding bird survey indexes population trends through time, and more than 2,700 individuals across 76 species were observed along three routes in YNP during 2015.

Mountain chickadee. NPS Photo-J. Peaco

Swainson's hawk. Photo © D. & L. Dzurisin

Table of Contents

Introduction

Yellowstone National Park (YNP) is surprisingly rich in bird diversity, given the challenging environmental conditions that characterize the landscape. Variations in elevation and the broad array of habitat types found within YNP contribute to the region's relatively high diversity. The YNP bird program monitors a small portion of its breeding bird species with the broad goals of gathering information (e.g., reproduction, abundance, habitat use) on multiple species from a wide variety of avian taxonomic groups, as well as to maintain long-term datasets (more than 30 years) for several species. Maintaining long-term monitoring efforts will inform biologists of potential shifts in ecosystem function (e.g., climate change effects) and may guide future management decisions with the aim of conserving avian resources in the park. Over 4 million visitors are welcomed by YNP annually; many of them are avid bird watchers. This report summarizes data gathered for these programs during 2015. Details regarding field protocols and program history were provided in the 2011 annual report, which is available at http://www.nps.gov/yell/naturescience/birdreports.htm.

The core bird program for YNP is divided into three groups meant to represent YNP's diversity: Raptor Monitoring Program, Wetland Bird Monitoring Program, and Passerine and Near Passerine Monitoring Program. Bald eagles, peregrine falcons, and ospreys are monitored under the Raptor Monitoring Program. With the removal of the peregrine falcon and bald eagle from the Federal List of Endangered and Threatened Wildlife and Plants in 1999 and 2007, respectively, there are no federally listed bird species in YNP. However, these species are monitored because they are of historical concern and to meet obligations outlined in post-delisting plans developed by the U.S. Fish and Wildlife Service (2003).

Trumpeter swans, common loons, and colony nesting species are included in the Wetland Bird Monitoring Program. Trumpeter swans, common loons, and colonial nesting birds on the Molly Islands are of particular concern in YNP due to small and locally declining numbers. The breeding bird survey, willow-bird survey, and forest burn survey are part of the Passerine and Near Passerine Monitoring Program. This program is particularly valuable since species in this group represent the majority of all bird species found within YNP.

The Yellowstone Raptor Initiative, is a five-year project initiated in 2011 to focus on diurnal and nocturnal raptors. Yellowstone supports 25 species of raptors that either breed or migrate through the park. Several raptors are of growing conservation concern in the United States, including the golden eagle and Swainson's hawk. Yet despite Yellowstone's raptor diversity, large relatively undisturbed landscape, and heightened conservation focus for several species, little data exists regarding the abundance, productivity, and seasonal movements for raptors in YNP. The Initiative is designed to fill this gap in knowledge by expanding inventory and monitoring efforts to select raptor species not traditionally covered under the program.

NPS Photo-D. Smith

Climate Change

Within YNP, climate change effects on ecosystem processes are largely unknown, especially with respect to birds. Detecting changes in ecosystem processes (e.g., timing of migration or onset of breeding) will inform management decisions and add to our understanding of the significance of such changes for bird communities in and near YNP. Birds are touted as bio-indicators of climate change because of their sensitivity and relatively rapid response to shifts in seasonal weather patterns. For example, climate change has influenced migration patterns, population size and distribution, and the timing of reproduction and nesting success for several bird species (Crick 2004).

Since 2005, D. W. Smith has recorded spring arrival dates (migrants) in the Mammoth/Gardiner area for many common species. In 2012, we expanded the scope of this project by encouraging park staff to submit their first arrival sightings. Twenty observers submitted 29 reports in 2015 (table 1). Eventually, this dataset may be used to determine if mean arrival date for certain species has shifted or if there is greater variability in mean arrival date. In addition to first arrivals, we monitor timing of nest initiation, incubation, and fledging for several species of raptors to monitor the effects of climate change on breeding behavior.

Western meadowlark. Photo © D. & L. Dzurisin

Red-tailed hawk. Photo © D. & L. Dzurisin

Table 1. Spring arrival dates for common species in the Mammoth-Gardiner area from 2005-2015. Asterisk (*) indicates estimated arrival from Paradise Valley (24-March) and Phantom Lake, YNP (17-March). Note that 2011-2015 observations were collected by multiple observers.

Species	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Osprey		6-Apr		8-Apr	19-Apr	12-Apr	7-Apr	5-Apr	4-Apr	6-Apr	
Red-tailed Hawk		4-Apr	23-Mar	3-Apr		20-Mar*	18-Mar	19-Mar	9-Mar	21-Mar	
American Kestrel		4-Apr	12-Apr	14-Apr	30-Apr	17-Apr	18-Apr	16-Apr	6-Apr	5-Apr	
Tree Swallow		28-Apr	8-Apr	13-Apr	2-May	24-Apr	11-May	22-Apr	25-Apr	27-Apr	
Ruby-crowned Kinglet		28-Apr	29-Apr	21-Apr	3-May	17-Apr	10-May	9-Apr	17-Apr	11-Apr	21-Apr
Mountain Bluebird	8-Mar	4-Mar	18-Mar	29-Mar	12-Mar	25-Mar	17-Mar	7-Mar	9-Mar	28-Feb	10-Mar
American Robin	20-Mar	14-Apr	17-Mar	28-Mar	21-Mar	18-Mar	25-Mar	18-Feb	6-Mar	1-Mar	10-Mar
Yellow Warbler	18-May	12-May	13-May	19-May	17-May	18-May	21-May	8-May	-	4-Jun	
Yellow-rumped Warbler		28-Apr	29-Apr	20-Apr	9-May	17-Apr		7-May	6-May	16-May	
Vesper Sparrow		3-May	13-May	4-May	6-May	7-May			9-May	-	
White-crowned Sparrow				1-May	1-May	7-May		26-May	-	-	
Western Meadowlark		3-Apr	5-Apr	14-Apr	8-Apr	1-Apr		31-Mar	8-Apr	16-Mar	12-Mar
Red-winged Blackbird	10-Mar	16-Mar	18-Mar	8-Apr	17-Mar	29-Mar	21-Mar	5-Mar	10-Mar	3-Mar	11-Mar

Yellowstone Core Bird Program

Raptor Monitoring Program

Peregrine Falcon

Peregrine falcons were once an imperiled species in North America because of widespread use of the pesticide DDT, but owing to nationwide recovery efforts, including those in and around YNP and bans placed on DDT, peregrines now thrive in Yellowstone. In 2015, we monitored 27 breeding territories from late-April through July (see Appendix A for raptor nesting terminology). Twenty-three territories were occupied by at least one adult. Seven of the 21 pairs for which we could determine the final outcome, successfully fledged at least 15 young for a nesting success per occupied territory of 33% (figure 1). On average peregrines produced 0.71 young per occupied territory (productivity per occupied territory) with an average brood size of 2.14 young fledged per successful pair (figure 2). We recently published data on peregrine reintroduction, long-term reproduction and nestling diet (Baril et al. 2015). At the time of publication, these data indicated YNP's peregrine population was stable and the major threat that caused their endangerment (thin eggshells as a result of chemical contamination) is no longer a threat. While our data show eggshell thinning is no longer an issue for YNP's peregrines, both productivity and nesting success have declined slightly over the last three years and both measures have remained at or below the 28-year average in 6 of the last 10 years. The lower nesting success and productivity warrants close monitoring and perhaps further study to determine the cause(s).

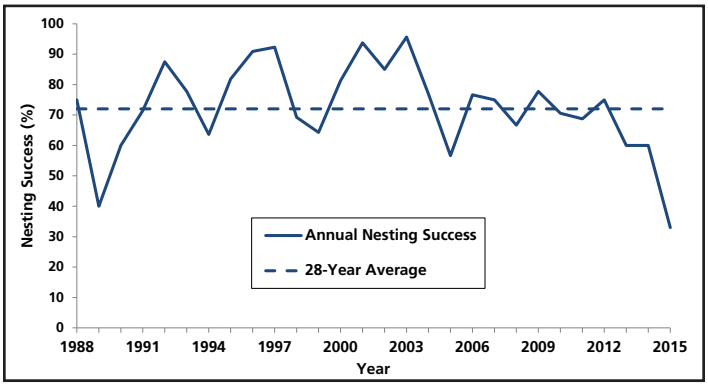

Figure 1. Peregrine falcon nesting success 1988-2015, and comparison with the 28-year average.

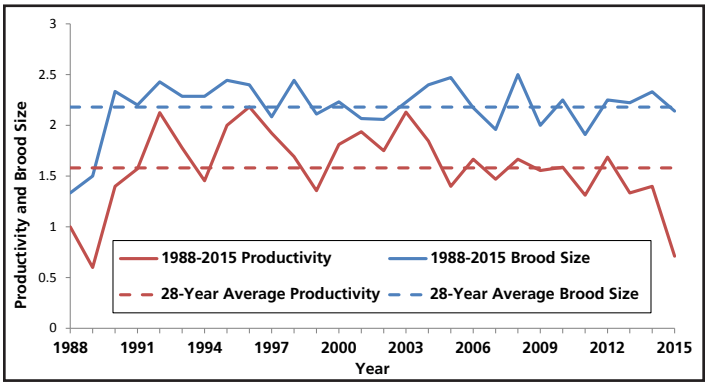

Figure 2: Peregrine falcon productivity and brood size 1988-2015, and comparison with the 28-year average.

