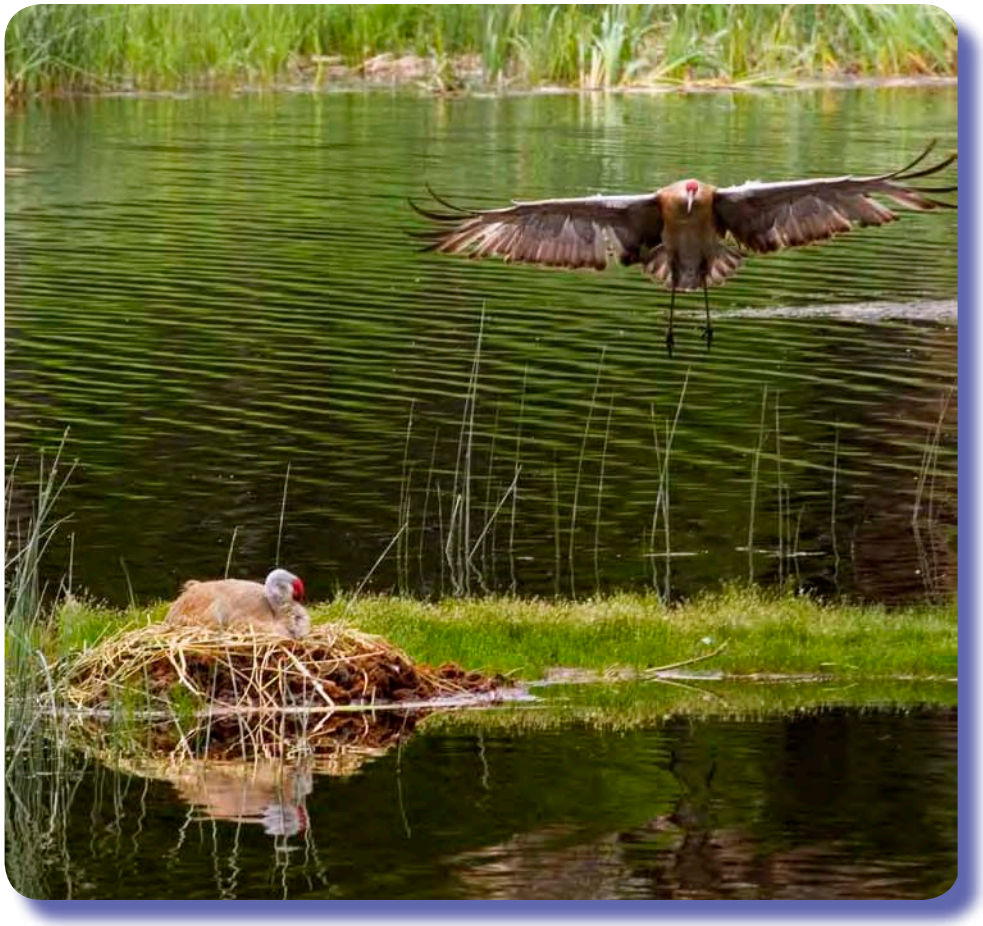
Yellowstone Bird Program
2011 Annual Report



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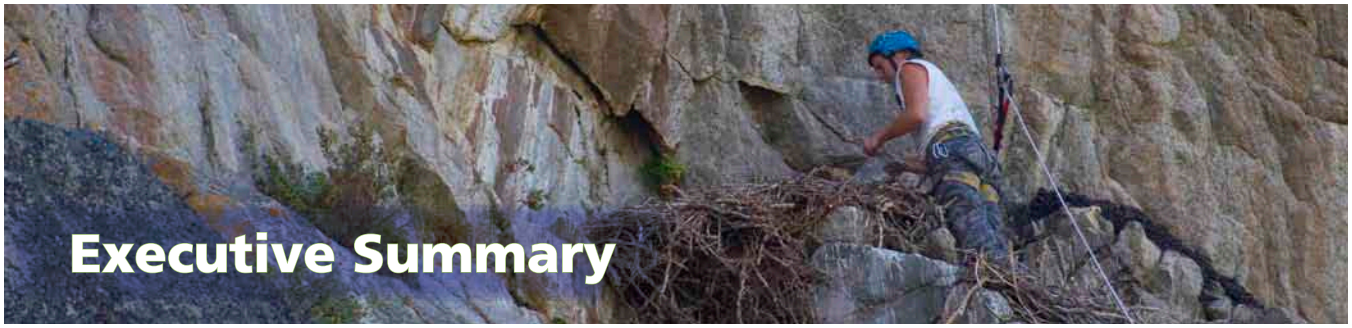
Front cover: Sandhill cranes nesting in a Yellowstone wetland, 2011
Back cover: Harlequin ducks, 2011 .



Executive Summary

During 2011, Yellowstone National Park (YNP) bird program continued its successful three-pronged approach to monitoring YNP bird species while introducing an important new element: the Yellowstone Raptor Initiative.

The YRI's focus —the roles of the many diverse species of aerial predators (hawks, eagles, and owls) in the Greater Yellowstone Ecosystem—is an expansion the bird program's overall knowledge base and program scope. YNP's core bird program activities focus on monitoring:

- Raptors (bald eagles, ospreys and peregrine falcons)
- Wetland birds
- Passerine/near passerine birds

Core Monitoring

Raptors

In 2011, the YNP bird program's core monitoring efforts continued to build our body of knowledge about three raptor species of ongoing concern.

Peregrine falcon monitoring, conducted by bird program staff from April through July 2011, focused on evidence of breeding and encompassed 27 peregrine falcon eyries. Of the 27 sites, 20 were occupied by at least one adult. We confirmed nesting at 12 of the 20 occupied sites, 11 of which fledged at least one young (92% success) for a total of 21 young produced in 2011. Eight territories were confirmed as unoccupied and only a single male was observed at one of the occupied sites. Nesting success during 2011 was significantly greater than during the majority of the previous 23 years. Brood size was somewhat smaller than the previous 23 years while productivity was consistent with the previous 23 years. Several cliffs not previously monitored for occupancy were observed during 2011. None of these cliffs were active peregrine sites, however one showed evidence of falcon activity but the species (peregrine or prairie) is unknown since birds were not observed there. The remaining cliffs were occupied by either golden eagles or prairie falcons. For the second year, peregrine nest sites were entered during August and October to collect biological materials important to understanding and evaluating the peregrine recovery process. Eggshell fragments including one addled egg and prey remains were collected from nine ledges across seven sites. Eggshell thickness, an indicator of environmental contaminants, averaged 0.27 mm and 0.34 without and with the inner eggshell membrane attached. These values are within the normal range of healthy peregrine eggs when compared with standard eggshell thicknesses from the Pacific Northwest. The prey remains found in nest

A juvenile peregrine falcon.

An osprey on the wing, 2011.

sites have revealed the highly varied diet of peregrines. However, samples collected in 2011 have not yet been analyzed.

Bald eagles were surveyed by fixed-wing aircraft during 2011. Of the 45 territories monitored, 25 were occupied. Seventeen of the 25 occupied sites were considered active. A total of 13 young fledged from 10 successful nests (59% nesting success). Productivity and brood size averaged 0.76 and 1.30 respectively. While the overall bald eagle population remains stable in YNP, decreased reproductive success has been observed for eagles nesting in the Yellowstone Lake area in recent years, possibly due to reductions in cutthroat trout abundance, human disturbance, climate change, or other unidentified variables. For the Yellowstone Lake population, nesting success was only 44% compared with 75% in all other areas of YNP. Similarly, productivity was just 0.56 at Yellowstone Lake, but 1.00 elsewhere. The low nest-success and productivity rates in the Yellowstone Lake area significantly influence this measure parkwide.

Ospreys within the park were surveyed aerially in 2011 in conjunction with bald eagle surveys. We monitored 36 territories, 26 of which were occupied. Of the 26 occupied territories, 24 were active and 13 were successful (54%), fledging a total of 24 young. Productivity and brood size averaged 1.0 and 1.85 respectively. Reproductive measures for osprey declined throughout Yellowstone from 1987–2003; however, osprey reproduction has increased since 2003 parkwide. Only four osprey pairs nested on Yellowstone Lake and none were successful. A second study nearing completion evaluates the relationship between cutthroat trout declines since lake trout introduction and rates of bald eagle and osprey reproduction (nest attempts, nesting success and productivity) at Yellowstone Lake region compared with reproduction elsewhere in YNP. This is a joint effort between YNP's bird monitoring program, YNP's fisheries program, and statistician Dr. Thomas Drummer at Michigan Technological University; findings will be submitted to a peer-reviewed journal.

Wetland Birds

Core monitoring efforts involving wetland birds focus primarily on trumpeter swans, common loons, and colony nesting birds.

Trumpeter swans were monitored in mid-winter and autumn as part of the tri-state annual survey coordinated by USFWS. We also monitored breeding swans in YNP and the Paradise Valley. During the winter survey (February 2, 2011) 372 swans were counted in YNP, on Hebgen Lake and the Paradise Valley. YNP accounted for 45% of the total swan count while Hebgen Lake accounted for 48% and Paradise Valley accounted for the remaining 7%. During the autumn survey (September 20, 2011) 37 swans were counted in the three study areas: 28 in Paradise Valley, nine in YNP, and none on Hebgen Lake. There was no swan reproduction in YNP during 2011. The YNP bird program hosted a trumpeter swan workshop from April 26-27 to assess the "state of knowledge" regarding swans in the tri-state region of Idaho, Montana, and Wyoming and particularly YNP, determine potential factors responsible for low productivity and breeding population size in YNP, and to discuss management possibilities. Among the several management options available, the bird program staff elected to install a nesting platform at Grebe Lake to mitigate for disturbance

(potentially human-caused) of swans nesting there. The platform, installed in October, was placed in the water several meters from the shoreline and will hopefully encourage swans to nest there rather than along the shoreline where predation and disturbance are likely greater. The efficacy of the experimental nesting platform will be evaluated at the end of each breeding season.

Trumpeter swans, spotted from the air during the 2011 midwinter survey.

Colony nesting birds were monitored on the Molly Islands; included were Caspian terns, American white pelicans, double-crested cormorants, and California gulls. The nesting success of double-crested cormorants and American white pelicans appears to be stable despite large year-to-year variability in weather and lake water levels. American white pelicans initiated 684 nests and cormorants initiated 35 nests however none fledged due to record setting lake water levels. No Caspian terns or California gulls were observed on the Molly Islands.

Common loons were surveyed at 22 historically occupied sites during late July and August. We counted 32 adults on 14 lakes and only one loonlet. The low productivity is likely a result of extremely high water levels extending into July. The number of adults observed in YNP remains stable; however, nesting pairs and fledglings have decreased since 1987.

Passerine/Near Passerine Birds

The third area orf focus for core monitoring activity involves the program's work with passerine and near passerine species.

Songbird monitoring continued in 2011 via three surveys: willow point counts, point counts in recently burned sites, and a breeding bird survey (BBS). We continued the work begun with Montana State University (MSU) as partners for the first three years of the seven-year project to study willow-songbird relationships, establish a long-term songbird dataset and fill a gap in the knowledge of songbird bird communities in the park. A total of 21 species were recorded across the range of willow growth conditions this year. We also continued a study initiated during 2009 where we are monitoring the effects of forest fire on bird species community composition. Given possible effects of global warming and a drying climate more frequent forest fires may occur and several species of birds, especially cavity nesters, use burned trees as habitat. To address this change, we initiated transects to sample birds in areas across a range of time after a burn. A total of 32 different species were detected across the five study areas. Twelve (38%) of the 32 species recorded were obligate cavity nesters. The BBS survey is an international survey designed to index bird population trends through time and we annually monitor three routes. On these routes we recorded 75 species and 2,079 individual birds across the three routes during 2011.

Yellowstone Raptor Initiative

The YRI's focus for 2011, the first year of a five-year program, was on breeding and non-breeding diurnal raptor monitoring in YNP. Specifically, we (1) began an inventory and monitoring program for breeding golden eagles (parkwide) and red-tailed hawks (northern range); (2) developed methods and baseline data to estimate the size of breeding populations of selected raptors across the northern range (red-tailed hawk, Swainson's hawk, American kestrel); (3) accessed golden eagle nest sites to collect biological materials (prey

NPS/J. LAYE

A great horned owl at Mammoth Hot Springs.

remains, eggshell fragments, bolus, and feathers) for information on diet and chemical contamination; (4) documented the autumn raptor migration in Hayden Valley; (5) maintained a parkwide raptor sighting record program and concurrent database to record all reported observations by staff and visitors; (6) collaborated with other raptor researchers in the region to better understand the ecological role of raptors in Yellowstone as well as in the larger Greater Yellowstone ecosystem; and (7) engaged visitors in the YRI program through ranger-led program and field trips. A small grant from the University of Wyoming-National Park Service Research Station launched this initiative and involves both the Yellowstone Center for Resources (YCR) and the park's Interpretation Division. Raptors are abundant and widespread in YNP, yet other than peregrine falcons, bald eagles, and ospreys there was no formal program to monitor them other than bird sighting reports. The purpose of this grant was to enhance public awareness and education and gather better information on the more than 30 raptor species observed here.

We located 17 territorial golden eagles and monitored five active nests. Four of these nests were successful fledging a total of five young. For the first time eggshell fragments and prey remains were collected from three of the five golden eagle nests that were active during 2011. We located and monitored 16 red-tailed hawk nests of which 14 were active fledging a total of 19 young. Our raptor road survey followed the road corridor from Indian Creek Campground to Baronette Peak. During this June and July survey we observed 122 individual raptors across 11 species. The red-tailed hawk was the most abundant species observed and made up 64% of all raptors documented. Our autumn migration counts in Hayden Valley occurred from September 13 through October 27. A total of nine observers spent 177 hours observing and documenting migrating raptors over a 35-day period. The proportion of raptors observed were buteos (61%), eagles (18%), accipiters (7%), falcons (6%), harriers (3%), ospreys (1%), turkey vultures (1%), and unknown raptors (3%). Of the raptors identified to species red-tailed hawks (31%) and Swainson's hawks (19%) were the most abundant. Over 500 raptor sighting forms were submitted and mapped from January through December. Most reports were observations of red-tailed hawks and some of these observations led to the discovery of new nests. In addition to our inventory and monitoring programs we participated in public outreach including a raptor ecology discussion and observation field trip led by Interpretive Ranger Katy Duffy on September 10. We also hosted a group of 20 college students from Northwest College in Powell, Wyoming at our migration site in Hayden Valley on October 27. During their visit, we observed 55 raptors among which were 15 golden eagles, 9 bald eagles, and 24 rough-legged hawks. Students learned to identify these species and learned about the ecology of migration. These programs served to foster enthusiasm and increase public appreciation for raptors in YNP. Finally, we collaborated with two leading raptor ecologists in the Greater Yellowstone area to locate golden eagle, red-tailed hawk, and Swainson's hawk territories.

Species Sightings

Lastly, we kept a species list that included all reliable bird sightings from the year in YNP. Notable sightings from 2011 included a black-crowned night heron, black tern, wild turkey, and blue jay.

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Introduction

Over 300 species of bird have been documented in Yellowstone National Park (YNP) since the park's establishment in 1872. Approximately half of those are regular breeders here. YNP is surprisingly rich in bird diversity given the harsh environmental conditions that characterize the landscape. The variation in elevation and broad array of habitat types found within YNP contributes to the relatively high diversity. The YNP bird program monitors a small portion of its breeding bird species with the goal of gathering information like reproduction, abundance, and habitat use, on multiple species from a wide variety of taxonomic groups; and maintaining long-term datasets (20 or more years) for several species. Long-term monitoring efforts help inform park staff of potential shifts in ecosystem function (e.g. climate change effects) for YNP's bird community and may guide future conservation of the park's birds and their habitats. There are more than 3 million visitors to YNP every year, including many bird watchers. It is our goal to share with the public information on the diversity of bird life and the status of birds in YNP. This report summarizes data gathered for these programs during 2011.


A male common yellowthroat.

The Yellowstone National Park core bird program (YNP-BP) is currently divided into three broad classes meant to include species representative of YNP's diversity: the Raptor Monitoring Program, the Wetland Bird Monitoring Program, and the Passerine and Near Passerine Monitoring Program. Three species—the bald eagle, peregrine falcon and osprey—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 currently no federally listed bird species in YNP. However, monitoring efforts for these species will continue to contribute to YNP's long-term dataset and to meeting the obligations outlined in the US Fish and Wildlife Service (USFWS) post-delisting monitoring plans.

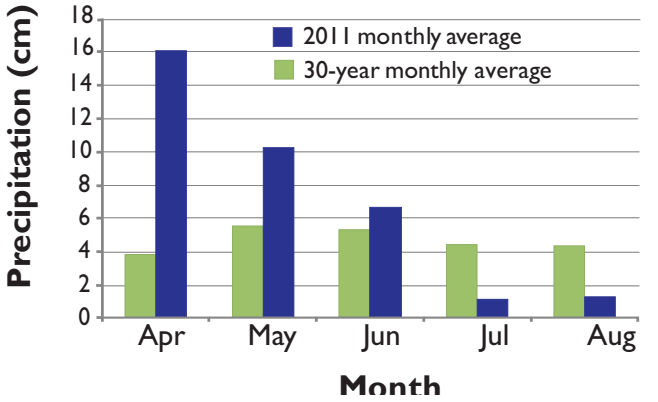
Trumpeter swans, common loons and colony nesting species, including double-crested cormorants and American white pelicans, are included in the wetland bird monitoring program. The trumpeter swan is of particular concern in YNP due to a locally declining population and low reproductive success during the last several decades, and the species continues to be studied through collaborative efforts with Montana State University (MSU) and Eastern Kentucky University (EKU) to help establish causal factors for observed declines. This spring, trumpeter swan experts convened in Bozeman, Montana to discuss potential future Yellowstone management actions.

The breeding bird survey (BBS), willow-bird survey, and the newly added forest-burn survey established in 2009 are part of the passerine and near-passerine monitoring program. This program

was recently expanded to fill the gap in knowledge regarding the abundance and habitat use by passerines and closely allied species in YNP. This program is particularly valuable since species in this group represent the majority of all species found within YNP.

The Yellowstone Raptor Initiative (YRI) is a new scientifically based project focused on diurnal and nocturnal raptors within YNP. This effort was developed to complement the bird program's more generalized focus and broad-based monitoring activities by focusing directly and more intensely on the role of aerial predators in the Greater Yellowstone Ecosystem. Yellowstone supports 12 diurnal and 7 nocturnal breeding species of raptor, and a further 14 species that have used or currently use the Yellowstone landscape during migrations and seasonal movements. Several are of growing conservation concern in the United States, including golden eagles, Swainson's hawks, and ferruginous hawks. Yet despite Yellowstone's raptor diversity, large relatively undisturbed landscape, and heightened conservation focus for several species, few data exist regarding population size, productivity, and seasonal movements for raptors in Yellowstone other than for those monitored under the core bird program. The YRI is designed to fill this gap in knowledge by expanding inventory and monitoring efforts to focus on a greater variety of raptors while maintaining our core program's traditional focus on several key raptor species of continuing concern (bald eagles, peregrines and ospreys).

The YRI has selected golden eagles, red-tailed hawks, Swainson's hawks, American kestrels, prairie falcons, and owls as focal species with specific research goals for each. Accipiters (sharp-shinned hawks, Cooper's hawks, and northern goshawks) are not included because of the intensity of surveys necessary for adequate sample sizes. If the YRI continues beyond this initial five-year period, accipiters will be added to program goals. The YRI will distribute the results of these research efforts in the form of internal reports, peer-reviewed publications, and popular literature. Finally, the YRI will provide public outreach and education opportunities to highlight the ecological and cultural importance of aerial predators throughout the Yellowstone landscape. This report summarizes monitoring efforts during the 2011 season.



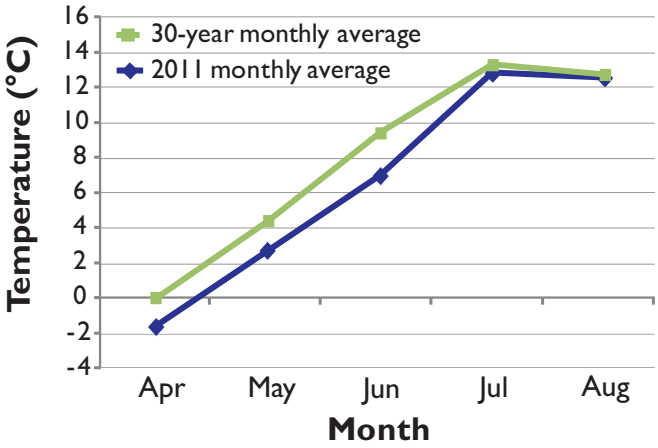
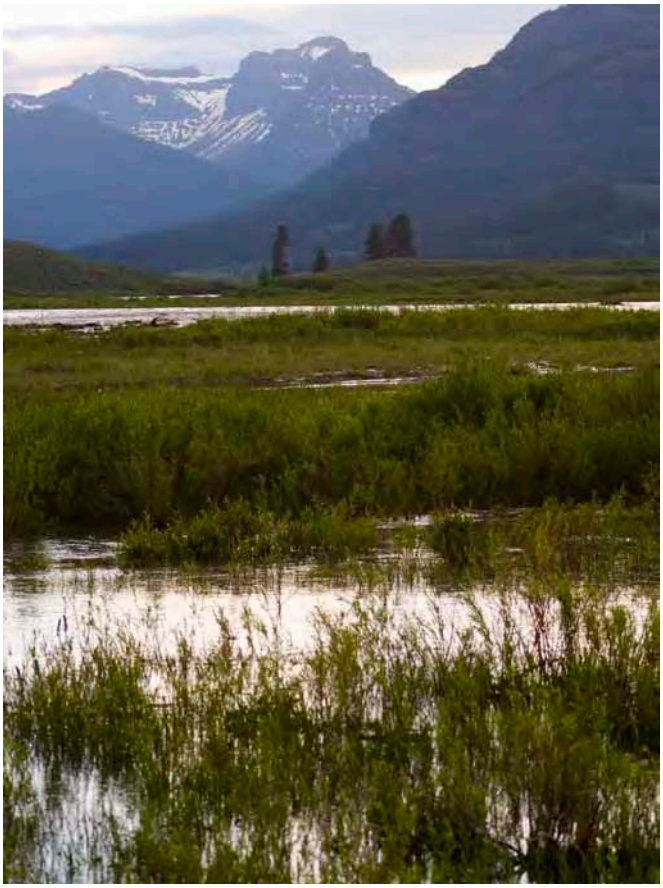


Figure 1, Monthly precipitation (top) and Figure 2, temperatures (bottom) at the Lake weather station during the core breeding season of April through August 2011. (Data provided by the Natural Resources Conservation Service, http://www.wcc.nrcs.usda.gov/nwcc/).

Breeding Season Weather

From a qualitative standpoint, the weather this year was anomalous to other years for several reasons. It was perhaps the hardest winter in decades and the latest spring in years (estimates have been from 2-4 weeks). Because of the amount of snow and rain in late winter and early spring, combined with warm temperatures later in the summer, water levels were at near-record stages during the breeding season. Precipitation was four times the 30-year average in April and about double this average in May but was below the average during July and August (Figure 1). Spring temperatures (April-June) were 1-2°C cooler than the 30-year average, but warmed to average temperatures during July and August (Figure 2).



Flooded willows

Climate Change

With rising temperatures and changing weather patterns, variance in the phenology of ecological events is expected. Within YNP however, it is largely unknown how climate change has affected or will affect ecosystem processes. In order to protect YNP's resources it is vital to be able to detect changes in ecosystem function so that appropriate management action can be taken. Birds have been touted as bio-indicators of climate change because of their sensitivity to shifts in seasonal weather patterns and relatively rapid response to these fluctuations. For example, climate change has been shown to influence migration patterns, population size and distribution, and the timing of reproduction and nesting success (Crick, 2004).

Since 2005, Douglas W. Smith has kept a record of spring arrival dates (migrants) in the Mammoth/Gardiner area for many common species. It is intended that this dataset will be ongoing to determine if a shift in the mean arrival date is occurring. These efforts normally represent observations of one person but this year data was recorded using observations from several individuals and several locations on the northern range. All raptor species (for which there are more than one year's data) appeared in sync with the average but there were two songbird species that seemed noticeably later this year (Appendix A). Tree swallows were observed 17 days later (averaged over 6 years) and ruby-crowned kinglets were observed 12 days later (averaged over 6 years). More data like these will be gathered in future years in order to determine trends in the timing of migration. In addition to first arrivals, the timing of nest initiation, incubation, and fledging will be monitored for several species of raptor and may be useful in determining the effects of climate change in Yellowstone.

Core Bird Program

Raptor Monitoring

Peregrine Falcons

Recovery of the peregrine falcon from near extirpation west of the Mississippi River to current population levels throughout North America has been an endangered species success story. Listed as endangered in 1970, drastic measures were taken to save this species from extinction. Captive breeding programs supplied young peregrines that fledged from hack boxes placed in carefully chosen sites within suitable nesting habitat. Yellowstone Park took part in this recovery effort, and beginning in 1983, 36 hatch-year peregrine falcons were released by the National Park Service (NPS), USFWS and state wildlife agencies at several hack sites in and around YNP over a six year period. Since that time, the number of nesting pairs in Yellowstone has steadily increased from one pair in 1984 to 32 pairs in 2007. Because of their strong success, peregrines were delisted in 1999 but continue to be monitored across the US for territory occupancy and reproductive success.

Monitoring & Reproduction

All monitoring consisted of ground surveys conducted from late April through July to determine occupancy and reproduction within known territories. Overall, we monitored 27 of the 32 known territories in YNP during 2011; of these, 20 were

occupied (although only one adult bird was observed at one of these sites). At two of the sites, the peregrines moved to a different nesting cliff within their territory. During 2011, there were 12 confirmed nest attempts, 11 of which fledged at least one young, yielding a 92% nesting success rate (Figure 3). Confirmed fledglings totaled 21, and productivity (young per nesting female) and brood size (young per successful nest) averaged 1.75 and 1.91, respectively (Figure 4; see Appendix B.for detailed nesting terminology following definitions provided by Postupalsky, 1974).

Nesting success during 2011 was significantly greater than during the majority of the previous 23 years. Brood size was somewhat smaller, while productivity was consistent with the average for that period.

Several cliffs not previously monitored for occupancy were observed during 2011. None of these cliffs held active peregrine sites; one showed evidence of falcon activity but the species (peregrine or prairie) is unknown since birds were not observed there. The remaining cliffs were occupied by either golden eagles or prairie falcons.

Nesting Chronology

Since 2009, detailed information regarding nesting chronology was collected for those nests where sufficient observations could be made. Nesting chronologies were determined by (1) estimating the age of nestlings and then back-calculating egg laying and hatching dates and forward-calculating fledging dates using standard estimates for the incubation and nestling periods (White et al. 2002); and (2) observing indications of breeding-stage behavior (e.g. courtship displays, incubation exchanges, carrying food). For each nest per year, we determined the earliest and latest possible dates for onset of incubation, hatching, and fledging. We then calculated the average early and late dates across all nests yielding a range for each nesting stage in a given year.

We found peregrine falcons in YNP began incubation during early May to mid-May (Table 1). Peregrines may begin incubation after laying the first egg if temperatures are low enough to compromise egg viability, which leads to asynchronous hatching and fledging (White et al. 2002).

Mean Date Range	2009 avg *(n=12)*	2010 avg *(n=11)*	2011 avg *(n=9)*
Incubation	May 5–8	May 1–4	May 9–12
Hatching	June 10–13	June 3–6	June 10–15
Fledging	July 20–23	July 11–15	July 19–24

Table 1. Peregrine falcon nesting chronology (2009–2011).

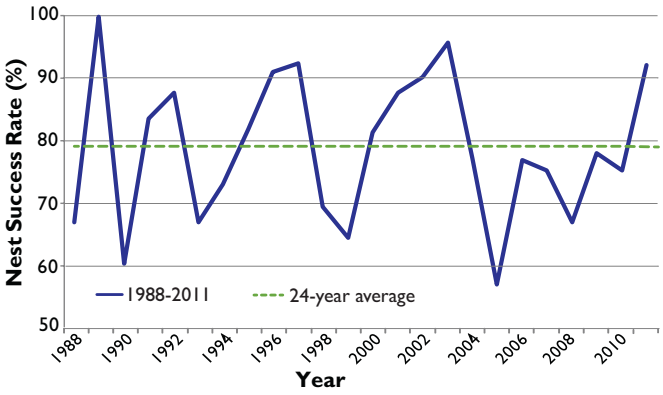


Figure 3. Peregrine falcon nest success (1988–2011) and comparison with the 24-year average.

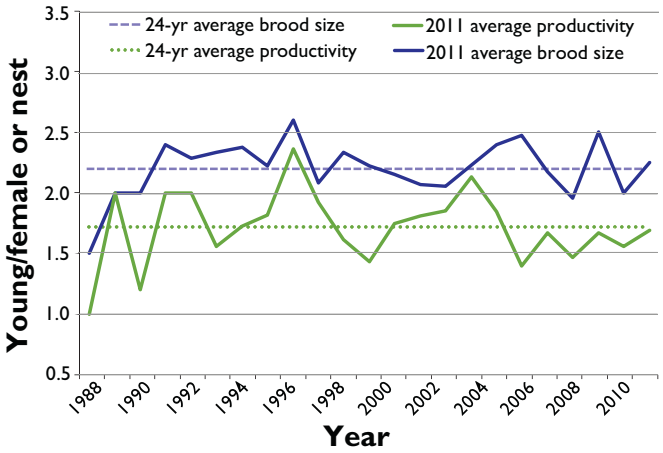


Figure 4. Comparison of 2011 peregrine falcon brood size and productivity to the 24-year average (1988–2011).

Incubation generally lasts 33–35 days and chicks generally fledge when they are 40–44 days old. In YNP, young peregrines typically hatch in mid-June and fledge mid- to late July. As we are able to gather more precise information on a larger number of territories over a longer period of time, we will be able to determine if there are differences in nest chronologies based on yearly weather patterns, variation in elevation, cliff aspect, or other

Joel Pagel rappels into a peregrine nest site.

factors. Knowledge of how the timing of nesting relates to environmental factors will help us to better understand peregrine ecology and climate change effects in YNP.

Peregrine Falcon Nest Entry

The collection of biological materials (e.g. eggshell fragments, addled eggs and prey remains) from peregrine nest sites offers unparalleled information on environmental contaminant levels and prey species composition that cannot be obtained via any other method. YNP's peregrine population is an ideal candidate for obtaining baseline measures of eggshell thicknesses to compare to other populations now and in the future because of its protected area status and long history of population monitoring. Eggshell thickness is an indicator of contaminant levels (i.e. thinner shells indicate the potential presence of environmental contaminants). Once adequate baseline information is collected, nest entries will occur at 5–10 year intervals to determine changes from baseline.