Bald Eagle

We monitored 32 of the 50 known extant and historical bald eagle territories for nesting activity. Similar to peregrines, not all territories are occupied every year and some have been inactive for years. Twenty-four of the 32 territories were confirmed occupied. Three of the territories were confirmed unoccupied with occupancy undetermined at the remaining five. Long-lived birds like eagles forgo breeding in some years, depending on the availability of spring food sources and the condition of adults as they enter the breeding season. We were able to determine the breeding season outcome for 22 of the 24 occupied territories. Nineteen territories were confirmed active and 13 successfully fledged young for a nest success of 68% (# successful nests/active territory) and 59% (# successful nests/occupied territory with known outcome). Nesting success per active territory in 2015 was greater than the 32-year average of 50% (figure 3). The 13 nests fledged 18 young for a productivity of 0.95 per active territory and 0.82 per occupied territory with known outcome. The average brood size was 1.4 (figure 4). Overall, bald eagle numbers in YNP are stable, including those nesting on Yellowstone Lake where nesting success declined from 1987 to 2007, probably a result of the catastrophic decrease in cutthroat trout (Baril et al. 2013). Park-wide, nesting success and productivity were above average during the last few years and is likely attributed to the greater nesting success of eagles on Yellowstone Lake. During the last four years (2012-2015) nesting success at Yellowstone Lake is well above average for the park, probably because eagles have switched to other prey, such as birds nesting on the Molly Islands and waterfowl.

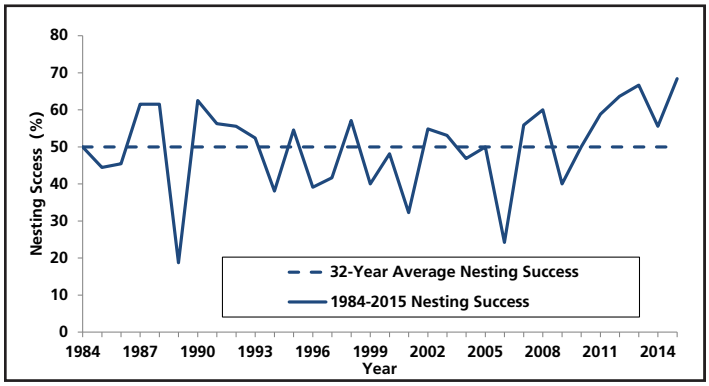

Figure 3. Bald Eagle nesting success 1984-2015, and comparison with the 32-year average.

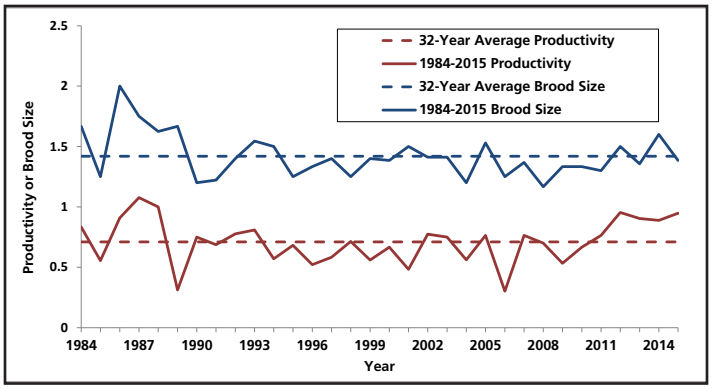

Figure 4. Bald eagle brood size and productivity during 1984-2015, and comparison with the 32-year average.

Osprey

We monitored 40 of the 51 known osprey territories from mid-May to mid-August; of these territories, 36 were occupied, 2 were unoccupied, and the occupancy for the remaining 2 could not be determined. Of the 36 occupied territories we could determine the breeding season outcome for 33; 30 of the 33 were confirmed active nests. Fifteen territories successfully fledged a total of 28 young for a nest success of 50% (# successful nests/active territory) and 45% (# successful nests/occupied territory with known outcome), and a productivity per active nest of 0.93 and a productivity per occupied territory with known outcome of 0.85 (figure 5). The average brood size was 1.87 young fledged per active nest (figure 6). Only one of the three active nests on Yellowstone Lake produced young.

Bald eagles. NPS Photo-L. Baril

Peregrine falcon. NPS Photo-B. Cassidy

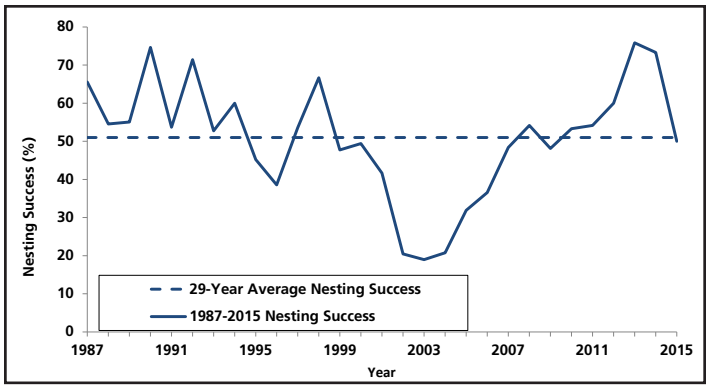

Figure 5. Osprey nest success 1987-2015, and comparison with the 29-year average.

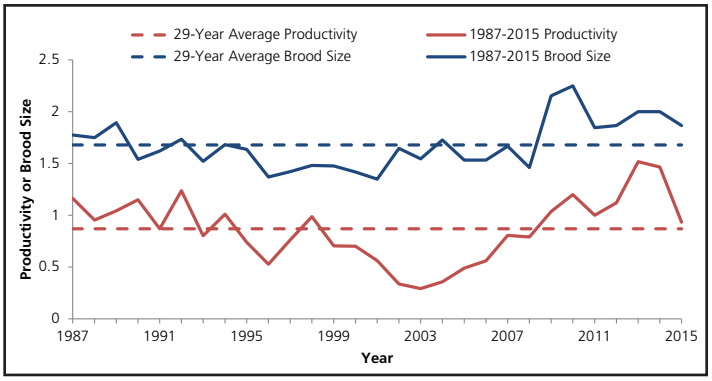

Figure 6. Osprey brood size and productivity during 1987-2015, and comparison with the 29-year average.

Wetland Bird Monitoring Program

Trumpeter Swan

Winter Count of Trumpeter Swans

We counted 168 swans in YNP during the aerial, mid-winter survey (table 2). The number of swans wintering in YNP has declined since surveys began in 1999 (figure 7). Changes in the wintering population cannot be attributed entirely to the declining resident population. Rather, declines in wintering swans appear to be driven by changes in the number of swans migrating from Canada to YNP for the winter.

Swans were also counted weekly from late-November through February along the Madison River from the West Yellowstone entrance to Madison Junction and along the Yellowstone River from Fishing Bridge to Chittenden Bridge. Many swans spend the first half of winter in the park, but numbers depend on the availability of ice-free portions of the rivers. By early January, 158 adults and 54 cygnets were counted on the Yellowstone River, a maximum count for the winter. By early March, the number of swans on the Yellowstone River declined to 64 adults and 14 cygnets. By early January, as many as 47 adults and 11 cygnets were wintering on the Madison River. By March 5, only one adult remained.

Table 2. Mid-winter aerial survey for trumpeter swans in YNP, 1999-2015.

Year	YNP		
	Adults	Cygnets	Total
1999	292	48	340
2000	87	13	100
2001	53	11	64
2002	233	35	268
2003	146	34	180
2004	149	33	182
2005	124	30	154
2006	121	14	135
2007	144	25	169
2008	65	7	72
2009	88	2	90
2010	18	5	23
2011	125	42	167
2012	51	4	55
2013	2	0	2
2014	45	8	53
2015	129	39	168

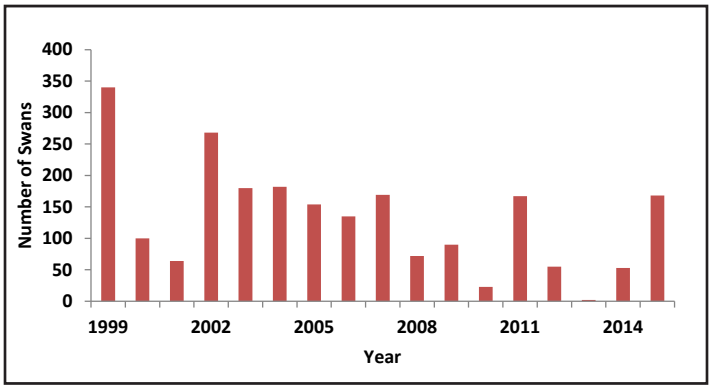

Figure 7. Total count of swans during the mid-winter aerial survey, 1999-2015.

Trumpeter Swan Reproduction and Breeding Season Observations

Two pairs of trumpeter swans nested in YNP in 2015 at Grebe Lake and Riddle Lake. The pair at Grebe Lake returned this spring and nested on the platform installed in October 2011. The pair laid two eggs which were taken and replaced with wooden replica eggs; the female continued to incubate them as normal. One egg that was taken was inviable, but the other egg was incubated and hatched in captivity at the Wyoming Wetlands Society (WWS) in Jackson, WY. YNP Bird Program has partnered with WWS to bolster YNP's swan population through releasing captive-raised cygnets and incubating eggs in captivity for later release. The cygnet hatched in captivity was released in September in Hayden Valley (see *Trumpeter Swan Release*). Two cygnets hatched at WWS were placed in the Grebe Lake nest just hours after hatching. The adults accepted the cygnets and raised them as their own. The western half of Grebe Lake was closed to protect this pair from human disturbance. The Riddle Lake pair successfully nested and raised one cygnet; although there were originally three cygnets hatched (presumed that two were killed by Riddle Lake bald eagles). Two additional eggs were seen in the nest, but they did not hatch. We decided to not attempt to retrieve the eggs to minimize human disturbance on the lake. To further protect nesting swans from human disturbance, which possibly interacts with bald eagle predation, Riddle Lake was closed for the entire summer and reopened on September 15.