From August 1 to August 11 and on October 11, USFWS raptor ecologist Dr. Joel Pagel returned to the park to conduct peregrine falcon nest ledge entries. During 2011, eggshell fragments, feathers, and prey remains including the first addled egg (unhatched) were collected from nine ledges across seven peregrine territories. Eggshell thickness averaged 0.27 mm and 0.34 without and with the inner eggshell membrane attached, and are consistent with measurements from 2010. These values are within the normal range of healthy peregrine eggs when compared with standard eggshell thicknesses from the Pacific Northwest. Prey remains were not available as of the publication of this report.

Bald Eagle

The bald eagle was designated endangered in 1978 as a result of persecution by humans and widespread use of DDT, which reduced survival and reproduction. Following extensive recovery efforts nationwide, the USFWS removed the bald eagle from the List of Endangered and Threatened Wildlife and Plants on August 8, 2007. The bald eagle is one of the most extensively researched of all North American bird species and continues to be studied and monitored across the United States.

In Yellowstone, bald eagles have been monitored intermittently since the 1950s. The YNP bird program has performed annual surveys since 1987 to determine territory occupancy and reproductive success for all known breeding areas in addition to locating new ones. Bald eagles are monitored via fixed-wing aircraft supplemented by ground-based surveys from April through June each year. Since surveys began, 45 bald-eagle territories have been identified in YNP, although not all territories are occupied in a given year. The number of nesting pairs in YNP has increased substantially as a result of increased protections afforded by the Endangered Species Act and the Bald and Golden Eagle Protection Act (1940), with 31-34 nest attempts per year since 2001. Thus, the park may have reached saturation in the number of nesting pairs that can be supported.

Bald Eagle Monitoring

Bald eagle nests were monitored via fixed-wing aircraft from May through June of 2011. Each of the three flights averaged approximately 4-5 hours; however, flight time was also devoted to osprey, trumpeter swan and common loon monitoring. We monitored all 45 known bald-eagle territories, 20 of which were unoccupied (i.e. no evidence of bald eagles during flight visits). There were 25 occupied sites, 17 of which were active (i.e. showed evidence of nesting).

Bald Eagle Reproduction

Of the 17 active nests, 10 (59%) were successful which is slightly higher than the 27-year average (Figure 5). Productivity across all active nests averaged 0.76 and the average brood size for the park was 1.30 (Figure 6). This year's productivity and nesting success rate were very close to last year's values (productivity = 0.67, average brood size = 1.33). The reproductive rates of bald eagles in YNP is stable but the productivity and success rates of birds found around the Yellowstone Lake area are much lower compared to the rest of the park. At Yellowstone Lake, there were nine active nests but only four produced young for a success rate of 44%. Outside of the lake area we monitored eight nests and six of these nests fledged young for a success rate of 75%. Productivity was also lower at Yellowstone Lake (0.56) compared to the non-lake area (1.00).

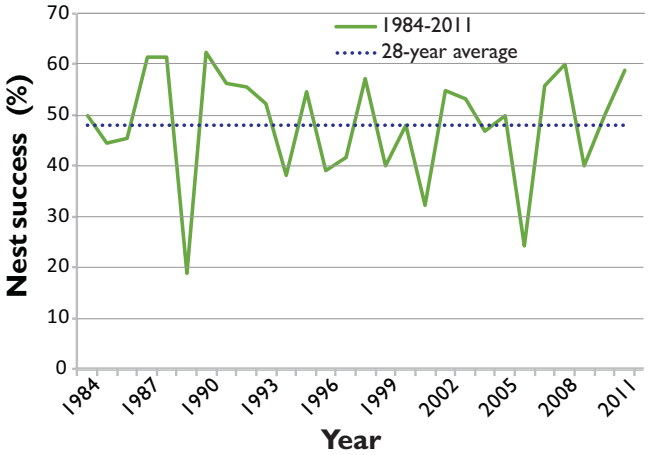


Figure 5. Bald eagle nest success (1984–2011).

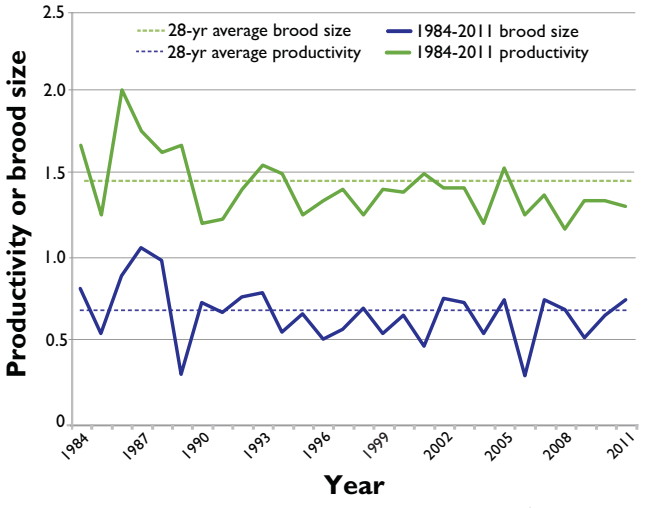


Figure 6. Bald eagle brood size and productivity (1984–2011).

Osprey

The first study of ospreys in Yellowstone National Park occurred in 1917 by M.P. Skinner, Yellowstone's first naturalist. It was not until 1987 that the Yellowstone Bird Program began monitoring breeding ospreys annually, although an extensive survey on reproduction, diet, and habitat was conducted by J. Swenson during the 1970s.

Ospreys are surveyed via fixed-wing aircraft supplemented by ground-based surveys from May through August. During the survey flights, all known nests are monitored for occupancy and breeding activity. In addition, all suitable lakes and rivers are surveyed for potential new territories and nest sites.

Osprey Monitoring

We monitored 36 osprey territories from mid-May through mid-August for activity. The majority of osprey nests were monitored via fixed-wing aircraft from May through August, although some were monitored from the ground.

Each of four flights averaged approximately 4–5 hours; however, flight time was also devoted to bald eagle, trumpeter swan and common loon monitoring. The early season (i.e. May and June) flights were used to determine territory occupancy and nest activity, while later season flights (i.e. July and August) were used to determine fledging success.

Osprey Reproduction

Of the 36 territories we monitored, 26 were occupied and 10 were unoccupied. Of the occupied territories, 24 were active but only 13 (54%) were successful, similar to other years although slightly higher (Figure 7). The overall productivity in the park was 1.00 and the average brood size was 1.85 (Figure 8). Consistent with previous years, none of the four active nests at Yellowstone Lake were productive, likely as a result of cutthroat trout declines. Of the 20 active nests in the remainder of YNP, 13 were successful (65%). Productivity for this region was 1.20 with an average brood size of 1.85. Parkwide, all three measures of reproductive success were greater during 2011 than the 24-year average.

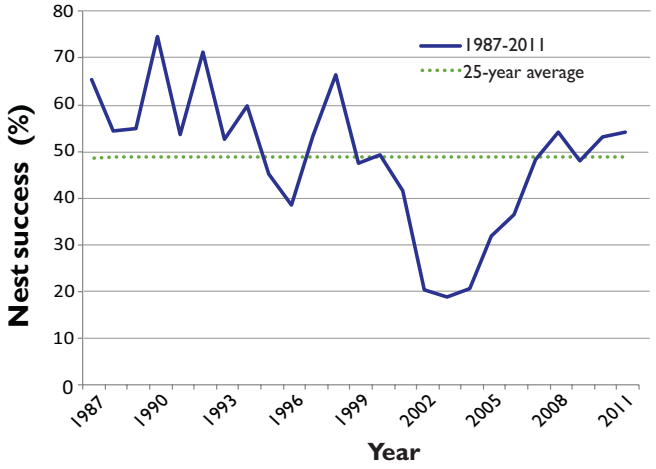


Figure 7. Osprey nest success (1987–2011).

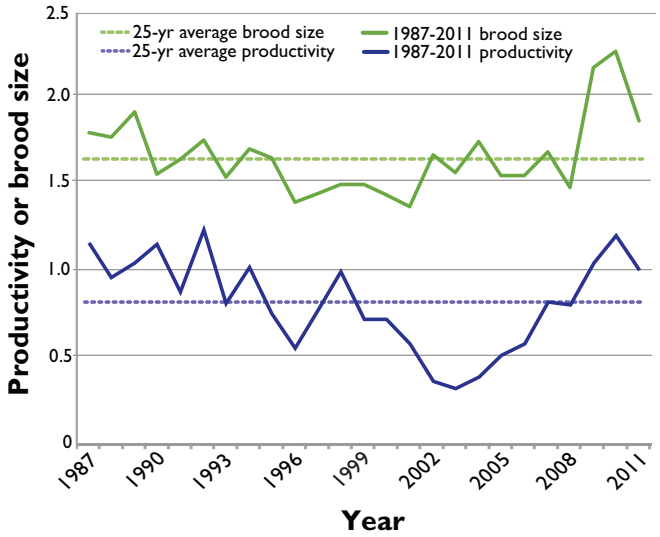


Figure 8. Osprey brood size and productivity (1987–2011).

Wetland Bird Monitoring

Trumpeter Swan

Trumpeter swans were first documented in Yellowstone in 1919 and were considered part of the last remaining population in the continental United States. The population increased through the middle part of the 20th century but declined after that, with the steepest decline from the early 1990s through the present. Factors responsible for declines in YNP's resident swan population and low productivity are unknown, but may be related to human disturbance, predation, changes in food quality and availability, insufficient nesting habitat, low recruitment of adults into YNP due to changes in management in areas outside of YNP, competition with wintering Canadian swans, or other unidentified factors. The YNP-BP is working towards understanding the cause(s) for Yellowstone's declining swan population and continues to closely monitor swans in the park.

Information on Yellowstone's resident swan and wintering swan population dates back to 1931 and 1971, respectively. These tri-state annual surveys are conducted in September and February as part of an inter-agency effort coordinated by USFWS. The objectives of the September survey are to: 1) estimate the resident swan population, 2) estimate yearly swan productivity or fledging success, and 3) use these data in conjunction with winter swan survey results to estimate the non-resident swan population.

The objective of the midwinter survey in February is to determine the number of migrant swans wintering in the region. Paradise Valley was added to the autumn and midwinter survey in 1989 and 1999 respectively while Hebgen Lake was added to the autumn and midwinter count in 2005 and 2000 respectively. In addition YNP has conducted bi-weekly winter ground-based surveys for portions of the Yellowstone and Madison Rivers since 1987. Swans are also monitored during the nesting season in order to determine the number of non-breeders, territory occupancy, nesting success (% of nests hatching young) as opposed to fledging success (cygnets surviving until September) which is accomplished via the autumn surveys.

Monitoring Trumpeter Swans

Trumpeter swans were monitored in 2011 via fixed wing aircraft on February 2 and September 20 as part of the USFWS tri-state midwinter and autumn surveys. Each flight was between 5.5 and 6 hours long (although the September 20 flight was split between two observers). All areas of YNP, the Paradise Valley, and Hebgen Lake were surveyed during each flight. Swan locations were obtained with a global positioning system (GPS) and the numbers of observed adults and cygnets were recorded. During the breeding season (May–August), we surveyed YNP for nesting swans and territory occupancy via fixed-wing aircraft concurrent with surveys of bald eagles, osprey, and Common Loons. Information gathered during flights was supplemented with ground observations.

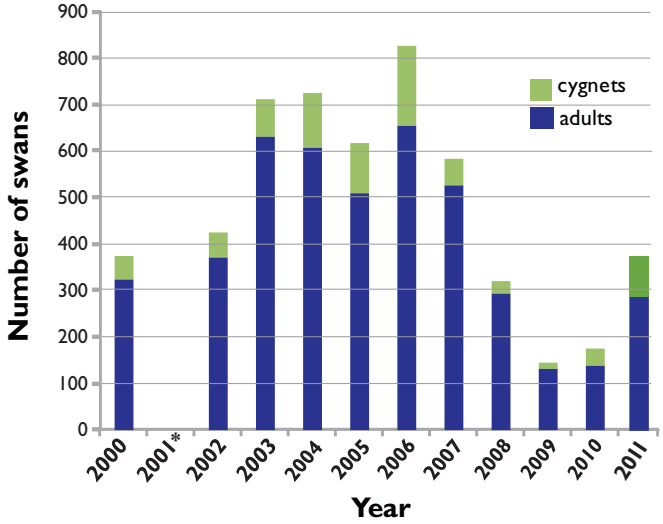


Figure 9. Summary, total number of adult and cygnet trumpeter swans observed during midwinter aerial surveys in YNP, in Paradise Valley, and on Hebgen Lake (2000–2011. *(*Data from 2001censored because Hebgen Lake was not surveyed that year.)*

Winter Count of Trumpeter Swans

A total of 372 swans were observed within the study region. YNP swans accounted for 167 swans, Hebgen Lake accounted for 180 swans, and Paradise Valley accounted for the remaining 25 swans (Table 2). YNP numbers increased over the previous three years and was highest during 2006 although numbers tend to fluctuate from year to year (Figure 9).

Trumpeter Swan Reproduction and Breeding Season Observations

The 2011 breeding season was unsuccessful. This may have been due in part to the large amounts of snow the area received this winter and the high water levels that resulted from snow melt and spring rains. Trumpeter Swans have a 140-160 day breeding period from the time eggs are laid to when cygnets fledge (Mitchell and Eichholz, 2010). In the case of unfavorable conditions early in the breeding season it is not uncommon to see a lack of breeding behavior. However, this is the first year documented that zero nest attempts were made in the park (Figure 10). Although no cygnets were fledged in YNP this year, Paradise Valley fledged six young. While Paradise Valley is lower in elevation than Yellowstone sites and ice-free regions occur earlier in spring, weather conditions cannot completely explain why there were no nest attempts in Yellowstone in 2011.

In addition to the two territorial pairs of swans in YNP, we observed six other adult swans. The Seven-Mile Bridge swan has continued to occupy this territory since losing its mate in 2008; however, despite occupancy during spring, this individual was not observed during the remainder of the breeding season. Two swans appeared to be paired, but had not yet settled on a territory. They were observed in multiple locations in the southern end of YNP during the past two years. The remaining three swans were usually observed together, often in the Yellowstone Lake area. It is not known if these swans recruited from areas outside of the park or if the swans produced from successful nests in YNP.

	Hebgen Lake		Paradise Valley		YNP	
Year	adults	cygnets	adults	cygnets	adults	cygnets
1999	Not surveyed		14	3	292	48
2000	220	31	16	6	87	13
2001	Not surveyed		28	1	53	11
2002	121	12	17	7	233	35
2003	462	40	23	5	146	34
2004	423	69	35	15	149	33
2005	367	72	18	6	124	30
2006	503	153	29	5	121	14
2007	340	31	41	3	144	25
2008	202	11	26	10	65	7
2009	4	0	38	12	88	2
2010	87	17	31	15	18	5
2011	136	44	25*	0 *	125	42

* adults and cygnets were not differentiated

Table 2. Results of midwinter aerial survey for trumpeter swans at Hebgen Lake, Paradise Valley, and YNP (1999–2011).

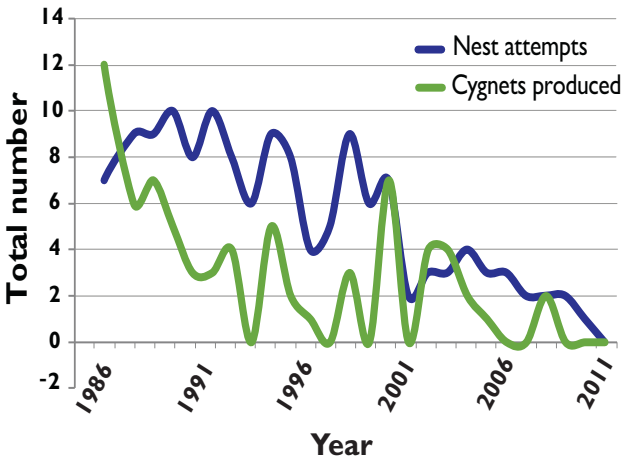


Figure 10. Trumpeter swan nest attempts and cygnets produced from 1986–2011 in YNP.

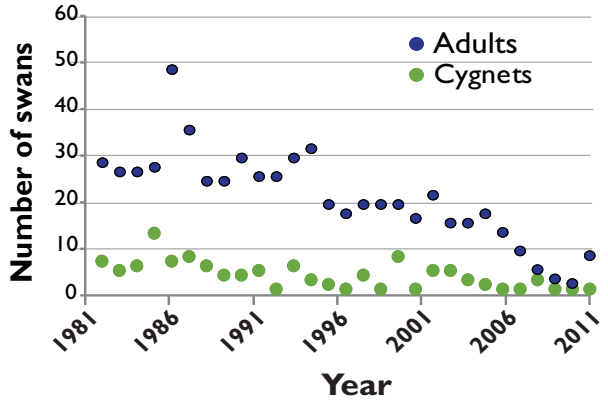


Figure 11. Autumn counts of trumpeter swans (1983–2011).

Autumn Trumpeter Swan Count

The region was divided into two areas each surveyed by a different observer via fixed-wing aircraft in order to conduct a complete and comprehensive survey. Each flight was approximately four hours long. Observers counted 28 swans (22 adults and 6 cygnets) in the Paradise Valley, nine swans (all adults) in YNP, and 0 swans on Hebgen Lake for a total of 37 swans. The number of swans observed during the autumn counts has declined although the number of adults is up from the past several years (Figure 11).

Trumpeter Swan Management

During April 26–27, 2011 an expert's workshop was held in Bozeman, MT to discuss the future of swans in Yellowstone. At this workshop the problem was clearly defined that swan numbers in the park have been declining for several decades yet there is no clear understanding of why. Four main potential reasons for this were discussed: (1) management changes outside the park, (2) habitat and food quality changes, (3) human disturbance, and (4) predation. A general consensus was expressed that swans are iconic in Yellowstone and all efforts should be made to prevent their further decline and to rebuild the Yellowstone population if possible.

From information presented and discussions held, several management possibilities were suggested including cygnet grafting, egg rescue, and nest platform installation. The seven-mile bridge swan territory is a possibility for releasing 70-day old cygnets or yearling birds early in the year as potential mates since it has been occupied by only one swan since 2008. Yellowstone is on the approved list to receive captive-raised 70-day-old trumpeter swan cygnets, the desired result being pair bond formation between one of the released cygnets and the resident swan at seven-mile bridge. However, while the YNP-BP is approved to receive these swans, their release is not yet authorized. Another complicating factor is that the single bird was not observed on this territory for most of the breeding season this year. Site fidelity and tradition were also emphasized at the workshop so it would be undesirable if this site was abandoned completely. If the lone swan is territorial to the seven-mile bridge area next year and approval is gained, cygnets will be released in the spring/summer period of 2012.

The next option discussed was the possibility of rescuing eggs from nests in danger of flooding, rearing the young swans in a captive setting, and then returning the cygnets to the adults upon or just after hatching. Since no nests were initiated in 2011, this was not an option for the current year. However, it remains a possible choice for consideration in future years, despite associated risks, because these may be offset by potential benefits such as enhanced nesting success rates and opportunities to collect valuable genetic data.

A third suggestion was to install a nesting platform at Grebe Lake since this pair nests along the shoreline and is thus subject to human disturbance, predation, and nest flooding. Swans typically build nests on muskrat houses, beaver lodges or floating mats of emergent vegetation however these

nest sites were not available at Grebe Lake. The floating platform was placed near the previous nesting site on October 18, 2011. This structure is designed to move up and down with fluctuating water levels (preventing nest flooding in most cases) and is placed strategically for protection from predators. Woody debris, grasses, and sedges were placed on top to look like a muskrat or dormant beaver lodge, and if the swan pair chooses to use the platform, they will add more of their own material during spring. A territorial pair must be established at a site for at least one year in order for a platform to be installed. Nesting platforms are meant to augment the quality of an existing territory rather than to attract swans. If this standard is met at other Yellowstone lakes in future years, more platforms may be installed. No trails or backcountry campsites were kept closed during 2011 since the two territorial pairs did not initiate nesting, but off-trail access and the closure of one campsite will likely be implemented during 2012 at Grebe Lake. Research will continue in order to better understand the decline of swans within YNP.

Colony Nesting Birds

Colonial nesting birds breeding on the Molly Islands have been monitored since the 1890 discovery of nesting American White Pelicans and California Gulls there. Located in the southern end of Yellowstone Lake's southeast arm these two small islands are cumulatively just 0.7–1.2 acres in size, depending on lake water levels, yet hundreds of birds have nested there in a single year. Caspian Terns were suspected of nesting on the Molly Islands by 1917, although information on breeding status was not collected until 1933. Double-crested Cormorants were confirmed nesters by 1928. Prior to the late 1970s the Molly Islands were surveyed only intermittently, but have been surveyed annually since that time.

Once monitored for abundance and reproduction by boat these species are now monitored by high resolution aerial photographs taken from fixed-wing aircraft. This minimizes the disturbance otherwise created by motorized boats and canoes. Birds nesting on the Molly Islands are subject to extreme environmental conditions ranging from flooding, frosts that can occur at any time of year, and high winds. As a result birds nesting there experience large year to year fluctuations in the number of nests initiated and fledglings produced (Table 3). Overall, populations appear stable for American white pelicans, California gulls, and double-crested cormorants. Caspian terns, however, have been declining for a number of years and currently no terns nest on the islands. The reason(s) for these declines are unknown.

Molly Islands Reproduction

Through photographic interpretation we observed approximately 684 American white pelican nests, and 35 nesting double-crested cormorants. Unfortunately, due to nearly record setting Lake water levels, the Molly Islands were submerged in July and all the nest attempts failed. In the initial photoset we did not observe any Caspian terns or California gulls on the islands.

Common Loon

Approximately 75% of Wyoming's population of breeding common loons occurs in Yellowstone and represents the southernmost breeding population of this species. In Wyoming, the common loon is listed as a Species of Special Concern owing to its limited range, small population, sensitivity to human disturbance, and loss of breeding habitat outside of Yellowstone. Common loons are surveyed June-August each year by fixed-wing aircraft supplemented by ground-based surveys. All lakes within Yellowstone are monitored to determine territory occupancy and reproductive success.

Pelican colony on one of the Molly Islands

Year	California gull	American white pelican	Caspian tern	Double-crested cormorant
1989	270	535	25	20
1990	295	572	28	203
1991	51	466	10	156
1992	70	522	0	210
1993	141	344	9	141
1994	240	210	22	240
1995	220	265	14	298
1996	0	3	0	61
1997	0	42	0	140
1998	21	295	3	147
1999	90	102	2	225
2000	255	584	0	152
2001	95	105	3	75
2002	65	180	3	280
2003	77	328	6	214
2004	207	237	3	154
2005	58	234	0	86
2006	81	362	0	261
2007	*	*	*	*
2008	0	13	0	16
2009	0	54	0	30
2010	0	184	0	59
2011	0	0	0	0

* no data available

Table 3. Young fledged from the Molly Islands (1989-2011).

Common Loon Reproduction

Loons were surveyed for territory occupancy and productivity primarily via fixed-wing aircraft supplemented by information submitted by park staff, volunteers, and visitors. We checked 22 lakes for loon activity (some lakes had more than one loon territory, e.g. Yellowstone Lake). Fifteen of these lakes were occupied with at least one loon and in total we estimated 34 adult loons and one loonlet (Table 4). Only one loon was observed on six lakes while seven lakes were unoccupied. It should be noted that loons can be difficult to observe from the air since they dive and sometimes hide in vegetation. Also, loons were recorded by multiple observers on multiple days and it is possible that some may have been counted twice although we feel that the total reflects a good estimate of the number of loons in the park. Productivity was low this year likely because of nearly record high water levels early in the breeding season lasting into July. Initiated nests were likely flooded causing the low loonet production observed. Much of the Wyoming population of common loons resides in YNP and we intend to monitor this species closely.

Passerine and Near Passerine Monitoring

Willow-Songbird Surveys

Willows and other woody vegetation have been highly suppressed in Yellowstone's northern range since the early 1900s. The loss and low stature of willows has been attributed to factors including elk herbivory, loss of beaver, fire, and/or climate change. Since 1997/1998, however, park biologists have observed that some willow stands in the northern range are expanding in height. Willows represent one of the few deciduous wetland habitat types in the region and biodiversity there is considerably greater than in adjacent grasslands, shrublands, and upland coniferous forests. Several bird species breeding in willow communities are not found elsewhere including Wilson's warbler, willow flycatcher, and gray catbird. Thus the observed increase in willow growth may be important to the re-colonization of these and other species associated with this habitat type in the region.

Monitoring of willow-songbird communities in Yellowstone began in 2005. The first three years (2005–2008) involved a collaborative study between Montana State University and the National Park Service to determine songbird response to change in willow structure. Subsequent years have been dedicated to a continuation of that study. The objective of this monitoring program is to compare the presence and abundance of breeding songbirds across the range of willow-growth conditions found throughout Yellowstone's northern range. Willows in this region range in growth from short, structurally simple willows to tall, structurally complex willows. Released willows, or willows exhibiting height increases

Site	Adults	Loonlets
Buela Lake	2	0
Cascade Lake	0	0
Cygnet Lakes	1	0
Delusion Lake	2	0
Grebe Lake	1	0
Grizzly Lake	1	0
Heart Lake	4	0
Herring Lake	0	0
Ice Lake	0	0
Lake of the Woods	0	0
Lewis Lake	3	0
Lilypad Lake	2	0
North Twin Lake	1	0
Obsidian Lake	0	0
Ranger Lake	1	0
Riddle Lake	2	0
Robinson Lake	0	0
Shoshone Lake	2	0
Tanager Lake	1	0
Winegar Lake	2	0
Wolf Lake	0	0
Yellowstone Lake:		
Mary Bay	0	0
Flat Mountain Arm	2	0
South Arm	2	0
Ashley's Beach	3	0
Trail Creek	2	1
Total	**34**	**1**

Table 4. Summary, common loons observed in YNP (2011).

since 1997/1998, are intermediate in complexity between suppressed and tall willows. Surveying birds in suppressed willows will shed light on species most likely inhabiting released willows before they increased in height while surveying tall willows will provide a frame of reference for the typical bird community associated with a well-established willow stand as well as enable biologists to make prediction about which bird species may begin to colonize released sites. Over time, we will be able to track changes in bird species composition as willows continue to change in structure.

Willow-Songbird Monitoring

This year was the seventh consecutive year of monitoring willow-songbird communities in YNP. For details of protocol and sample plots, refer to Baril et al., 2011. In most years, three types of willows were surveyed for breeding passerines including previously tall (averaging >1.5 meters in height and experiencing little browsing), suppressed (generally <1 meter and experiencing heavy browsing), and released (formerly height suppressed—now similar in height to protected willows, but with lower overall canopy cover). Previously tall point count stations are located in Willow Park (*n = 16*), suppressed plots are located at two sites along Soda Butte Creek (*n = 19*), and released plots are located along upper Slough Creek (*n = 9*) and Blacktail Deer Creek (*n = 8*) for a total of 52 point counts.

When possible, two rounds of counts are completed for each point count station and results are averaged between visits. However, due to flooding in 2011, only one visit was conducted at Willow Park and Slough Creek counts were omitted. Our objective is to determine presence and abundance of breeding birds in these three willow growth conditions. Waterfowl and shorebirds are excluded in the final analysis since point counts are not designed to adequately sample these species. We also exclude fledglings or any birds flying through the point count but not landing within the 40-meter radius. Richness and abundance averages are calculated for each point and then averaged over all points per growth condition.

Results

With early breeding season conditions being cool and wet and with phenological events occurring remarkably later than typical years, we speculated that this had a significant impact on breeding songbirds although we do not measure nesting success directly. For this reason, we delayed starting willow counts until conditions were somewhat consistent with other years (e.g. willows were leafed out and water had receded some). All counts were still completed by July 15 according to protocol. A total

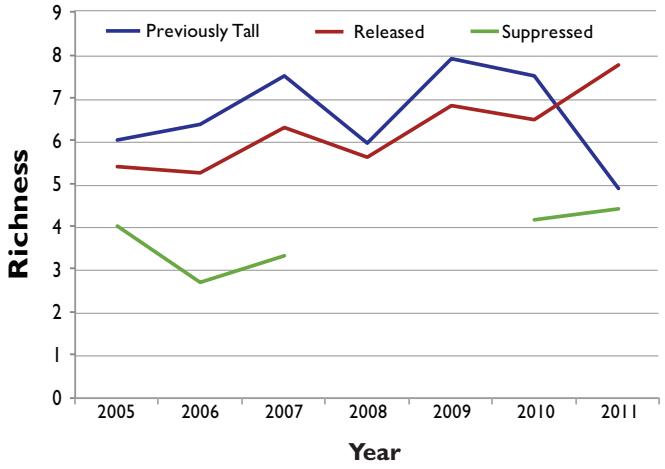


Figure 12. Species richness across three willow growth conditions (2005–2011).

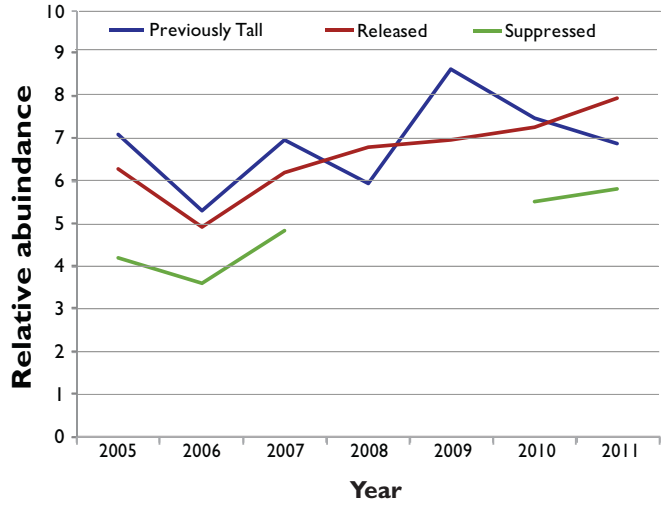


Figure 13. Species abundance across three willow growth conditions (2005–2011).

of 21 species were recorded across the range of willow growth conditions this year. Released sites had the highest average richness for the first time since the study began in 2005 (Figure 12). Relative abundance (hereafter abundance) was also greater than in previously tall willows, but has generally been similar to previously tall willows during the course of the study (Figure 13). Suppressed willows were not surveyed in all years, but exhibited substantially lower richness and abundance than either released or previously tall willows during all year's surveys were conducted. Richness was stable in previously tall willows, but increased in released and suppressed. Abundance increased in all three willow stand types, but the rate of increase was greatest in suppressed and lowest in previously tall willows. The stability over time observed in richness and abundance in previously tall stands is expected since these willows are have likely reached maximum growth potential and are subject to minimal browsing pressure. Increasing richness and abundance in released willows could mean that willow structure is changing such that more species and individuals are attracted to these areas. Similarly, suppressed willows could also be increasing in height growth thereby attracting more birds. Differences between released and previously tall willows may be exaggerated for 2011 since only one round of surveys were completed for Willow Park and Slough Creek was not surveyed at all. The Blacktail Deer Creek points have denser willows that are taller and have greater horizontal cover than the Slough Creek willows so since the Slough Creek points were not averaged in this year, perhaps it inflated the averages slightly. Generally time series data of at least 10 years is necessary for patterns to emerge.