Nine additional non-breeding adult swans over-summered in YNP. Two moved between Cygnet Lakes and Wolf Lake, and are likely the two remaining cygnets produced by the Grebe Lake pair in 2012. A single swan spent at least 1.5 months at North Twin Lake. The four birds released in September 2014 spent the entire winter and summer in Hayden Valley, mostly near Alum Creek. A pair was commonly seen on the Firehole River near Fountain Flats, one of which was a banded individual released at West Tern Lake in 2013. A single bird had

been seen along the Firehole River since at least 2013.
A number of swans were seen occasionally throughout the breeding season at Duck Creek, Cascade Lake, Robinson Lake, on the Falls River, and being chased off Wolf Lake by the two swans that summered there.

Trumpeter Swan Release

Three male swans were released in Hayden Valley on September 8. Trumpeter swans in YNP have declined since the early 1960s. The number of nest attempts peaked during the 1990s, but has since declined substantially and is currently comprised of only two breeding pairs (figure 8). The current management goal is to increase the number of territorial pairs and, in turn, the probability of long-term persistence. In cooperation with WWS, the park has released 17 cygnets including the three swans released this year since 2013.

Autumn Trumpeter Swan Count

On the September 18 aerial survey, we counted 23 adult trumpeter swans and 6 cygnets, including the 3 swans released in 2015. The autumn count provides an estimate of the resident population and total productivity for tri-state area at the junction of Wyoming, Idaho, and Montana. In YNP, both adults and cygnets have declined over the last several decades; however, numbers have increased since swan releases began in 2013 (figure 9).

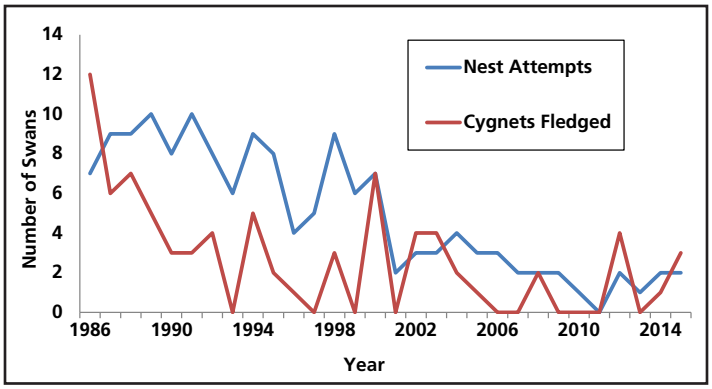

Figure 8. Trumpeter swan nest attempts and cygnets fledged in YNP, 1986-2015.

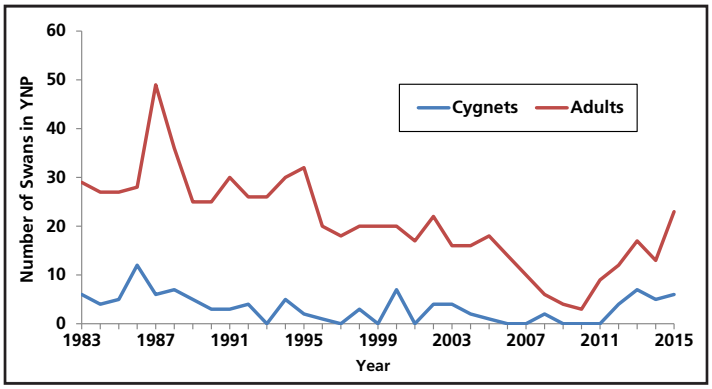

Figure 9. YNP autumn counts of trumpeter swans, 1983-2015.

Nesting trumpeter swan and cygnet, Grebe Lake. NPS Photo-B. Cassidy

Common loon in non-breeding plumage. Photo © D. & L. Dzurisin

Colony Nesting Birds

Through photographic interpretation from four overflights made in June through August 2015, we observed approximately 463 American white pelican nests that fledged an estimated 291 young. We counted 64 nesting double-crested cormorants that fledged an estimated 9 young. Nineteen California gull nests were observed, yet they did not produce young; three Caspian terns were observed on the islands but none attempted nesting.

The number of pelicans, cormorants, and gulls fledged from the Molly Islands has declined since the early 1990s and Caspian terns have not nested there since 2005 (figure 10). The reasons are not well understood, but a previous study indicates the high levels of water in Yellowstone Lake are associated with low reproduction for pelicans nesting there (Diem and Pugesek 1994). The decline in cutthroat trout, the primary food source for colonial nesting birds, is also a factor which likely influences nesting success.

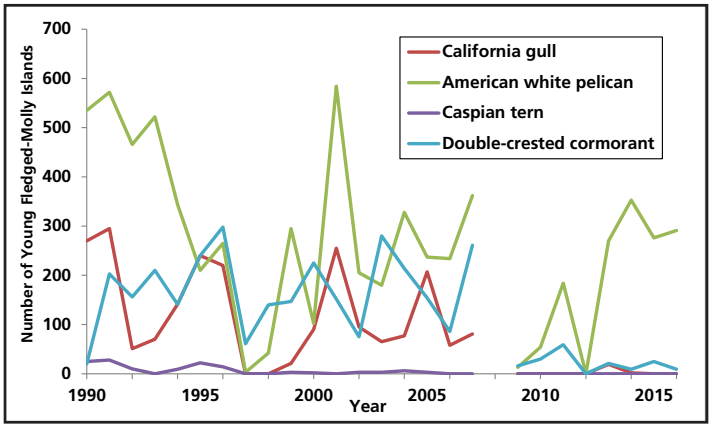

Figure 10. Number of young fledged from the Molly Islands, 1989-2015.

Common Loon

The park's common loon population is one of the most southerly breeding populations in North America. The majority of Wyoming's population of breeding common loons occurs in Yellowstone. The common loon is listed as a Species of Special Concern in Wyoming because of its limited range, small population, sensitivity to human disturbance, and loss of breeding habitat outside of Yellowstone. Wyoming's breeding loon population is isolated from populations to the north by more than 200 miles, limiting immigration from other populations. Since the mid-2000s, Wyoming's population has declined by 42%. Yellowstone's loon population has declined since surveys began in 1989. However, detailed data from a study initiated in 2012 in collaboration with Biodiversity Research Institute (BRI) based in Portland, Maine, indicate the number of loons present in the park can vary widely from year to year. Continuing research will analyze any trends in productivity, nesting success, and number of breeding pairs to try to determine why some years are more productive than others.

In 2015, BRI biologists checked at least 18 lakes for loon activity. Some lakes, like Yellowstone Lake, had more than one loon territory. Eleven of the lakes were occupied by at least one loon, with a total estimate of 26 adult loons. Only six

pairs attempted to nest and four of those failed. The two successful pairs produced four loonlets during 2015 (figure 11). BRI biologists captured three adults in the park. The Wolf Lake female was a recapture from the previous year and the geolocator deployed during 2014 was recovered. Mercury levels were assessed in both blood and feathers for all birds captured in 2015. Although mercury levels were below the thresholds for adverse effects, the Wolf Lake female had concentrations above what is found for other northwestern Wyoming loons. The geolocator revealed that this bird spent the winter of 2014/2015 around the southern end of the Baja Peninsula. The fall migration path was southward over land across the Colorado Plateau. Location data over time suggest the bird wintered on the west side of the Baja Peninsula for most of October, then spent November and December on the east side of the peninsula. The location data lost accuracy in mid-December so there is no data on late winter and spring locations or migration path (Spagnuolo 2016). These efforts are part of a large-scale Intermountain West effort to better understand loon population dynamics.

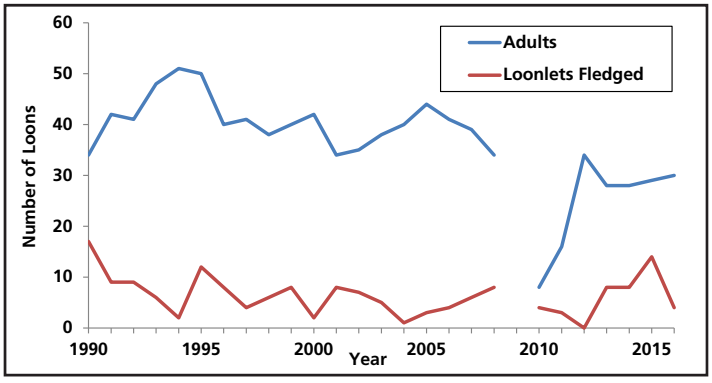

Figure 11. Common loon adults and fledgings in YNP, 1989-2015.

In the western United States, common loons breed in Idaho, Montana, Washington, and Wyoming. The total western U.S. breeding population is estimated at 90 territorial pairs. Wyoming's breeding population totals approximately 16 territorial pairs, including the 11 in Yellowstone. Western populations of breeding common loons are known to overwinter from Washington south to California. Spring and fall migrants in Wyoming represent breeding populations from Saskatchewan that overwinter around Mexico's Baja California peninsula.

There are several threats to Yellowstone's loon populations. Direct human disturbance to shoreline nests lowers survival rates, as do the loss of breeding habitats due to water level fluctuations (e.g., erratic spring flooding). Predation by bald eagles and other predators may also be significant given the limited number of nesting pairs. Fish are the primary prey of loons. As part of a multi-park study on mercury concentration in fish, fish from various lakes where loons nest were screened for mercury. Fish were sampled from Beula, Grebe, Yellowstone, and Lewis lakes. Fish from Beula, Grebe, and Yellowstone lakes exceeded the threshold at which fish-eating birds may be affected by mercury toxicity. Fish from Lewis Lake did not exceed that threshold although they still contained mercury. Loons are long-lived, but they have relatively low chick production and a poor ability to colonize new breeding areas. Given the very small size and isolation of Wyoming's breeding loon population, it is at a particularly high risk of local extinction.

American avocets along the shore of Grebe Lake. NPS Photo-B. Cassidy

Passerine & Near Passerine Monitoring

Willow Songbird Surveys

This year was the 11th consecutive year of monitoring willow-songbird communities in YNP. Details of the sampling protocol are available in Baril et al. (2011). In most years, three types of willows were surveyed for breeding passerines, including previously tall (averaging more than 1.5 meters in height and experiencing little browsing), suppressed (generally less than 1 meter in height and experiencing heavy browsing), and released (formerly height suppressed - now similar in height to previously tall willows but with lower overall canopy cover; figure 12).