Lincoln's sparrow was the most commonly observed species in the previously tall plots followed by yellow warbler and common yellowthroat (Table 5). Yellow warbler was most common in released willows followed by warbling vireo and American robin in equal abundance. In suppressed plots Savannah sparrow was the most common species followed by Lincoln's sparrow and Brewer's blackbird. Five of the 21 species occurred in all three stand types: American robin, common yellowthroat, Lincoln's sparrow, song sparrow and yellow warbler. Wilson's warblers were recorded during the first round of point counts at Round Prairie (suppressed) but were not recorded during the second round so it is probable that they did not breed there. Although these surveys are intended to only sample breeding birds in an area, it is possible that with the cold, wet spring that they were delayed migrants or they were still selecting a territory. Generally, Wilson's warblers are associated with tall dense willows typical of previously tall stands. Wilson's warblers do however appear to be expanding into released sites. During 2008 the first Wilson's warbler was detected at Slough Creek and in 2010 Wilson's warblers were recorded at both Slough Creek and Blacktail Deer Creek and had not been recorded in released sites previously

(Baril et. al 2011).

In her paper on willow-bird relationships in Yellowstone, Baril et al. identified seven particular species known to be associated with willows in this area. These species are common yellowthroat, Lincoln's sparrow, warbling vireo, song sparrow, yellow warbler, willow flycatcher, and Wilson's warbler. We examined trends over time for these seven species. Common yellowthroat and Lincoln's sparrow appear stable over time in both released and previously tall stands with slightly greater abundance in previously tall willows than in released willows. Warbling vireo abundance was also stable over time, but with an unusually high abundance during 2011, likely because Slough Creek (which has significantly fewer warbling vireos) was not surveyed. Yellow warbler, song sparrow and willow flycatcher abundance all increased over time with a greater rate of increase in released willows. Wilson's warbler abundance fluctuates somewhat from year to year in previously tall willows while increasing slightly in released willows. Changes in abundance could be related to changing willow structure, food resources, reproduction or other factors.

One factor responsible for changes in bird populations is brood parasitism and nest predation. Brown-headed cowbirds are brood parasites that lay their eggs in the nests of other species at the expense of the host's brood. Cowbirds were fairly prominent in released stands this year, but not all points in this stand type were sampled this year so this observation may not be comparable to other years. While these species (brown-headed cowbird, black-billed magpie) have shown fluctuations from year to year, they have not shown consistent increase and sample sizes are generally too low to determine patterns in abundance.

Species	Previously tall	Released	Suppressed
American robin	0.63	1.06	0.16
Black-billed magpie	—	—	0.05
Brown-headed cowbird	0.19	0.44	—
Brewer's blackbird	—	0.25	0.68
Brewer's sparrow	0.06	—	—
Chipping sparrow	0.19	—	—
Common yellowthroat	0.75	0.75	0.45
Fox sparrow	0.25	—	—
Gray catbird	—	0.44	—
Lincoln's sparrow	1.56	0.56	1.03
Northern flicker	—	0.19	—
Red-winged blackbird	0.19	—	0.29
Savannah sparrow	0.13	—	1.55
Song sparrow	0.19	0.38	0.55
Vesper sparrow	0.06	—	0.03
Warbling vireo	0.25	1.06	—
White-crowned sparrow	0.50	—	—
Western meadowlark	—	—	0.05
Willow flycatcher	0.63	0.88	—
Wilson's warbler	0.06	—	0.11
Yellow warbler	1.25	1.94	0.11

Table 5. Relative abundance of 21 species recorded in previously tall, released, and suppressed willow stands during 2011.

Forest Burn Surveys

The persistence of cavity nesting birds in YNP is dependent on patterns of fire across the landscape. Variation in burn severity, time since burn, and post-burn forest structure create a mosaic of different aged and structured stands that different species specialize on (Saab et al., 2007). For example, black-backed, three-toed, and hairy woodpeckers

An American three-toed woodpecker.

are associated with recently (2–4 years), low to moderate severity burned forests (Saab et al., 2007) while northern flickers are associated with three-year-old, high-severity burns (Smucker et al., 2005). Standing dead trees left behind after a fire 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, 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 Yellowstone is expected to increase as climate becomes warmer and drier (Westerling et al., 2006); 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.

	Young burn (1-5 yrs)	Old burn (6-10 yrs)
Richness	6.83	7.13
Abundance	6.86	7.69

Table 6. Average richness and abundance per forest-fire age category.

Forest Burn Monitoring Strategy

During our pilot study year (2009) we used line transects to sample birds; however, this method proved to be somewhat challenging given the abundance of fallen logs requiring observers to maneuver over a difficult landscape while surveying birds, therefore we implemented the point count method as described for the willow-bird surveys. A total of 34 point-counts were established across four discrete past sites of forest fires (Appendix C). Two sites were located in the East fire (*n=16*) which burned 17,294 acres on the east side of Yellowstone Lake in 2003, the third was located within the Le Hardy fire (*n=4*) which burned 9,604 acres in 2008 (north of Yellowstone Lake), the fourth was located in the Arnica fire (*n=8*) which burned 10,659 acres in 2009, and the last was located within the Antelope Creek fire (*n=6*) which burned 5510 acres in 2010. Each of the 34 point count locations were sampled twice. The Antelope Creek fire was added so that we can continue to study recently burned areas and to augment our data set and understanding of different aged burn areas. Total richness and abundance were calculated for each of the two fire categories: old burn (6–10 years since burn) and young burn (1–5 years since burn). The East fire is classified as an old burn while the Le Hardy, Arnica, and Antelope are classified as young burns.

Results

A total of 32 species were detected across the five study areas (27 young, 22 old). Twelve (38%) of the 32 species recorded were obligate cavity nesters. Both average richness and relative abundance were greater in old burn sites than in young sites (Table 6). The most abundant species in young burns were dark-eyed junco, American robin, and yellow-rumped warbler, while the most abundant species in old burns were tree swallow, American robin, and dark-eyed junco (Table 7). Dark-eyed junco and American robin were more abundant in young burn plots than in old burn plots, while the tree swallow was substantially more abundant in the old burn plots. Five of the species recorded were primary cavity nesters (i.e. excavate their own nest holes) and occurred in low abundance (<5 detections) in both burn types. Seven of

Species	Young burn (1-5 yrs)	Old burn (6-10 yrs)	Nesting guild*
American 3-toed woodpecker	0.08	0.03	1° CA
Hairy woodpecker	0.14	0.00	1° CA
Northern flicker	0.06	0.06	1° CA
Red-breasted nuthatch	0.06	0.09	1° CA
Williamson's sapsucker	0.03	0.00	1° CA
American kestrel	0.00	0.03	2° CA
House wren	0.00	0.03	2° CA
Mountain bluebird	0.06	0.41	2° CA
Mountain chickadee	0.53	0.13	2° CA
Tree swallow	0.25	1.78	2° CA
Violet-green swallow	0.00	0.03	2° CA
White-breasted nuthatch	0.00	0.03	2° CA
American robin	1.31	0.97	OP
Brewer's blackbird	0.06	0.00	OP
Cassin's finch	0.22	0.13	OP
Chipping sparrow	0.19	0.03	OP
Clark's nutcracker	0.03	0.03	OP
Dark-eyed junco	1.50	0.84	OP
Gray jay	0.03	0.00	OP
Lincoln's sparrow	0.11	0.63	OP
Olive-sided flycatcher	0.19	0.00	OP
Pine siskin	0.08	0.00	OP
Song sparrow	0.03	0.00	OP
Swainson's thrush	0.00	0.03	OP
Towsend's solitare	0.03	0.00	OP
Vesper sparrow	0.03	0.00	OP
Warbling vireo	0.17	0.00	OP
Western wood-pewee	0.44	0.63	OP
White-crowned sparrow	0.14	0.81	OP
Yellow-rumped warbler	0.89	0.72	OP
Brown-headed cowbird	0.03	0.19	PA
Ruby-crowned kinglet	0.19	0.06	PE
	27	**22**	

* Nesting guild also included (Nesting Guild: 1°CA = excavates own cavity, 2° CA = uses abandoned cavities, OP = open, PA = nest parasite, PE = pendant).

Table 7. Relative abundance and (total abundance) of species occurring in young and old burns.

the species detected were secondary cavity nesters (use the abandoned holes of primary cavity nesters or natural holes). Of these, the mountain bluebird and tree swallow show a preference for older burned areas rather than younger burns while the opposite was observed for the mountain chickadee. Data from 2010 shows a similar trend and it should be mentioned that average abundances were greater in both areas this year compared to last year. Of the non-cavity nesting species, most were more abundant in young burn plots than in old burn plots, including American robin, chipping sparrow, dark-eyed junco, warbling vireo, and ruby-crowned kinglet. Lincoln's sparrow, western wood-pewee, and white-crowned sparrow were more abundant in old burn plots.

It was somewhat surprising that despite greater overall species in young burn sites and greater individual abundances that average richness and abundance was lower than in old burn plots. A reasonable explanation is that all old burn plots were located in one fire while young burn plots were distributed across three different forest fires thereby adding increased variation. Moreover, an individual species' response to fire may vary substantially from fire to fire (Smucker et al. 2005). These "mixed" responses are likely due to variation between and even 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 Survey

Breeding bird surveys (BBS) are a nationwide monitoring effort that has been coordinated by the US Geological Survey and the Canadian Wildlife Service's Research Center since 1966. Currently there are over 4100 BBS routes scattered across the continental US and Canada. The surveys are road-based with the registered observer recording all birds seen and heard within a ¼ mile radius with points occurring every ½ mile. YNP has participated in this survey since 1982 and has three established routes (Appendix C): Mammoth area, Northeast Entrance area (Tower to Round Prairie), and the interior (Dunraven Pass through Hayden Valley and Yellowstone Lake). Each route traverses slightly different habitat with some overlapping types. The Mammoth route passes through big sagebrush/Idaho fescue and Douglas fir forest, as well as small areas of sedge bogs. The majority of habitat on the Northeast entrance route is big sagebrush/Idaho fescue, with lesser amounts of subalpine fir and tufted hairgrass/sedge meadows. The Yellowstone route consists of mostly subalpine fir, interspersed with areas of silver sage, big sagebrush and Idaho fescue. Current and past data are available on the BBS website at http://www.pwrc.usgs.gov/bbs/.

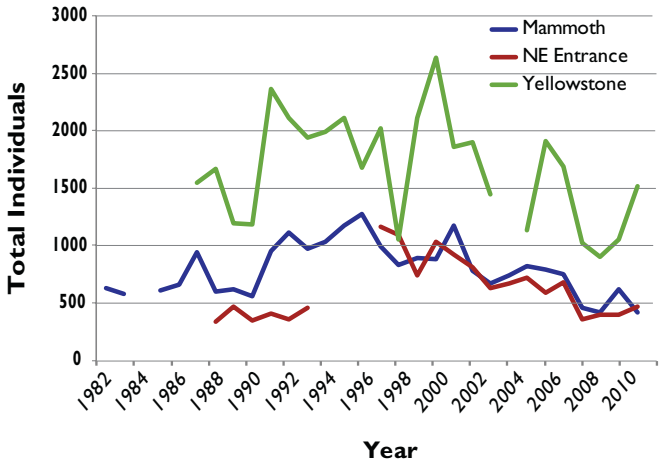


Figure 14. Number of individuals observed during the 2011 breeding bird survey, by location.

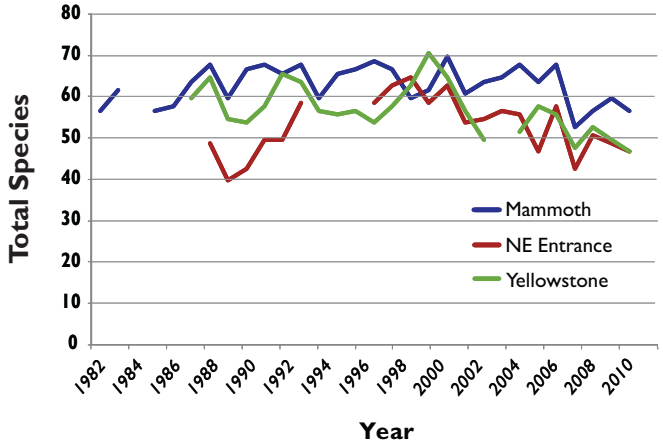


Figure 15. Number of species identified during the 2011 breeding bird survey, by location.

Results

Dates of the surveys were as follows: Mammoth on June 9, Yellowstone on June 24, and the Northeast Entrance on June 13. Along these three routes we recorded 2,405 individuals of 71 species (Figures 14, 15). The Mammoth route had the highest diversity of species, but the lowest number of individuals. The Yellowstone route had more than three times the number of individuals than either of the other routes. This was due to large flocks of Canada geese along the Yellowstone River that accounted for 70 percent of all observations along this route. Canada goose numbers vary widely from year to year, however during 2011 were the highest they have been since surveys began in 1987.

Yellowstone Raptor Initiative

Golden Eagle

The golden eagle is a wide-ranging species that occurs largely in the western United States and only during winter in the eastern US. Golden eagles inhabit a wide variety of habitats from the arctic to the desert, and require open spaces for hunting mammals (rabbits, hares, ground squirrels) and cliffs that provide nesting substrate, although large trees may also be used as nest sites. More northerly breeding birds migrate during the winter months while southern birds tend to be residents. It is unknown whether YNP's golden eagle population migrates, but it is likely that lower elevation birds (e.g. those in the northern range where carcasses are abundant) are residents while higher elevation and interior birds (where food availability is more limited) are at least partial migrants. Eagles from Alaska and Canada migrate to YNP during the winter months as

evidenced by radio-tagged individuals.

Golden eagles may be undergoing population declines in some regions as a result of lead poisoning, loss of habitat, and collisions with power lines and wind turbines (Kochert et al., 2002). Prior to this year YNP had no information on territorial golden eagles. Data on population size, occupancy, nesting success, and productivity may provide baseline information for YNP in future years and for regions outside of YNP experiencing declines in golden eagles and/or threats to occupancy and reproduction.

Our objectives for golden eagle surveys during 2011 were to (1) evaluate the potential for locating and monitoring golden eagle nests via fixed-wing aircraft; (2) search for golden eagle breeding areas throughout YNP; (3) determine reproductive success for territorial pairs with active nests; (4) follow up on visitor and staff golden eagle observations to locate additional territories; (5) to photograph and digitize golden eagle nests, territories, and observation points; (6) determine nesting chronology; and (7) collect biological materials including prey remains and eggshell fragments to provide baseline data for the presence of chemical contaminants and diet analysis.

Golden Eagle Monitoring

Surveys for territorial golden eagles began in May and continued through August. The majority of surveys were conducted from the ground; however, two aerial surveys to locate birds and nests occurred on May 12 and August 7, by two different observers experienced in searching for cliff nesting raptors. Although golden eagles may also nest in trees, we concentrated our search efforts for territorial birds on cliffs not currently occupied by peregrine or prairie falcons. A territory was considered occupied if two adult eagles were observed in the area or if fresh material/greenery was placed in nest structures. A nest was considered active if it contained eggs or young. During each observation period we documented behavior and determined nesting status. Once a territory was confirmed we photographed the main cliff structure and all nests. For future reference, we also recorded observation locations and mapped the cliff structure using ArcMAP.

A Brewer's blackbird.

Golden Eagle Reproduction

From previous observations of bird program staff we knew of six possible golden eagle territories. However, little information existed for most of them. In 2011, we discovered an additional 10 territories for a total of 16 confirmed territories. A probable 17th territory was located, but could not be confirmed. Due to extreme weather conditions across YNP this spring, we restricted most of our search efforts for golden eagles to the northern range. This lower elevation region experiences less snow fall and greater accessibility than interior regions of the park.

We located 36 golden eagle nests across the 16 confirmed territories. Of the 16 confirmed occupied territories, five were found with active nests (i.e. eggs or young). Four of these successfully fledged a total of five young while the 5th failed during incubation for unknown reasons. We did not calculate nesting success or productivity since surveys for nesting eagles did not begin until well after the egg-laying period. Since nesting is dependent in large part on prey availability, we cannot be sure if pairs initiated nests and then failed or if pairs without active nests did not attempt breeding at all. All observation points were marked with a GPS (Global Positioning System) and all nests were photographed and archived.

Based on the four nests monitored through fledging and on backdating from chicks aged in the nest, we estimate that golden eagles began egg-laying between March 28 and April 1 (Table 8). With a typical incubation period of 41–45 days

2011 Average	Mean Incubation Range	Mean Hatching Range	Mean Fledging Range
Red-tailed Hawk (*n=10*)	May 8–10	June 8–10	July 22–24
Golden eagle (*n=5*)	March 28–April 1	May 10–14	July 18–22

Table 8. Golden eagle and red-taileed hawk nesting chronology in Yellowstone National Park (2011).

(Kochert et al., 2002) hatching occurred between May 8 and May 20. Fledging generally occurs when the eaglets are between 65–70 days post-hatch and occurred between July 17 and July 25. As we are able to gather more precise information on a larger number of territories over a longer period of time, we will be able to determine if there are differences in nest chronologies based on yearly weather patterns, variation in elevation, cliff aspect, or other factors. Knowledge of how the timing of nesting relates to environmental factors will augment reproductive data and help us to better understand climate change effects and golden eagle ecology in YNP.

Golden Eagle Nest Entry

Of the five confirmed active nests, three were accessed for collection of prey remains and eggshell fragments. Data from both activities had not yet been released at the time of this writing.

Red-tailed Hawk

Red-tailed hawks are arguably the most ubiquitous raptor species in YNP, yet little is known about their population size, territorial spacing, or reproductive success. In an effort to fill this gap in knowledge we initiated a red-tailed hawk monitoring program across the northern range for which the goals were to (1) implement pilot study protocol designed to provide an index of population size via standardized surveys; (2) determine the efficiency and reliability of using a fixed-wing aircraft to locate and monitor nests; (3) locate and monitor nests for occupancy, productivity, and fledging success; (4) follow up on visitor and staff reports to locate and monitor additional nests; (5) digitize observations obtained by visitors and staff where breeding is suspected, but not yet confirmed; and (6) determine nesting chronology.

Red-tailed Hawk Population Index

We evaluated the potential for rapidly surveying red-tailed hawks, among other open country raptor, using the point-count method along the road corridor in the northern range. Results are summarized in the *Raptor Road Survey* section of this report.

Red-tailed Hawk Nest Monitoring and Reproduction

The majority of surveys were conducted via ground monitoring, however due to the time limitations of ground surveys we evaluated the potential of conducting some surveys via a fixed-wing aircraft. On May 12, Charles Preston Ph.D., an experienced raptor biologist with the Draper Museum in Cody, WY conducted an aerial survey for red-tailed hawk and golden eagle nest sites in the northern range. The objective of the flight was to determine activity at several known nest sites in addition to locating new nests, however since forests in the northern range (and throughout YNP) are predominantly coniferous locating red-tailed hawk nests proved difficult using this technique since nests are easily missed in the dense foliage of coniferous trees. Thus, it was recommended that a combination of behavioral observations, nest searches from the ground, and call playback be used to locate nests instead.

Using these methods we confirmed 33 red-tailed hawk territories. Although many more red-tailed hawks were observed and mapped throughout the season, this represents those territories were breeding behavior was observed (e.g. undulating flight, carrying prey or nesting material, vocalizations) or where adults were observed repeatedly in the same location. Within these territories we located 14 active nests and two inactive nests. A minimum of 19 young fledged from 12 of the 14 active nests (86%

nest success). Productivity averaged 1.36 young fledged/nesting female and brood size averaged 1.58 young fledged/successful nest. Several nests however, were located later in the breeding season when the probability of fledging is high. Therefore, our estimates of reproductive success are probably somewhat inflated. Our objectives are to monitor a minimum of 30 nests during each breeding season for more robust estimates of reproductive success.

All nests were photographed and the location of each was digitized in a GIS. This will allow observers to quickly locate nests in future years as well as to monitor changes in nest sites occupied over time. Observations made by YNP staff and visitors that indicated territoriality or breeding behavior were also digitized in order to narrow future nest searching efforts. Both visitors and staff contributed to locating several of the red-tailed hawk nests monitored during 2011, particularly Yellowstone Association and Yellowstone Center for Resources personnel. Contributions made by these and other individuals will be an invaluable resource as the YRI expands in scope. (See the *Raptor Sightings Program* section of this report for red-tailed hawk and other species observations reported throughout YNP.)

An active red-tailed hawk nest with one chick, 2011.

Red-tailed Hawk Nesting Chronology

From ageing red-tailed hawk nestlings then backdating we determined average range of incubation initiation, hatch date, and fledging date (Table 9). Red-tailed hawks began incubation approximately May 8–10. The incubation period lasts between 28–35 days and generally occurred on or near June 8–10. Fledging occurs between 42–46 days after hatching and occurred around July 22–24. These dates are somewhat later than others have reported for the Rocky Mountains and were likely influenced by severe winter/spring weather during 2011. As additional nests are monitored more precise estimates of nesting chronology will be obtained.

Swainson's Hawk

YRI staff surveyed for Swainson's hawks primarily via the road-based surveys in the northern range (see below), however we did confirm the location of 20 territories based on repeated observations at the same location and breeding behavior. An additional 13 potential territories were identified by YRI contributor, Jack Kirkley, Ph.D. University of Montana–Western. Due to limited staff we were unable to thoroughly check these territories for active nests; however, Kirkley located one active nest at the north end of Hayden Valley in August. The information gathered during 2011 will help narrow search efforts for active nests during 2012. Only five of the 33 territories were located on the northern range. Most were located in Hayden Valley and the Thorofare region. red-tailed hawks arrive on breeding grounds and begin nesting earlier than Swainson's hawks and may occupy the most productive habitat leaving suboptimal

habitat for later arriving Swainson's hawks. The northern range is arguably the most productive region in YNP supporting high small mammal density–favored prey for both red-tails and Swainson's hawks.

Prairie Falcon

We surveyed for prairie falcons while searching cliffs for peregrine falcons and golden eagles. We discovered two additional prairie falcon territories over the three previously known territories. All five territories were occupied during 2011 with confirmed nesting at two locations; however neither nest was monitored for reproduction due to staff limitations. The YRI plans to continue opportunistic surveys for this species. With additional staffing planned for 2012 we plan to monitor territories for occupancy and, if time allows, reproductive success.

Raptor Road Survey

The road-side survey objective is to estimate raptor density for select species within the northern range of YNP and is meant to complement nest monitoring surveys. By the end of 2015 the YRI plans to have a complete estimate of the adult red-tailed hawk population on the northern range, including an estimate of the number of breeding pairs. This survey primarily focuses on the open country soaring birds such as the buteos, eagles, and possibly most falcons although all raptor species detected are recorded. The survey consists of points of unlimited distance beginning at Indian Creek Campground and ending at Barronnette Peak. Point count locations were selected from a subset of the points used on two existing Breeding Bird Survey (BBS) routes located in the northern range. We used the BBS count stations as a random starting point from which to select a subset of point count stations. The criteria used to select point count stations from the total stations available on the BBS routes were: 1) stations were at least one mile apart to accommodate the large territory size of most raptor species (i.e. every other BBS point count station); and 2) the viewshed in each station was not obstructed by landscape features such that observing raptors was limited (i.e. in a canyon). This resulted in 41 stations located throughout the northern range (20 for the Northeast Route and 21 for the Mammoth route).

At each point an observer recorded all raptors heard and/or observed during a 10 minute period. For every raptor sighting the observer recorded the location on a topographic map along with corresponding information regarding species, abundance, type of detection (i.e. call or visual), sex, age, and color morph. Each point was surveyed once between July 6 and July 11.

Results

We recorded 122 detections across 11 species (Table 9). Every attempt was made to avoid double counting individuals, thus the 122 detections likely represented individual birds. Red-tailed hawks accounted for 64% of all detections identified to species followed by American kestrels (11%) and golden eagles (6%). Most raptors (70%) were observed within one km of the road and all were

Species	Total Abundance
Red-tailed hawk	64% (67)
American kestrel	11% (11)
Golden eagle	6% (6)
Osprey	4% (4)
Peregrine falcon	4% (4)
Prairie falcon	4% (4)
Turkey vulture	3% (3)
Sharp-shinned hawk	2% (2)
Bald eagle	1% (1)
Cooper's hawk	1% (1)
Swainson's hawk	1% (1)
Unknown buteo	NA (7)
Unknown raptor	NA (11)
Total	**122**

Table 9. Percent and (count) of raptors observed during the 2011 road survey by species observed. Percent is calculated for total observations identified to species (*n=104*).

observed within 3.5 km of the road. Estimating detection probabilities based on distance will be an important aspect of obtaining accurate density estimates. Based on implementing the pilot protocol and consulting with experts in the field adjustments will be made so that surveys accurately estimate raptor density with standardization across years to determine population size for select species on the northern range and eventually to detect changes over time. We did not calculate density estimates since this was the pilot study year and represents only one year of data.

David Haines, bird program staff, in the midst of his observations during a raptor study (2011).

Raptor Sightings Program

Since the raptor sightings program began in 2010 we received 964 sightings across 22 raptor species. More than half (636 or 66%) were reported during 2011. Red-tailed hawks (28%) were the most commonly reported raptor identified to species followed by bald eagles (13%), American kestrels (10%), and Swainson's hawks (10%). Not surprisingly 80 percent of all observations occurred from May through August, however most of those occurred during either May or August with relatively few observations submitted during June and July despite high visitation during those months. A possible explanation in that during May many species, except eagles and owls, are just beginning their breeding season and are therefore highly visible. Most raptors fledge during late July and become highly active and visible during August. Observers ranged from park staff to visitors exploring YNP for just a day. The report forms that are submitted (Figure 16) assisted in narrowing YRI staff search efforts for breeding raptors and contributed to locating several of the red-tailed hawk nests monitored during 2011. In general, owls and accipiters (sharp-shinned hawk, Cooper's hawk, and goshawk) are infrequently reported in large part because of their secretive nature and nocturnal behavior (most owls). Sightings of these species are especially important since little is known about their distribution and abundance in Yellowstone. In addition to aiding YRI staff in understanding raptor distribution throughout YNP, the raptor sightings program stimulates interest in YNP's raptors and enables visitors to contribute to scientific research within Yellowstone. Many of the raptor species that visitors observe and report on in YNP also occur in their own states or even backyards therefore endowing the public with the ability to recognize and appreciate these species in their home states or countries.

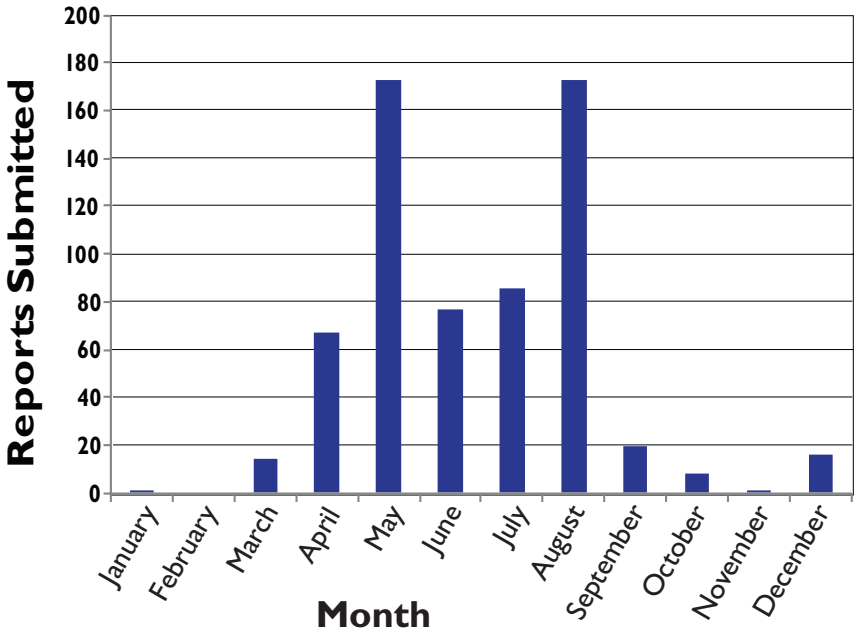


Figure 16. Number of raptor sighting reports submitted each month (2011).

Raptor Migration Count

The raptor migration count in Hayden Valley was initiated during autumn of 2010. The goal is provide long-term information on populations of raptors migrating through Yellowstone's Hayden Valley during autumn. The Hayden Valley migration site is located within the northern portion of the Rocky Mountain Flyway. Due to the closure of Hayden Valley west of the road as a result of fatal grizzly bear attack July of this year we were unable to access our original migration observation point for 2011. After scouting several potential alternative locations we moved the observation point to the north end of Hayden Valley near the confluence of Sour Creek and the Yellowstone River. While not ideal, this location afforded observers the best available vantage point for observing migrating raptors.

Observation Effort

Observations began September 13 and continued through October 27. We observed on 35 of the 47 available observation days. Counts typically began at 1000 hours and were completed by 1600 hours MST. 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 177 observation hours and observer hours (total hours x number of observers per day then summed over all days) totaled 448 hours.

Weather Summary

Weather information was collected in one hour intervals on the half hour in addition to the start and end of each observation day. We recorded temperature (°C), barometric pressure (Hg), average wind speed (km/hr), maximum wind speed (km/hr), wind direction (°), cloud coverage (%), cloud type, an index of thermal lift, and visibility distance (km).