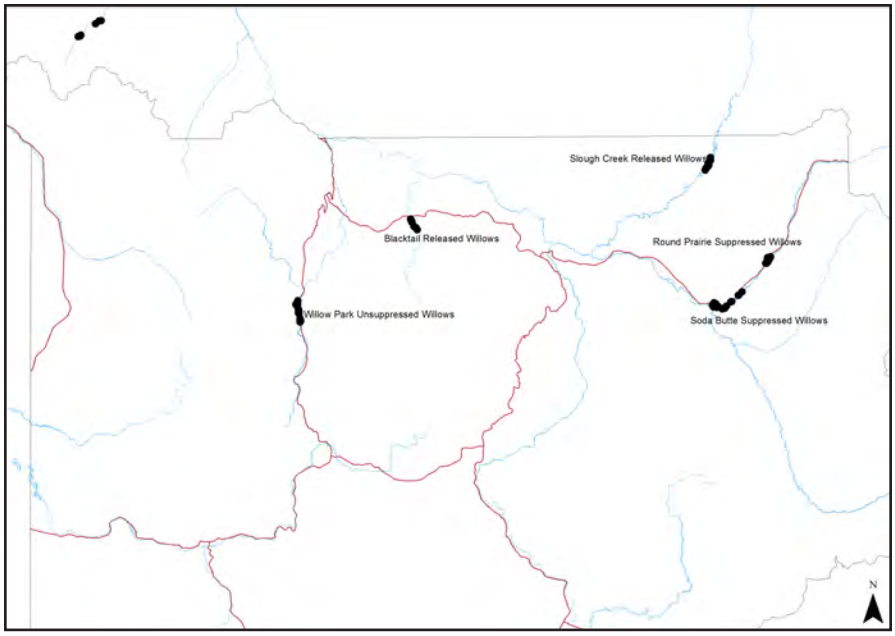

Figure 12. Map of willow point count locations in YNP.

We recorded 24 species across the range of willow growth conditions. Species richness, which is the average number of species found in a particular habitat, was about the same among the previously tall willows and released willows, and lower in suppressed willows (figure 13). Wilson's warblers, a willow specialist, were mostly found in previously tall willows and gray catbirds were mostly found in released willows (table 3). Gray catbirds are ground nesters and released sites tend to be drier than previously tall sites, while still providing adequate shrubby cover not available in suppressed sites. Suppressed willows essentially function as grasslands and provide habitat for generalist species like Lincoln's sparrows. Lincoln's sparrows were found in all three willow types. In addition to Lincoln's sparrows, the most common species observed in previously tall sites were common yellowthroat and yellow warbler. Yellow warblers were found in both released willows and previously tall willows, while savannah sparrows were most common to released and suppressed willows. Released willows exhibit similar structural characteristics to both previously tall and suppressed willows (i.e., tall but dispersed willow shrubs) which contribute to the species overlap.

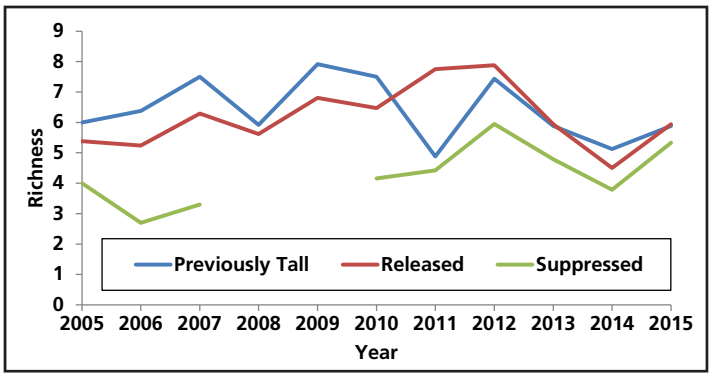

Figure 13. Species richness across three willow growth conditions, 2005-2015.

Table 3. Relative abundance of songbirds observed in previously tall, released, and suppressed willow stands during 2015. Bold numbers indicate highest abundances.

Species	Previously tall	Released	Suppressed
American Robin	0.41	**0.75**	0.32
Brewer's Blackbird	-	0.47	0.15
Common Yellowthroat	**1.19**	0.59	0.32
Fox Sparrow	0.13	0.13	-
Gray Catbird	0.16	0.28	-
Lincoln's Sparrow	**0.91**	**0.75**	**1.21**
Red-winged Blackbird	-	-	0.06
Savannah Sparrow	0.09	0.41	**1.03**
Song Sparrow	0.06	0.53	0.26
Warbling Vireo	0.09	0.56	-
White-crowned Sparrow	0.25	-	0.24
Willow Flycatcher	0.25	0.41	-
Wilson's Warbler	**0.72**	-	0.03
Yellow Warbler	**1.78**	**1.69**	0.65

Forest Burn Surveys

The persistence of cavity nesting birds in YNP is dependent on patterns of fire across the landscape. Variations in burn severity, age, and post-burn forest structure create a mosaic that supports a diversity of species (Saab et al. 2007). Standing dead trees attract bark and wood-boring beetles—primary prey for woodpeckers (Saab et al. 2007). Woodpeckers excavate nest holes in standing dead trees, many of which

have been softened by fungus, thus making excavation easier. Nest cavities created by woodpeckers are also used by a host of secondary cavity nesters, such as chickadees, nuthatches, and bluebirds. Fire size, frequency, and intensity in YNP is expected to increase, at least in the short-term, as the climate becomes warmer and drier (Rocca et al. 2014); however, it is not clear how changes in fire regimes will affect cavity nesting and fire-dependent bird species in the region. Since birds are among the first returning vertebrates to a fire-affected area, studying this ecological relationship is important. Therefore, we initiated a monitoring program in 2009 to evaluate the presence and abundance of post-fire adapted bird species.

We conducted point count surveys in two burned areas in YNP in 2015: the Point Fire (8 points) and the Cygnet Fire (8 points; figure 14). The Point Fire burned 867 hectares along the east shore of Yellowstone Lake during 2011, and the Cygnet Fire burned 1,431 hectares south of the road between Norris and Canyon during 2012. Both are considered recent fires (less than 4 years since time of burn).

We observed 24 species in the two study areas (table 4). Ten of the 24 species (41%) were obligate cavity nesters. The most abundant species in these burns were the tree swallow, American robin, dark-eyed junco, and yellow-rumped warbler. Five of the 24 species recorded were primary cavity nesters (i.e., excavate their own nest holes) and occurred in low abundance (less than 5 detections) in both burn areas. Five of the species detected were secondary cavity nesters (i.e., use the abandoned holes of primary cavity nesters or natural holes).

The response of a given species may vary substantially from fire to fire (Smucker et al. 2005). These mixed responses are likely due to variation between and within an individual fire (e.g., fire severity), and the type of forest and forest structure present prior to a fire. All burns included some points that contained a mixture of burned and live trees or wet meadow areas. Because of this, some species were recorded that may not have been strictly using burned habitat.

Breeding Bird Surveys

The three Breeding Bird Survey (BBS) routes in Yellowstone are part of a widespread, long-term international effort to monitor trends in bird populations in North America. During 2015, surveys were conducted in and near Mammoth on June 15, the Northeast Entrance on June 24, and along the route from Dunraven Pass to Mary Bay on June 23. More than 2,700 individual birds and 76 species were observed (figures 15 and 16). The number of species observed has declined since 2002 along all three routes, while the number of individuals has declined for the Mammoth and Northeast Entrance routes, but not for the Yellowstone Route largely due to an increase in the number of Canada geese along the Yellowstone Route.

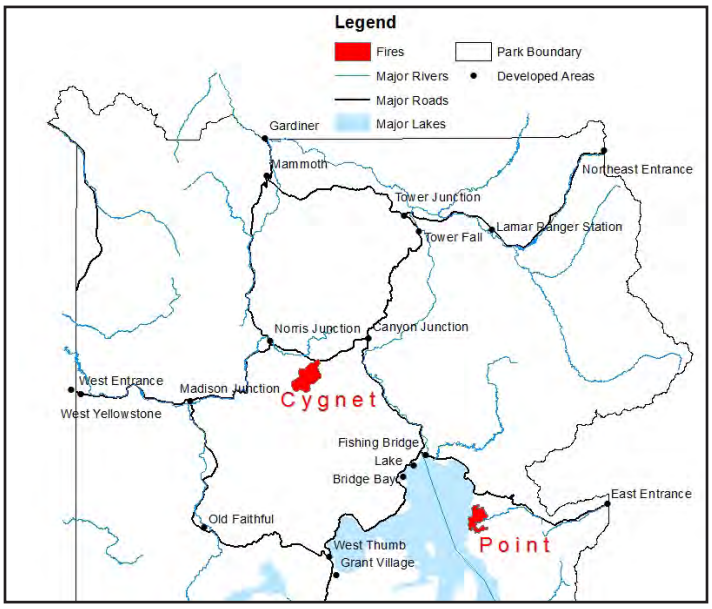

Figure 14. Map of burn area point count transect locations in YNP.

Table 4. Abundance by species occurring in recent (1-3 yrs since time of burn) burns during 2015. Nesting Guild: 1°CA = excavates own cavity, 2° CA = uses abandoned cavities, OC = open cup, PA = nest parasite.