Temperature averaged 13° C with a maximum of 26.6 °C and a minimum of -4.1 °C. Wind speed averaged 5.3 kph with average gusts of 10.3 kph. Wind came primarily from the southwest (53% of the time) followed by northwest (22% of the time), southeast (13% of the time), and northeast (12% of the time). The index of thermal lift was on average a three or fair on a scale of 1-4 with one representing excellent conditions and four representing poor conditions. Barometric pressure averaged 22.74 Hg. On most days visibility was un-obscured by fog or cloud and was designated at 10 km or unlimited. Cumulus clouds dominated when clouds were present, but cumulonimbus, cirrus, and stratus cloud types were present on many of the days. Raptors in addition to other groups of birds are observed to migrate in large numbers a few days after the passage of a cold front (Allen et al. 1996). The passage of a cold front is typically associated with shifts in temperature, humidity, barometric pressure, wind speed, and wind direction. Patterns of migration with regards to weather are also related to species morphology (e.g. long pointed wings of falcons which flap more and

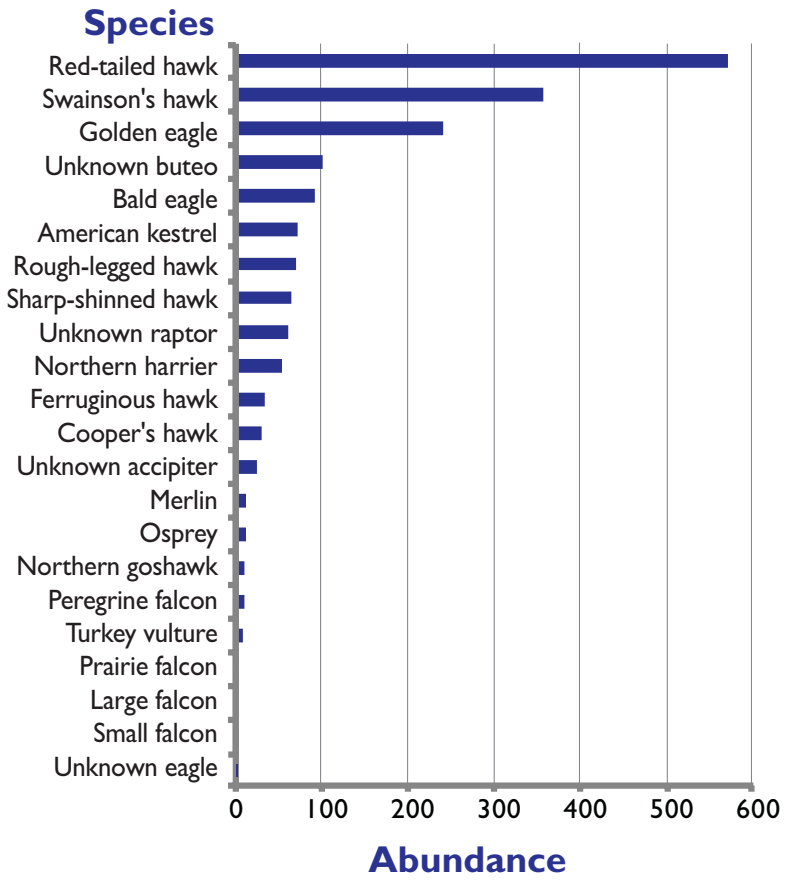


Figure 17. 2012 Total abundance of migrating raptors observed in Hayden Valley, YNP.

soar less than the relatively broad winged buteos) and timing of migration (Allen et al. 1996). Early season migrants like accipiters and falcons are in a better position to wait for the passage of cold fronts before migrating, but later migrants such as golden eagles are more constrained by time and may migrate during a variety of weather conditions (Allen et al. 1996).

Flight Summary

Observers counted migrants in 30 minute intervals and when possible recorded age, sex, and color morph of individuals. Observers also recorded the dominant direction of flight (east, west, or mixed) at the end of each 30 minute interval. A total of 1846 raptors across 16 species were recorded (Figure 18). The majority of all raptors observed were buteos (61%), eagles (18%), accipiters (7%), falcons (6%), harriers (3%), ospreys (1%), turkey vulture (1%), and unknown raptors (3%). The most abundant species were red-tailed hawks (31% of the total count), Swainson's hawks (19% of total count), and golden eagles (13% of total count). All other species represented <5% of the total count.

The average number of birds per hour or passage rate was 9.9 birds/hr (Figure 18). Passage rate generally peaked at 13.1 birds/hr from 1200 hours to 1300 hours with slight subsequent declines to approximately 10 birds/hr for the remainder of the day. The majority of raptors migrated to the east of the observation point although most flight summaries recorded a mixed flight pattern. Only

Staff member Leslie Henry makes careful observations.

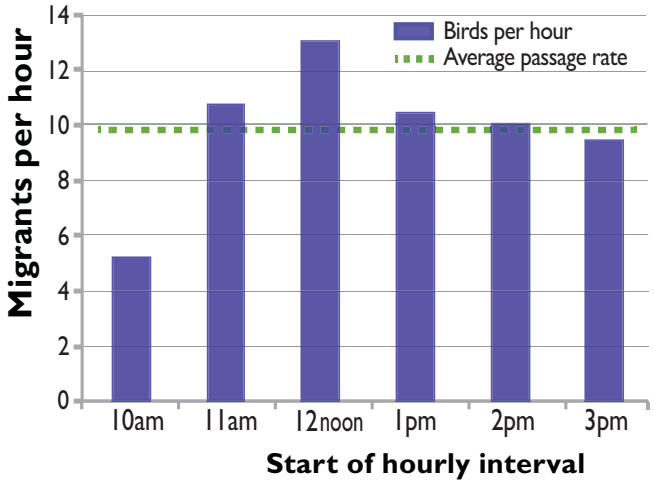


Figure 18. Cumulative passage rate for migrating raptors in Hayden Valley, Yellowstone National Park.

rarely did raptors fly directly overhead. On average 53 individuals were counted per day. More than 150 individuals were counted on three of the 35 observation days. Observers counted the largest number of migrants on October 12 with 224 raptors, 79 of them golden eagles and 68 red-tailed hawks. Most accipiters, buteos, and falcons were counted during September except for rough-legged hawks, which were not observed until October 12. Swainson's hawks migrated earlier than most other raptors and none were observed after September 29. We observed fewer Swainson's hawks during 2011 (357) than during the previous year (526) despite the increase in effort. This may be a result of the change in observation location, however Swainson's hawks are known to be highly variable from year to year.

Although most red-tailed hawks were observed during September, some were still moving through in October. By September 30 most falcons had migrated through Hayden Valley. American kestrels were the most abundant of the four falcon species observed. Although Merlins are not documented as Yellowstone breeders observers counted 13 during the count period. Low numbers of Golden and bald eagles were observed during September, but both increased during October particularly golden eagles. Observers documented 241 golden eagles and 226 of them were observed during October. Northern harriers, turkey vultures, and ospreys were observed in low numbers during September and October.

Species	Immature:Adult Ratio
Sharp-shinned Hawk (n = 21)	1.33
Red-tailed Hawk (n = 377)	0.58
Golden Eagle (n = 116)*	1.64
Bald Eagle (n = 86)*	0.51

* includes juveniles and subadults

Table 10. Immature to adult ratio for select migrating species.

Age and sex classes may differ in timing of migration. For most raptors the sexes are indistinguishable, but adults and juveniles are often distinguishable if observed at close enough range to determine plumage characteristics. For those species where there were more than 20 observations of adult and immature birds combined we calculated immature to adult ratios. Over time this index will help us to understand migration patterns in a more detailed way. For example, age ratios may be used to assess annual reproductive success and changes in migratory behavior (e.g. short-stopping). Changes in age ratios were used to document the decline in reproductive success in raptors as a result of DDT (McCarty and Bildstein, 2005). Both sharp-shinned hawks and golden eagles showed a greater number of immatures than adults while a greater number of adults versus immature red-tailed hawks and bald eagles were observed migrating (Table 10). We observed slightly more adult versus juvenile red-tails migrating in September (127 adults versus 104 juveniles) and significantly more during October (111 adults versus 35 juveniles). Standard observations did not begin until September 13, but prior to this large numbers of juvenile red-tailed, Swainson's, and several ferruginous hawks were observed foraging in Hayden Valley. Many of these individuals were juveniles probably dispersing from their natal territories. We speculate that this area may be an important foraging site for juveniles (and adults) as they prepare for migration.

Partnerships

Joel Pagel, Ph.D, of the US Fish and Wildlife Service, once again headed up the nest-entry program and provided valuable assistance and input on the Raptor Initiative. Pagel's involvement dates back to 2009 when he assisted with peregrine falcon nest monitoring, which he continued this year, as well as helping design critical aspects of the Raptor Initiative–especially with advice on golden eagles. He also was an observer for the fall migration through Hayden Valley.

Charles Preston of the Draper Museum in Cody, Wyoming, provided valuable input about raptors and conducted a monitoring flight in May searching for red-tailed hawks and golden eagles. Preston heads up a golden eagle and red-tailed monitoring program east of YNP in the Bighorn Basin and his involvement with YNP will help coordinate efforts between the two programs.

Jack Kirkley, Ph.D., of the University of Montana–Western, partnered with the YRI to survey for Swainson's hawks in Hayden Valley and the Yellowstone Lake area. In August, Kirkley reported large groups of juvenile red-tailed hawks in Hayden Valley, a juvenile ferruginous hawk, and an active Swainson's hawk nest. Kirkley identified 13 potential Swainson's hawk territories, several potential red-tailed hawk territories, and made multiple observations of bald eagles and peregrine falcons. Yellowstone Park Foundation (YPF) funding provided trailer rental space as well as reimbursement for travel expenses during his seven-day stay in August 2011.

Public Outreach

For the second year, Interpretive Ranger Katy Duffy led a hawk ecology and identification program September 10 that involved more than 60

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Drs. Joel Pagel and Charles Preston assisted Yellowstone staff with golden eagle monitoring.

people. Visitors met at the Fishing Bridge Ranger Museum to learn raptor ecology and identification using mounts of raptors. The talk was followed by a field trip to Hayden Valley where Duffy pointed out migrating raptors and discussed identification tips and the ecology behind migration. This program has helped raise awareness of raptors in YNP while contributing to the larger goal of increased knowledge regarding these species.

On October 27, a group of 20 biology majors from Northwestern College joined our hawk migration effort in Hayden Valley. The students learned the art of identifying migrating raptors and the utility of such knowledge. Although a cold day, students actively pointed out raptors and identified them to species with the help of YRI staff. During the visit we observed 55 raptors, including 15 golden eagles, 9 bald eagles, and 24 rough-legged hawks. It is our objective to increase opportunities such as these for the public.

2011 Noteworthy Birds

Several reports of pileated woodpeckers along the Beaver Ponds Trail were reported for the third year in a row. A second pileated woodpecker sighting was made in late July near the Yellowstone Lake area. In the Rocky Mountains, pileated woodpeckers generally occur in northern Idaho and northwest Montana, but may possibly be undergoing range expansion. Reports and photos were submitted from the field of a young black-crowned night heron in the Lamar Valley along Soda Butte Creek. This species is not commonly seen in the park although it breeds in nearby counties. A vagrant blue jay was observed in the upper Mammoth employee housing area in early August. A parasitic jaeger was reported chasing gulls over Mary Bay in July; however, due to the late submission of the report, this could not be verified. The observer reported more than 15 years' experience viewing this species. A black tern was also reported near Blacktail Ponds in July. A wild turkey was photographed and reported near the Northeast Entrance ranger station. A varied thrush was observed near the Terrace Grill in Mammoth in late December and stayed at least a month. A lark sparrow was observed in the Upper Geyser Basin in late May.

Lastly, observations of turkey vultures appear to be increasing throughout the park, particularly in the Firehole River drainage. In previous years turkey vultures were observed in the spring and only rarely during the summer. However, over the last few years, this species has been observed frequently during summer months and is potentially breeding in YNP. Staff will attempt to confirm breeding of this species during 2012.

2011 Conferences Attended

- Raptors Research Foundation Annual Conference in Duluth, MN. October 2011.
- 22nd Trumpeter Swan Society Conference in Polson, MT. October 2011.

Acknowledgments

We would like to thank Katy Duffy for many hours volunteering with peregrine falcon and osprey monitoring; Amy Marie Hammesfahr for helping with common loon monitoring; Bill Long and Drew Reed from the Wyoming Wetlands Society for their expertise and help in installing the swan nesting platform; pilots Steve Ard and Roger Stradley for safely piloting numerous flights for eagles, swans, and loons; and all visitors and staff who submitted bird sightings. We appreciate interest in the birds of Yellowstone and welcome input and volunteer efforts to help with monitoring birds across the park and throughout the region.

The Wyoming Wetlands Society shared expertise and elbow grease to install the swan nesting platform.

Male common yellowthroat, ***Geothlypis trichas.***

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Appendix A. Spring Arrival Dates

Spring arrival dates for common species in the Mammoth-Gardiner area (2005-2011).

Species	2005	2006	2007	2008	2009	2010	2011+	Mean
Osprey		6 Apr		8 Apr	19 Apr	12 Apr	7 Apr	10 Apr
Red-tailed hawk		4 Apr	23 Mar	3 Apr		20 Mar *	18 Mar	26 Mar
American kestrel		4 Apr	12 Apr	14 Apr	30 Apr	17 Apr	18 Apr	16 Apr
Sandhill crane		4 Apr		13 Apr				8 Apr
Killdeer		2 Apr						2 Apr
Belted kingfisher			2 Mar		17 Apr			25 Mar
Violet-green swallow		14 May	13 May					14 May
Tree swallow		28 Apr	8 Apr	13 Apr	2 May	24 Apr	11 May	24 Apr
Ruby-crowned kinglet		28 Apr	29 Apr	21 Apr	3 May	17 Apr	10 May	28 Apr
Mountain bluebird	8 Mar	4 Mar	18 Mar	29 Mar	12 Mar	25 Mar	17 Mar	14 Mar
American robin	20 Mar	14 Apr	17 Mar	28 Mar	21 Mar	18 Mar	25 Mar	25 Mar
Swainson's thrush				12 May		22 May		17 May
Gray catbird						29 May		29 May
Yellow warbler	18 May	12 May	13 May	19 May	17 May	18 May	21 May	17 May
Yellow-rumped warbler		28 Apr	29 Apr	20 Apr	9 May	17 Apr		27 Apr
Wilson's warbler						29 May		29 May
Vesper sparrow		3 May	13 May	4 May	6 May	7 May		7 May
White-crowned sparrow				1 May	1 May	7 May		3 May
Song sparrow		20 Apr	24 Mar			27 Apr		13 Apr
Western meadowlark		3 Apr	5 Apr	14 Apr	8 Apr	1 Apr		6 Apr
Lazuli bunting						22 May		22 May
Red-winged blackbird	10 Mar	16 Mar	18 Mar	8 Apr	17 Mar	29 Mar	21 Mar	21 Mar
Peregrine falcon							3 Mar	3 Mar
Horned lark							3 Mar	3 Mar
Prairie falcon							18 Mar	18 Mar
Swainson's hawk							29 Mar	29 Mar
Great blue heron							26 Mar	26 Mar

*Indicates estimated arrival from Paradise Valley (24 March) and Phantom Lake, YNP (17 March).
+Note that 2011 observations were collected by multiple observers.

Appendix B. Raptor Nesting Terminology

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.

Nest Success — the percentage of active nests in a monitoring region in which one or more young fledges successfully. Young that reach 28 days of age for peregrines and 80% of fledging age for eagles are expected to fledge and therefore considered successful nests.

Productivity — the total number of young fledged per nesting female.

Brood Size — the average number of young fledged per successful nest.

Active Nest — a nest in which eggs have been laid. This definition is more restrictive than occupied nest and is only used if sufficient observations were made early in the breeding season to definitively determine this.