Species	Abundance	Nesting guild
American Robin	0.81	OC
American Three-Toed Woodpecker	0.06	1° CA
Black-backed Woodpecker	0.03	1° CA
Brown Creeper	0.03	2° CA
Cassin's Finch	0.06	OC
Chipping Sparrow	0.13	OC
Clark's Nutcracker	0.28	OC
Dark-eyed Junco	0.78	OC
Hairy Woodpecker	0.03	1° CA
Hermit Thrush	0.03	OC
House Wren	0.03	2° CA
Mountain Bluebird	0.34	2° CA
Mountain Chickadee	0.16	2° CA
Northern Flicker	0.06	1° CA
Olive-Sided Flycatcher	0.03	OC
Red-breasted Nuthatch	0.13	1° CA
Ruby-crowned Kinglet	0.13	OC
Ruffed Grouse	0.03	OC
Swainson's Thrush	0.06	OC
Towsend's Solitare	0.09	OC
Tree Swallow	0.88	2° CA
Vesper Sparrow	0.06	OC
Western Wood-pewee	0.16	OC
Yellow-rumped warbler	0.69	OC

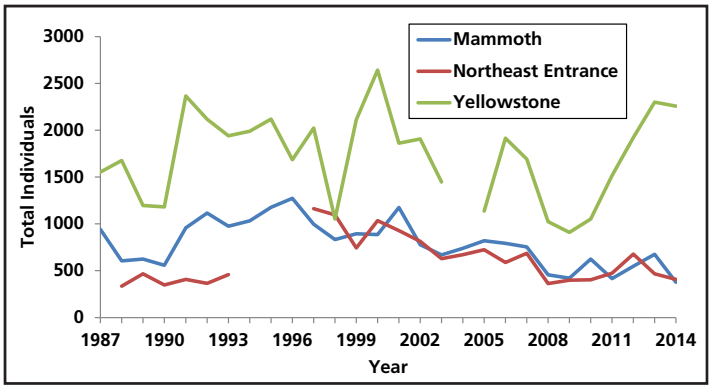

Figure 15. Number of total individuals observed during three breeding bird surveys, 1982-2015.

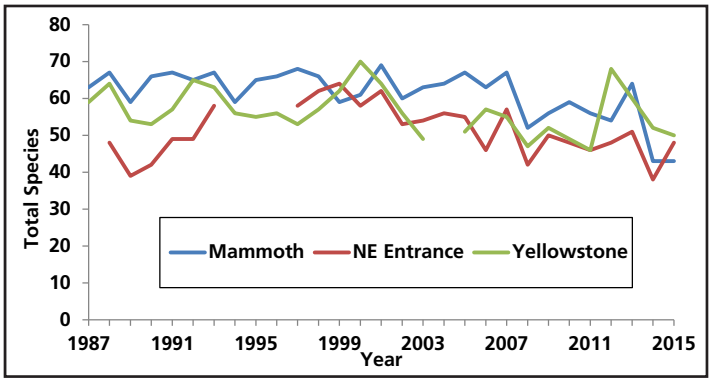

Figure 16. Number of total species observed during three breeding bird surveys, 1982-2015.

Mid-winter Bald & Golden Eagle Survey

The mid-winter bald and golden eagle survey was initiated by the National Wildlife Federation in 1979, but has been organized by the United States Geological Survey since 1992. The objectives are to establish an index of the winter population, determine winter distribution, and identify important wintering habitat for eagles. Yellowstone has participated since at least 1987, but there were a few years surveyed prior to that date.

Thirteen volunteers participated in the mid-winter eagle survey on January 10, 2015. Observers recorded seven adult bald eagles during the survey: 2 along the Madison River, 1 at Old Faithful, 1 near Gibbon Falls, 2 in the northern range, and 1 along the Yellowstone River. Four golden eagles were observed in the northern range. No immature eagles were observed during the survey. Juvenile bald eagles usually migrate south and west, and wander over a wide area during their first 3-4 years until they reach adult plumage (Harmata et al. 1999). Many then return to the Greater Yellowstone Ecosystem to breed. There is no information on golden eagle movements in YNP.

Yellowstone Raptor Initiative (YRI)

This was the final year of the YRI. Here we summarized data from 2015 only. A separate five-year summary report will be available in 2017.

Golden Eagle

We discovered two additional territories in 2015 bringing the total known golden eagle pairs in YNP to 28. We monitored 27 of 28 golden eagle territories in YNP during 2015, all of which were occupied. Five pairs did not breed and we could not confirm the outcome for eight pairs. We determined the breeding season outcome for 19 territories, 5 of the 14 pairs that nested were successful for a nest success of 26% per occupied territory with known outcome. The five successful territories fledged a total of five young for a productivity of 0.26 per occupied territory with known outcome.

Over the past five years, nesting success and productivity has fluctuated substantially (figure 17). Despite these fluctuations, all territories remained occupied and new territories were located annually. This relatively high density of golden eagles may limit productivity through competition for limited food resources in late winter and early spring. Density in YNP's northern range of 49.7 km²/pair falls at the higher end of the density ranges found in nearby regions. In the western U.S., densities range from 29 to 251 km²/pair (Kochert et al. 2002). Density ranges from 34-89 km²/pair in Wyoming (Philips et al. 1984) to 65-192 km²/pair in Montana (Reynolds 1969). In southwestern Idaho density is 66 km²/pair (Kochert 1972). Denali National Park in Alaska has the highest density with 28 km²/pair (McIntyre and Adams 1999).

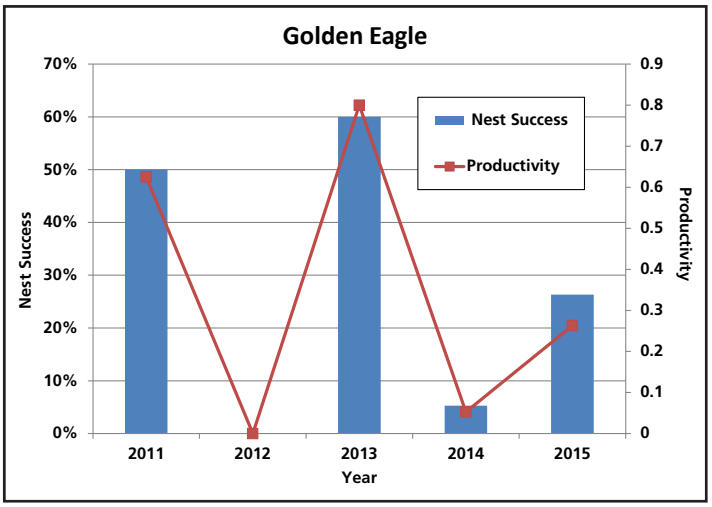

Figure 17. Golden eagle nesting success and productivity, 2011-2015.

Golden eagle. Photo © D. Schneider

We collected prey remains and eggshell fragments from four golden eagle nest sites, three of which fledged young and one which failed. Nests were entered in late August after chicks fledged and breeding activity subsided. This sampling method only identifies what eagles feed young during the nestling stage. Prey remains have not been analyzed, but in 2011 and 2013 we found a nestling diet composed largely of birds, such as Clark's nutcracker, Canada goose, black-billed magpie, dusky grouse, and even other raptors such as Swainson's hawk. Mammalian prey included the remains of ground squirrels and marmots. Eggshell fragments are measured for thickness as an indicator of environmental contaminants, primarily DDE (a derivative of DDT), and may later be analyzed for specific compounds. As of the writing of this report, only eggshell fragments collected during 2011 and 2013 were measured. Eggshell thicknesses ranged from 0.448 to 0.555 mm and averaged 0.489 mm excluding the membrane. Membrane is only recovered some of the time when collecting eggshell fragments from nest sites, and is why we report thickness excluding membrane. The thickness for membrane that was collected from nests in YNP averaged 0.074 mm. We excluded one set of unusually thin eggshell fragments since there was some doubt as to whether they were from golden eagle eggs.

There are two studies for which to compare eggshell thickness for golden eagles. In a study of eggshell thickness of four captive eagles, Grier (1973) found average eggshell thickness measured 0.55 mm with the membrane and 0.476 mm without the membrane (using the average membrane thickness of 0.074 mm from YNP eggshells). In Montana, eggshell thickness for seven eggs averaged 0.637 mm (Anderson and Hickey 1972). Although the latter thickness was greater than what was found in YNP, it is not clear if this value includes the membrane. In Montana, organochlorine pesticides were found to be low in eggs, adult tissue and nestling tissue (Reynolds 1969). Species that prey on mammals were generally less affected by DDT than species that prey on fish and birds; although in England, golden eagles showed a highly significant decrease in eggshell thickness from 1951 to 1966 (Ratcliffe 1970).

Red-Tailed Hawk

In 2015, we monitored 30 territories occupied by red-tailed hawks in the northern portion of YNP. Though we did not monitor all known territories, we continued to document all nest sites found. We determined the breeding season outcome for 29 of the occupied territories. Pairs in 22 territories laid eggs, but only 12 successfully fledged young, yielding a nest success of 41%. Productivity, or young per occupied territory, was 0.76 and brood size was 1.83. Seven pairs did not lay eggs (figure 18).

The productivity observed over the last two years are an acute drop from the higher productivity observed during the first 3 years of this monitoring effort. We are unaware of the environmental factors leading to this decrease. Continued monitoring may also reveal a cyclic nature to annual reproduction that likely corresponds with primary prey species. The assessment of these prey species and potentially the annual weather variables may provide insight to the drivers responsible for reproductive output of red-tailed hawks in YNP.

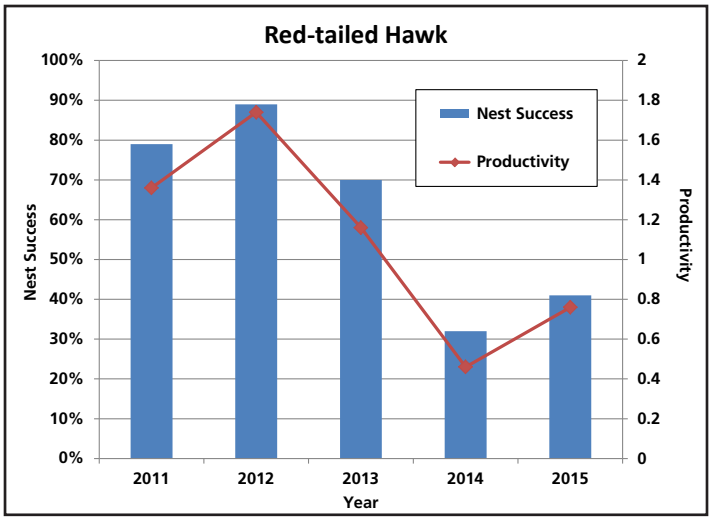

Figure 18. Red-tailed hawk nesting success and productivity, 2011-2015.

Swainson's Hawk

All 15 monitored Swainson's hawk territories were occupied. Three of these were monitored for nesting, two of which successfully fledged three young. Staff could not determine if the third nest fledged young, but the pair did lay eggs. We were unable to visit all other territories documented in previous years due to time constraints.

The majority of Swainson's hawks occur at higher elevations within the interior of the park. The mostly forested interior is dominated by lodgepole pine so Swainson's hawks nest along the edges of open valleys and meadows. Some nests are situated near the top of live conifers set back from the forest edge, creating difficulty determining actual nest locations. Yellowstone differs from most described breeding habitat in that it is generally higher in elevation, more densely forested, and lacks agricultural influence (Bechard et al. 2010). Yellowstone likely represents the historical nesting habitat for Swainson's hawks in the northern Rocky Mountains.

Swainson's hawk. Photo © R. Domenech

Prairie Falcon & American Kestrel

We monitored two prairie falcon territories in 2015; both were occupied, one of which fledged three young. We could not confirm nesting in the second territory. Prairie falcons appear to be outcompeted for territories by more dominant peregrine falcons and golden eagles.

American kestrels have been observed at multiple locations. Biologists documented 90 sightings of a territorial individual, mated pair, fledglings, or nest cavities during 2010-2015. This total includes some repeat locations. We observed kestrels most frequently in aspen stands and less frequently in conifers. Kestrels nest in cavities hollowed out of trees that have become infected with heart rot, a fungus which allows woodpeckers, the primary cavity builders, to create holes in trees for nesting. Kestrels use natural cavities and the abandoned nesting cavities of woodpeckers. American kestrels may be declining in some areas throughout their range, with most research done on populations using nest boxes. Therefore, natural nest cavities in YNP provide a baseline and contrast to these studies (Smallwood et al. 2009).

Road-side Raptor Survey

The objective of the road-side raptor survey is to estimate raptor density for adult red-tailed hawks, Swainson's hawks, and American kestrels in the northern portion of YNP. The protocol consists of 20-minute surveys conducted at established points along the road, beginning at Indian Creek Campground and ending at Barronette Peak. Each point is surveyed twice: once in May and once in June. For more details regarding this survey, please refer to the 2012 annual bird report (http://www.nps.gov/yell/learn/nature/birdreports.htm). We recorded 328 raptors of 11 species during the two surveys in 2015. Red-tailed hawks were the most numerous species recorded representing 78% of all observations. After red-tails, the next most abundant species was the American kestrel at 6% and golden eagles at 5%.

Raptor Migration Count

The goal of monitoring migrating raptors is to provide long-term information on changes in migratory populations. In the autumn of 2010, we observed a large number of Swainson's hawks migrating through Hayden Valley. The number of observed raptors appeared much larger than the number of birds thought to be breeding in the area. This suggested

that Hayden Valley may be a previously unknown migratory corridor in the western U.S. Therefore, we began counting migrating raptors beginning in the autumn of 2011.

Observations began on September 2 and continued through October 23. Weather and staffing allowed for counts on 35 of the 53 available observation days. We counted migrating raptors for six hours each day, from 10 am to about 4 pm. Nine observers participated in the count over the study period, with an average of 2-3 observers per day. The observation point was staffed for 190 observation-hours and 474 observer-hours (i.e., total hours multiplied by the number of observers per day and summed over all days).

A total of 1,248 raptors across 17 species were observed for an average of 6.45 raptors per hour. The majority of all raptors observed were buteos (47%), followed by accipiters (16%), eagles (13%), falcons (10%), northern harriers (10%), turkey vultures (<1%), and osprey (1%). The most abundant species observed were red-tailed hawk (32%), northern harrier (10%), golden eagle (8%), and American kestrel (8%; table 6). We observed a greater number of northern harriers this year than we have in the past. Anecdotal reports indicate an increased number of harriers in the park during summer and fall. During a late summer trip into the Thorofare, staff recorded numerous harriers, many of which were juveniles. Other park staff also commented on the apparently higher number of harriers in the park.

Because Hayden Valley is a non-traditional count site, observations made from that location are difficult. The wide valley disperses raptors one mile or more east and west from the count site, rather than concentrating them as ridgelines do. These distant raptors usually require more time to identify, resulting in less time scanning for other migrating raptors which may then pass unnoticed. Furthermore, Hayden Valley appears to be a stopover location. Raptors passing over the mountains to the north often drop into the valley and begin foraging, which makes it difficult to differentiate between a bird actively migrating and one that is foraging for a day or two before continuing to migrate. Because of these difficulties, we are actively scouting for other more favorable count sites where bird passage is more consistent.

On nine days in September and October, biologists counted raptors from the top of Observation Peak, which lies north of Hayden Valley at the southern terminus of a north-south ridge on the western side of the Washburn Range. With over 10 kilometers of ridgeline, Observation Peak provides topography that can promote orographic lift and serve as a more traditional count site. Over the nine days, we counted 415 raptors of 6 species during 42 hours of observation. Migrant sightings averaged 9.8 raptors per hour, more than 3 raptors per hour than in the Hayden Valley. Golden eagles (33%) were the most abundant species, followed by red-tailed hawks (20%), Cooper's hawk (14%), and sharp-shinned hawk and American kestrels (7% each). All other species each represented less than 5% of the total. Counts from Observation Peak occurred simultaneously with Hayden Valley; on most days observers recorded more raptors, had fewer unidentified birds, and observed significantly more accipiters and golden eagles at Observation Peak. Because birds pass closer to observers at Observation Peak, raptors are more easily seen and identified. Furthermore, observers spend less time watching a migrating raptor as it makes its way past the migration point before scanning for other birds. These factors are responsible for the greater number of birds and altered species composition between the two sites.

Table 6. Summary of raptors observed by species at Hayden Valley during 2015.

Species	Total	Percent
American Kestrel	104	8.33%
Bald Eagle	60	4.81%
Broad-winged Hawk	9	0.72%
Cooper's Hawk	85	6.81%
Ferruginous Hawk	10	0.80%
Golden Eagle	105	8.41%
Gyrfalcon	0	0.00%
Merlin	7	0.56%
Northern Goshawk	3	0.24%
Northern Harrier	131	10.50%
Osprey	11	0.88%
Peregrine Falcon	5	0.40%
Praire Falcon	3	0.24%
Red-tailed Hawk	402	32.21%
Rough-legged Hawk	61	4.89%
Sharp-shinned Hawk	80	6.41%
Swainson's Hawk	68	5.45%
Turkey Vulture	2	0.16%
Unknown Buteo	36	2.88%
Unknown Accipiter	37	2.96%
Unknown Eagle	1	0.08%
Unknown Large Falcon	5	0.40%
Unknown Small Falcon	7	0.56%
Unknown Raptor	16	1.28%
Total	**1248**	**100.00%**

Owls

We conducted nocturnal surveys for owls from February through April in YNP's northern range using passive listening, call playback, and observations of perched owls. This time period is centered on courtship and breeding to provide an index of the locations of nesting activities. Observers detected individuals of five owl species: great horned owls, boreal owls, northern saw-whet owls, northern pygmy-owls, and long-eared owls. Boreal owls were calling when surveys began in mid-February and were detected through late March. Northern saw-whet owls were not detected until early March. Northern pygmy-owls were vocalizing by mid-February.

Public Outreach & Education

For the sixth year, retired education ranger Katy Duffy led hawk ecology and identification programs during September. Forty visitors met at the Fishing Bridge Visitor Center to learn about raptor ecology and identification using mounts of raptors. The talk was followed by a field trip to Hayden Valley with 60 visitors to observe migrating raptors, and discuss identification tips and the ecology of migration. Duffy also taught an owl ecology and identification class for the Yellowstone Association Institute on May 24-25 at the Lamar Buffalo Ranch, and a raptor ecology and identification course for the Yellowstone Association Institute in September.

Noteworthy Birds & Bird Sightings Program

Since 2010, visitors and park staff submitted more than 1,600 observations from 25 species of raptors. Red-tailed hawks and bald eagles are most commonly reported, but observations also include rarely observed species, such as short-eared owls, broad-winged hawks, and merlin. These sightings help staff locate new breeding territories and refine the bird species checklist. We encourage park staff and visitors to submit all raptor sightings and observations of rare or unusual birds at http://www.nps.gov/yell/naturescience/wildlife-sightings.htm.

In spring, a YNP bird staff member observed an orchard oriole in lower Mammoth – the first documented occurrence in the park. A week later a bullock's oriole was heard singing and was observed in a cottonwood in lower Mammoth. A burrowing owl was observed near the Stephen's Creek area in October by several park visitors and bird program staff. Burrowing owls do not breed in YNP and this species has only been observed in Yellowstone one other time. A chestnut-sided warbler was observed in the Mammoth Campground. This species normally breeds in eastern North America and is a rare visitor to the western U.S. Around Thanksgiving several wild turkeys wandered into the park via the northeastern entrance from the town of Silver Gate, Montana. Turkeys have been observed in this area in past years. A white-throated sparrow was also observed in the Mammoth area in October and a western grebe was observed in December at Yellowstone Lake. Western grebes do not normally winter in YNP and it is considered rare in summer as well. All of the unusual or rare species reported were observed during spring or autumn when birds are migrating and more likely to wander or get blown off course. For this reason, the shoulder seasons are excellent times to birdwatch. These observations provide important information regarding distribution; occurrence and breeding status of species for which we have little information (see Appendix B for a complete list of birds observed during 2015).