Occupied Nest — any nest for which at least one of the following activities were observed:

- eggs were laid
- young were raised
- adult incubation posture (i.e. sitting low in nest)
- two adults present on or near the nest
- one adult bird and one in immature plumage at or near the nest if mating behavior was observed near there earlier in the season
- a recently repaired nest with fresh sticks, fresh greenery, fresh droppings on the rim of the nest or directly below it, and/or shed feathers.

Frustration Nest — following a nesting failure adults may build a new nest that is generally unused that season, primarily because the nesting season is advanced. This is particularly common in ospreys.

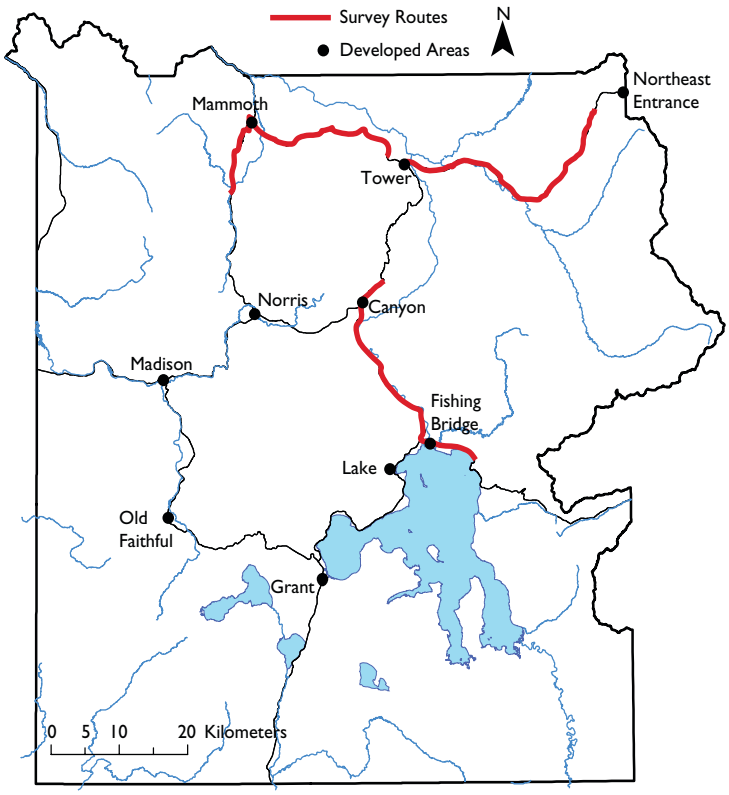
Alternate Nest — one of several nest structures or scrapes within a single breeding territory.

Occupied Territory — a territory where either a mated pair of birds is present, or a single bird that exhibits territorial display or other reproductive-related activity. A territory is also considered occupied 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)]. Fresh nesting material added to a nest structure may also indicate occupancy, but care must to 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.

Breeding Territory — an area that contains, or that was previously known to contain, one or more nests or eyries within the territorial range of a mated pair of birds. Often breeding areas contain multiple nests or eyries.

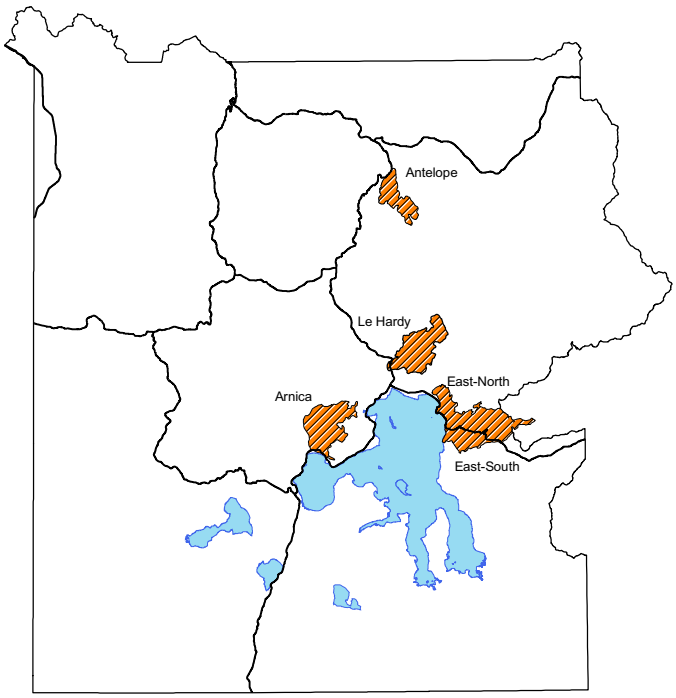
Unoccupied Breeding Territory — a nest or group of alternate nests at which none of the activity patterns diagnostic of an occupied nest were observed.

Appendix C. Survey Maps



2011 Breeding Bird Survey Routes.

Forest Burn Point-Count Survey Locations, 2011



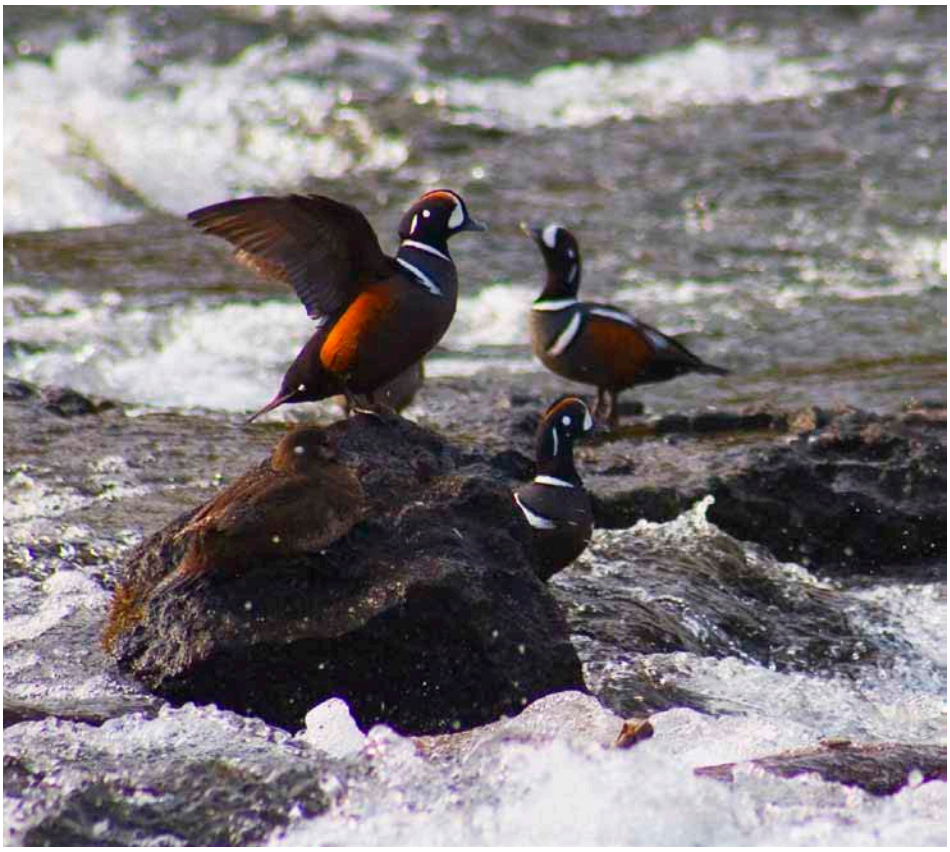
Appendix D. 2011 Birds Observed

Common name	*Latin Name*
Canada goose	*Branta canadensis*
Cackling goose	*Branta hutchinsonii*
Trumpeter swan	*Cygnus buccinator*
Wood duck	*Aix sponsa*
Gadwall	*Anas strepera*
American wigeon	*Anas americana*
Mallard	*Anas platyrhynchos*
Blue-winged teal	*Anas discors*
Cinnamon teal	*Anas cyanoptera*
Northern shoveler	*Anas clypeata*
Northern pintail	*Anas acuta*
Green-winged teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Greater scaup	*Aythya marila*
Lesser scaup	*Aythya affinis*
Harlequin duck	*Histrionicus histrionicus*
Bufflehead	*Bucephala albeola*
Barrow's goldeneye	*Bucephala islandica*
Hooded merganser	*Lophodytes cucullatus*
Common merganser	*Mergus merganser*
Ruddy duck	*Oxyura jamaicensis*
Gray partridge	*Perdix perdix*
Ruffed grouse	*Bonasa umbellus*
Dusky grouse	*Dendragapus obscurus*
Wild turkey	*Meleagris gallopavo*
Common loon	*Gavia immer*
Pied-billed grebe	*Podilymbus podiceps*
Red-necked grebe	*Podiceps grisegena*
Eared grebe	*Podiceps nigricollis*
Western grebe	*Aechmophorus occidentalis*
Clark's grebe	*Aechmophorus clarkii*
American white pelican	*Pelecanus erythrorhynchos*
Double-crested cormorant	*Phalacrocorax auritus*
American bittern	*Botaurus lentiginosus*
Great blue heron	*Ardea herodias*
Great egret	*Ardea alba*
Black-capped night heron	*Nycticorax nycticorax*
White-faced ibis	*Plegadis chihi*
Turkey vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Bald eagle	*Haliaeetus leucocephalus*
Northern harrier	*Circus cyaneus*

Common name	*Latin Name*
Sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperii*
Northern goshawk	*Accipiter gentilis*
Broad-winged hawk	*Buteo platypterus*
Swainson's hawk	*Buteo swainsoni*
Red-tailed hawk	*Buteo jamaicensis*
Ferruginous hawk	*Buteo regalis*
Rough-legged hawk	*Buteo lagopus*
Golden eagle	*Aquila chrysaetos*
American kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine falcon	*Falco peregrinus*
Prairie falcon	*Falco mexicanus*
Virginia rail	*Rallus limicola*
Sora	*Porzana carolina*
American coot	*Fulica americana*
Sandhill crane	*Grus canadensis*
Killdeer	*Charadrius vociferus*
American avocet	*Recurvirostra americana*
Spotted sandpiper	*Actitis macularia*
Wilson's snipe	*Gallinago delicata*
Wilson's phalarope	*Phalaropus tricolor*
Red-necked phalarope	*Phalaropus lobatus*
Franklin's gull	*Larus pipixcan*
California gull	*Larus californicus*
Caspian tern	*Sterna caspia*
Black tern	*Chlidonias niger*
Rock pigeon	*Columba livia*
Mourning dove	*Zenaida macroura*
Great horned owl	*Bubo virginianus*
Northern pygmy-owl	*Glaucidium gnoma*
Great gray owl	*Strix nebulosa*
Boreal owl	*Aegolius funereus*
Northern saw-whet owl	*Aegolius acadicus*
Short-eared owl	*Asio flammeus*
Long-eared owl	*Asio otus*
Common nighthawk	*Chordeiles minor*
White-throated swift	*Aeronautes saxatalis*
Rufous hummingbird	*Selasphorus rufus*
Belted kingfisher	*Ceryle alcyon*
Williamson's sapsucker	*Sphyrapicus thyroideus*
Red-naped sapsucker	*Sphyrapicus nuchalis*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*

Common name	*Latin Name*
American 3-toed woodpecker	*Picoides dorsalis*
Black-backed woodpecker	*Picoides arcticus*
Northern flicker	*Colaptes auratus*
Pileated woodpecker	*Dryocopus pileatus*
Olive-sided flycatcher	*Contopus cooperi*
Western wood-pewee	*Contopus sordidulus*
Willow flycatcher	*Empidonax traillii*
Hammond's flycatcher	*Empidonax hammondii*
Dusky flycatcher	*Empidonax oberholseri*
Eastern kingbird	*Tyrannus tyrannus*
Northern shrike	*Lanius excubitor*
Warbling vireo	*Vireo gilvus*
Blue jay	*Cyanocitta cristata*
Gray jay	*Perisoreus canadensis*
Steller's jay	*Cyanocitta stelleri*
Pinyon jay	*Gymnorhinus cyanocephalus*
Clark's nutcracker	*Nucifraga columbiana*
Black-billed magpie	*Pica hudsonia*
American crow	*Corvus brachyrhynchos*
Common raven	*Corvus corax*
Horned lark	*Eremophila alpestris*
Tree swallow	*Tachycineta bicolor*
Violet-green swallow	*Tachycineta thalassina*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bank swallow	*Riparia riparia*
Cliff swallow	*Petrochelidon pyrrhonota*
Barn swallow	*Hirundo rustica*
Black-capped chickadee	*Poecile atricapillus*
Mountain chickadee	*Poecile gambeli*
Red-breasted nuthatch	*Sitta canadensis*
White-breasted nuthatch	*Sitta carolinensis*
Brown creeper	*Certhia americana*
Rock wren	*Salpinctes obsoletus*
House wren	*Troglodytes aedon*
American dipper	*Cinclus mexicanus*
Golden-crowned kinglet	*Regulus satrapa*
Ruby-crowned kinglet	*Regulus calendula*
Mountain bluebird	*Sialia currucoides*
Townsend's solitaire	*Myadestes townsendi*
Swainson's thrush	*Catharus ustulatus*
Hermit thrush	*Catharus guttatus*
Varied thrush	*Ixoreus naevius*
American robin	*Turdus migratorius*
Gray catbird	*Dumetella carolinensis*

Common name	*Latin Name*
Sage thrasher	*Orescoptes montanus*
European starling	*Sturnus vulgaris*
American pipit	*Anthus rubescens*
Bohemian waxwing	*Bombycilla garrulous*
Cedar waxwing	*Bombycilla cedrorum*
Orange-crowned warbler	*Vermivora celata*
Yellow warbler	*Dendroica petechia*
Magnolia warbler	*Dendroica magnolia*
Yellow-rumped warbler	*Dendroica coronata*
Black-and-white warbler	*Mniotilta varia*
MacGillivray's warbler	*Oporonis tolmiei*
Common yellowthroat	*Geothlypis trichas*
Wilson's warbler	*Wilsonia pusilla*
Western tanager	*Piranga ludoviciana*
Green-tailed towhee	*Pipilo chlorurus*
Spotted towhee	*Pipilo maculatus*
Chipping sparrow	*Spizella passerine*
Brewer's sparrow	*Spizella breweri*
Vesper sparrow	*Pooecetes gramineus*
Lark sparrow	*Chondestes grammacus*
Savannah sparrow	*Passerculus sandwichensis*
Fox sparrow	*Passerella iliaca*
Song sparrow	*Melospiza melodia*
Lincoln's sparrow	*Melospiza lincolnii*
Harris's sparrow	*Zonotrichia querula*
White-crowned sparrow	*Zonotrichia leucophrys*
Dark-eyed junco	*Junco hyemalis*
Snow bunting	*Plectrophenax nivalis*
Lazuli bunting	*Passerina amoena*
Red-winged blackbird	*Agelaius phoeniceus*
Western meadowlark	*Sturnella neglecta*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Brewer's blackbird	*Euphagus cyanocephalus*
Brown-headed cowbird	*Molothrus ater*
Gray-crowned rosy-finch	*Leucosticte tephrocotis*
Black rosy-finch	*Leucosticte atrata*
Common redpoll	*Carduelis flammea*
Pine grosbeak	*Pinicola enucleator*
Cassin's finch	*Carpodacus cassinii*
House finch	*Carpodacus mexicanus*
Red crossbill	*Loxia curvirostra*
White-winged crossbill	*Loxia leucoptera*
Pine siskin	*Carduelis pinus*
House sparrow	*Passer domesticus*



Yellowstone Bird Program 2011 Annual Report

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Yellowstone National Park, Wyoming
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