Acknowledgments

We would like to thank volunteers Shannon Rebinski, Stacia Near, Rohan Kensey, and Charlotte Chesney; pilots Steve Ard and Roger Stradley; Bill Long from the Wyoming Wetlands Society for his expertise and help with Trumpeter Swan activities; Vincent Spagnuolo, Carl Brown, Chris Persico, Carl Anderson, Jeff Fair, Michelle Kneeland, and David Evers from Biodiversity Research Institute for their work, help, and knowledge of common loons; John Parker for assistance with BBS surveys; and Jon Nicholson, Angela Trnka, Rachel Berger, Mary Heberger, Sarah Holman, Leah Collins, Molly Moore, and Bruce James for weekly winter swan counts along the Yellowstone and Madison rivers. We would also like to thank volunteers who participated in the mid-winter eagle survey: John Cataldo, Matt Nagel, Beth Coombs, Amanda Bramblett, Temia Keel, Joe Keel, Kira Cassidy, Erik Oberg, and Jody Lyle. We are grateful to the numerous YNP rangers who helped with field logistics, especially Michael Curtis, Kevin Dooley, Brian Helms, Pat Navaille, and Dave Ross. We thank Joshua Theurer, Scott Hancock, Diane Renkin, Jane Olson and Howard Weinberg for assistance with owl surveys. We also thank all visitors, YNP staff, and Yellowstone Association staff who submitted bird sightings. Finally, we thank Yellowstone Park Foundation, most notably Bob and Annie Graham, for funding provided to the Yellowstone Raptor Initiative.

Literature Cited

Anderson, D.W., and J.J. Hickey. 1972. Eggshell changes in certain North American birds. Pages 514–540 *in* K.H. Voous, editor, Proceedings of the XVth International Ornithological Congress. E.J. Brill, Leiden, Netherlands.

Baril, L.M., D.B. Haines, D.W. Smith, and R. Oakleaf. 2015. Long-term reproduction (1984-2013), nestling diet, and eggshell thickness of peregrine falcons (*Falco peregrinus*) in Yellowstone National Park. Journal of Raptor Research 49:347-358.

Baril, L.M., D.W. Smith, T. Drummer, and T.M. Koel. 2013. Implications for cutthroat trout declines for breeding ospreys and bald eagles at Yellowstone Lake. Journal of Raptor Research 47:234-245.

Baril, L.M., A.J. Hansen, R. Renkin, and R. Lawrence. 2011. Songbird response to increased willow (*Salix* spp.) growth in Yellowstone's northern range. Ecological Applications 21:2283-2296.

Bechard, M.J., C.S. Houston, J.H. Sarasola, and A.S. England. 2010. Swainson's Hawk (*Buteo swainsoni*). The Birds of North America Online, Cornell Lab of Ornithology, Ithaca, New York. http://bna.birds.cornell.edu/bna/species/265.

Crick, H.Q.P. 2004. The impact of climate change on birds. Ibis 146:48–56.

Diem, K.L., and B.H. Pugesek. 1994. American white pelicans at the Molly Islands, in Yellowstone National Park: twenty-two years of boom-and-bust breeding, 1966-87. Colonial Waterbirds 17: 130-145.

Grier, J.W. 1973. Techniques and results of artificial insemination with golden eagles. Raptor Research 7:1-12.

Harmata, A.R., G.T. Montopoli, B. Oakleaf, P.J. Harmata and M. Restani. 1999. Movements and survival of bald eagles banded in the Greater Yellowstone Ecosystem. The Journal of Wildlife Management 63: 781-793.

Kochert, M.N. 1972. Population status and chemical contamination in golden eagles in southwestern Idaho. Thesis. University of Idaho, Moscow, Idaho, USA.

Kochert, M.N., K. Steenhof, C.L. Mcintyre, and E.H. Craig. 2002. Golden Eagle (*Aquila chrysaetos*). The Birds of North America Online, Cornell Lab of Ornithology, Ithaca, New York. http://bna.birds.cornell.edu/bna/species/684.

McIntyre, C.L., and L.G. Adams. 1999. Reproductive characteristics of migratory golden eagles in Denali National Park, Alaska. Condor 101:115-123.

Phillips, R.L., T.P. McEneaney, and A.E. Beske. 1984. Population densities of breeding golden eagles in Wyoming. Wildlife Society Bullletin 12:269-273.

Postupalsky, S. 1974. Raptor reproductive success: some problems with methods, criteria, and terminology. Proceedings of the conference on raptor conservation techniques, Raptor Research Foundation, Fort Collins, Colorado, USA.

Ratcliffe, D.A. 1970. Changes attributable to pesticides in egg breakage frequency and eggshell thickness in some British birds. Journal of Applied Ecology 7: 67-115.

Reynolds, H.V. 1969. Population status of the golden eagle in south-central Montana. Thesis. University of Montana, Missoula, Montana, USA.

Rocca, M.E., P.M. Brown, L.H. MacDonald, and C.M. Carrico. 2014. Climate change impacts on fire regimes and key ecosystem services in Rocky Mountain Forests. Forest Ecology and Management 327:290-305.

Saab, V., W. Block, R. Russell, J. Lehmkuhl, L. Bate, and R. White. 2007. Birds and burns of the interior West: descriptions, habitats, and management in western forests. General Technical Report PNW-GTR-712. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon, USA.

Spagnuolo, V. 2016. Common loon (*Gavia immer*) monitoring report, 2015. Biodiversity Research Institute, Portland, Maine, USA.

Smallwood, J.A., M.F. Causey, D.H. Mossop, J.R. Klucsarits, B. Robertson, S. Robertson, J. Mason, M.J. Maurer, R.J. Melvin, R.D. Dawson, G.R. Bortolotti, J.W. Parish Jr., T.F. Breen, and K. Boyd. 2009. Why are American kestrel (*Falco sparverius*) populations declining in North America? Evidence from nest-box programs. Journal of Raptor Research 43:274-282.

Smucker, K.M., R.L. Hutto, and B.M. Steele. 2005. Changes in bird abundance after wildfire: importance of fire severity and time since fire. Ecological Applications 15:1535–1549.

Steenhof, K., and I. Newton. 2007. Assessing nesting success and productivity. Pages 181-192 *in* D.M. Bird and K.L. Bildstein, editors. Raptor research and management techniques. Hancock House Publishers, Blaine, Washington, USA.

U.S. Fish and Wildlife Service. 2003. Monitoring plan for the American peregrine falcon, a species recovered under the Endangered Species Act. U.S. Fish and Wildlife Service, Divisions of Endangered Species and Migratory Birds and State Programs, Pacific Region, Portland, Oregon, USA.

Canada geese. NPS Photo-N. Herbert

Appendix A: Raptor Nesting Terminology

Active nest – a nest in which eggs have been laid. A nest is considered active if evidence of reproduction (e.g., one adult is observed sitting low in the nest, eggs or young are seen, or food is delivered into eyrie [nest site]).

Breeding – a mated pair of birds that have laid eggs or raised young. Often breeding areas contain multiple nests or eyries.

Brood size - the average number of young fledged per successful nest.

Nest or Eyrie – a structure built or occupied by birds for the purposes of breeding. For cliff-nesters this definition denotes an individual scrape or ledge (i.e., eyrie).

Nesting success per active territory – the percentage of active nests in a monitoring region in which one or more young fledges successfully (used for ospreys and bald eagles). Young at least 80% of fledging age for eagles and ospreys are expected to fledge and are, therefore, considered successful nests at this point.

Nesting success per occupied territory - the percentage of occupied nests/territories in a monitoring region in which one or more young fledges successfully (used for all raptors except ospreys and bald eagles). Young reaching at least 28 days old for peregrines and 80% of fledging age for eagles and ospreys are expected to fledge and are, therefore, considered successful nests at this point. This is a better measure of nesting success since not all raptors, particularly eagles, nest annually. Including non-breeding territorial pairs in measures of nesting success is important to understanding population health. It also allows for the inclusion of nesting pairs that failed early or territorial pairs discovered late in the season that may have nested, but did not produce young.

Occupied territory – a territory where either a mated pair of birds is present, or a single bird is present that exhibits territorial display or other reproductive-related activity. A territory is also considered occupied if there is evidence of reproduction (e.g., one adult is observed sitting low in the nest, eggs or young are seen, or food is delivered into eyrie [nest site]). Fresh nesting material added to a nest structure may also indicate occupancy, but care must be taken to be sure these materials were added by the species in question. Occupancy within a region is the number of occupied territories divided by the number of territories that were checked for occupancy.

Productivity per active territory – the total number of young fledged per active nest (used for ospreys and bald eagles). Although accurate, a better measure of productivity would be productivity per occupied territory (described below); however, since these data were historically calculated in this way, it is not possible to calculate productivity per occupied territory.

Productivity per occupied territory – used for all raptors except ospreys and bald eagles. This is a accurate measure of productivity since not all raptors, particularly eagles, nest annually. Including non-breeding territorial pairs in measures of productivity is important to understanding population health. It also allows for the inclusion of nesting pairs that failed early or territorial pairs discovered late in the season that may have nested, but did not produce young.

Unoccupied – a known breeding area containing a nest or group of nests at which none of the activity patterns diagnostic of an occupied nest were observed.

Definitions based on Postupalsky 1974, and Steenhof and Newton 2007.

Appendix B: Birds Species Observed in 2015

American Avocet *(Recurvirostra americana)*
American Coot *(Fulica americana)*
American Crow *(Corvus brachyrhynchos)*
American Dipper *(Cinclus mexicanus)*
American Goldfinch *(Spinus tristis)*
American Kestrel *(Falco sparverius)*
American Pipit *(Anthus rubescens)*
American Robin *(Turdus migratorius)*
American Three-toed Woodpecker *(Picoides dorsalis)*
American White Pelican *(Pelecanus erythrorhynchos)*
American Wigeon *(Anas americana)*
Bald Eagle *(Haliaeetus leucophalus)*
Bank Swallow *(Riparia riparia)*
Barn Swallow *(Hirundo rustica)*
Barrow's Goldeneye *(Bucephala islandica)*
Belted Kingfisher *(Ceryle alcyon)*
Black-backed Woodpecker *(Picoides arcticus)*
Black-billed Magpie *(Pica hudsonia)*
Black-capped Chickadee *(Poecile atricapillus)*
Black-necked Stilt *(Himantopus mexicanus)*
Black-rosy Finch *(Leucosticte atrata)*
Blue-winged Teal *(Anas discors)*
Bohemian Waxwing *(Bombycilla garrulous)*
Bonaparte's Gull *(Larus philadelphia)*
Boreal Owl *(Aegolius funereus)*
Brewer's Blackbird *(Euphagus cyanocephalus)*
Brewer's Sparrow *(Spizella breweri)*
Broad-winged Hawk *(Buteo platypterus)*
Brown Creeper *(Certhia americana)*
Brown-headed Cowbird *(Molothrus ater)*
Bufflehead *(Bucephala albeola)*
Bullock's Oriole *(Icterus bullockii)*
Burrowing Owl *(Athene cunicularia)*
California Gull *(Larus californicus)*
Calliope Hummingbird *(Stellula calliope)*
Canada Goose *(Branta canadensis)*
Canvasback *(Aythya valisineria)*
Caspian Tern *(Sterna caspia)*
Cassin's Finch *(Carpodacus cassinii)*
Cedar Waxwing *(Bombycilla cedrorum)*
Chestnut-sided Warbler *(Setophaga pensylvanica)*
Chipping Sparrow *(Spizella passerine)*
Cinnamon Teal *(Anas cyanoptera)*
Clark's Grebe *(Aechmophorus clarkii)*
Clark's Nutcracker *(Nucifraga columbiana)*
Clay-colored Sparrow *(Spizella pallida)*
Cliff Swallow *(Petrochelidon pyrrhonota)*
Common Goldeneye *(Bucephala clangula)*
Common Loon *(Gavia immer)*
Common Merganser *(Mergus merganser)*
Common Nighthawk *(Chordeiles minor)*
Common Raven *(Corvus corax)*
Common Redpoll *(Acanthis flammea)*
Common Tern *(Sterna hirundo)*
Common Yellowthroat *(Geothlypis trichas)*
Cooper's Hawk *(Accipiter cooperii)*
Dark-eyed Junco *(Junco hyemalis)*
Double-crested Cormorant *(Phalacrocorax auritus)*
Downy Woodpecker *(Picoides pubescens)*
Dusky Flycatcher *(Empidonax oberholseri)*
Dusky Grouse *(Dendragapus obscurus)*
Eared Grebe *(Podiceps nigricollis)*
Eurasian Collared-Dove *(Streptopelia decaocto)*
European Starling *(Sturnus vulgarus)*
Ferruginous Hawk *(Buteo regalis)*
Fox Sparrow *(Passerella iliaca)*
Gadwall *(Anas strepera)*
Golden Eagle *(Aquila chrysaetos)*
Golden-crowned Kinglet *(Regulus satrapa)*
Gray Catbird *(Dumetella carolinensis)*
Gray Jay *(Perisoreus canadensis)*
Gray Partridge *(Perdix perdix)*
Gray-crowned Rosy-Finch *(Leucosticte tephroctis)*
Great Blue Heron *(Ardea herodias)*
Great Gray Owl *(Strix nebulosa)*
Great Horned Owl *(Bubo virginianus)*
Green-tailed Towhee *(Pipilo chlorurus)*
Green-winged Teal *(Anas crecca)*
Hairy Woodpecker *(Picoides villosus)*
Hammond's Flycatcher *(Empidonax hammondii)*
Harlequin Duck *(Histrionicus histrionicus)*
Hermit Thrush *(Catharus guttatus)*
Hooded Merganser *(Lophodytes cucullatus)*
Horned Grebe *(Podiceps auritus)*
Horned Lark *(Eremophila alpestris)*
House Finch *(Carpodacus mexicanus)*
House Sparrow *(Passer domesticus)*
House Wren *(Troglodytes aedon)*
Killdeer *(Charadrius vociferus)*
Lark Bunting *(Calamospiza melanocorys)*
Lazuli Bunting *(Passerina amoena)*
Lesser Scaup *(Aythya affinis)*
Lesser Yellowlegs *(Tringa flavipes)*
Lincoln's Sparrow *(Melospiza lincolnii)*
Long-eared Owl *(Asio otus)*
MacGillivray's Warbler *(Geothlypis tolmiei)*

Mallard *(Anas platyrhynchos)*
Mallard x American Black Duck hybrid
Marbled Godwit *(Limosa fedoa)*
Marsh Wren *(Cistothorus palustris)*
Merlin *(Falco columbarius)*
Mountain Bluebird *(Sialia currucoides)*
Mountain Chickadee *(Poecile gambeli)*
Mourning Dove *(Zenaida macroura)*
Northern Flicker *(Colaptes auratus)*
Northern Goshawk *(Accipiter gentilis)*
Northern Harrier *(Circus cyaneus)*
Northern Pintail *(Anas acuta)*
Northern Pygmy-Owl *(Glaucidium gnoma)*
Northern Rough-winged Swallow *(Stelgidopteryx serripennis)*
Northern Saw-whet Owl *(Aegolius acadicus)*
Northern Shoveler *(Anas aclypeata)*
Northern Shrike *(Lanius excubitor)*
Northern Waterthrush *(Seiurus noveboracensis)*
Olive-sided Flycatcher *(Contopus cooperi)*
Orange-crowned Warber *(Oreothlypis celata)*
Orchard Oriole *(Icterus spurius)*
Osprey *(Pandion haliaetus)*
Peregrine Falcon *(Falco peregrinus)*
Pied-billed Grebe *(Podilymbus podiceps)*
Pine Grosbeak *(Pinicola enucleator)*
Pine Siskin *(Spinus pinus)*
Pinyon Jay *(Gymnorhinus cyanocephalus)*
Prairie Falcon *(Falco mexicanus)*
Red Crossbill *(Loxia curvirostra)*
Red-breasted Nuthatch *(Sitta canadensis)*
Redhead *(Aythya americana)*
Red-naped Sapsucker *(Sphyrapicus nuchalis)*
Red-necked Phalarope *(Phalaropus lobatus)*
Red-tailed Hawk *(Buteo jamaicensis)*
Red-winged Blackbird *(Agelaius phoeniceus)*
Ring-billed Gull *(Larus delawarensis)*
Ring-necked Duck *(Aythya collaris)*
Rock Pigeon *(Columba livia)*
Rock Wren *(Salpinctes obsoletus)*
Ross's Goose *(Chen rossii)*
Rough-legged Hawk *(Buteo lagopus)*
Ruby-crowned Kinglet *(Regulus calendula)*
Ruddy Duck *(Oxyura jamaicensis)*
Ruffed Grouse *(Bonasa umbellus)*
Rufous Hummingbird *(Selasphorus rufus)*
Sage Thrasher *(Orescoptes montanus)*
Sandhill Crane *(Grus canadensis)*
Savannah Sparrow *(Passerculus sandwichensis)*
Sharp-shinned Hawk *(Accipiter striatus)*
Short-billed Dowitcher *(Limnodromus griseus)*
Short-eared Owl *(Asio flammeus)*
Snow Bunting *(Plectrophenax nivalis)*
Song Sparrow *(Melospiza melodia)*
Sora *(Porzana carolina)*
Spotted Sandpiper *(Actitis macularia)*
Spotted Towhee *(Pipilo maculatus)*
Steller's Jays *(Cyanocitta stelleri)*
Swainson's Hawk *(Buteo swainsoni)*
Swainson's Thrush *(Catharus ustulatus)*
Townsend's Solitaire *(Myadestes townsendi)*
Townsend's Warbler *(Setophaga townsendi)*
Tree Swallow *(Tachycineta bicolor)*
Trumpeter Swan *(Cygnus buccinator)*
Tundra Swan *(Cygnus columbianus)*
Turkey Vulture *(Cathartes aura)*
Vesper Sparrow *(Pooecetes gramineus)*
Violet-green Swallow *(Tachycineta thalassina)*
Virginia Rail *(Rallus limicola)*
Warbling Vireo *(Vireo gilvus)*
Western Grebe *(Aechmophorus occidentalis)*
Western Meadowlark *(Sturnella neglecta)*
Western Tanager *(Piranga ludoviciana)*
Western Wood-Pewee *(Contopus sordidulus)*
White-breasted Nuthatch *(Sitta carolinensis)*
White-crowned Sparrow *(Zonotrichia leucophrys)*
White-faced Ibis *(Plegadis chihi)*
White-throated Sparrow *(Zonotrichia albicollis)*
White-throated Swift *(Aeronautes saxatalis)*
White-winged Crossbill *(Loxia leucoptera)*
Wild Turkey *(Meleagris gallopavo)*
Willet *(Tringa semipalmata)*
Williamson's Sapsucker *(Sphyrapicus thyroideus)*
Willow Flycatcher *(Empidonax traillii)*
Wilson's Phalarope *(Phalaropus tricolor)*
Wilson's Snipe *(Gallinago delicata)*
Wilson's Warbler *(Cardellina pusilla)*
Wood Duck *(Aix sponsa)*
Yellow Warbler *(Setophaga petechia)*
Yellow-headed Blackbird *(Xanthocephalus xanthocephalus)*
Yellow-rumped Warbler *(Setophaga coronata)*

To stay informed about science in Yellowstone National Park, visit our website - www.nps.gov/ycr

NPS Photo-B. Cassidy