Yellowstone Bird Program 2009 Annual Report

Peregrine falcon with three young

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Executive Summary

From April–July of 2009, we monitored 23 peregrine falcon eyries for evidence of breeding. Nineteen territories were occupied by a breeding pair, 14 of which were successful fledging 28 young. Four nest sites failed and 1 was documented as unknown. The remaining 4 territories were unoccupied. Nest success, productivity, and brood size averaged 78%, 1.56, and 2, respectively. All three measures indicate an increasing population that may act as a source for repopulation of other areas. The 2009 monitoring effort represents a significant improvement over 2008 in large part due to visiting raptor ecologist Joel Pagel, volunteer Katy Duffy, and a second seasonal bird staff member. Continued monitoring of peregrines will be essential to maintain the long-term dataset, comply with post-delisting monitoring plans, and evaluate potential climate change effects on this sensitive species which serves as barometer for environmental contaminants and avian communities. Potential future research includes collecting eggshell fragments, addled eggs, and feather samples from nest sites for chemical contamination analysis—a renewed threat to continued peregrine recovery due to contaminants including DDT/DDE, PCBs, Dioxins, and polybrominated diphenly ethers (PBDEs).

Bald eagle surveys were conducted via fixed-wing aircraft. We found 15 occupied bald eagle nests, 40% of which successfully fledged a total of eight eaglets. While the overall bald eagle population remains relatively stable in Yellowstone National Park (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. In 2009, none of the nine nests in the Yellowstone Lake area fledged young while the six nests elsewhere in YNP were all successful. The 26-year average productivity of 0.68 is slightly below the 0.7 estimated to maintain a stable population. The low nest success in the Yellowstone Lake area significantly influences this measure.

Osprey surveys were conducted in conjunction with bald eagle surveys. We monitored 27 nests of which 48% successfully fledged a total of 28 young. 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, similar to bald eagles, none were successful. The 23-year average productivity for YNP is 0.78, significantly lower than the 0.95 minimum estimated productivity required to maintain a stable population. A study to examine the relationship between prey availability (i.e. fish) and osprey and bald eagle nest success between the lake trout influenced region of Yellowstone Lake and elsewhere in the park unaffected by lake trout predation of cutthroat trout is currently underway.

Trumpeter swans were monitored during the midwinter and autumn tri-state count in YNP, the Paradise Valley, and on Hebgen Lake. We counted 144 swans total during the midwinter survey, including 88 adults and two cygnets in Yellowstone. We counted 24 swans total during the autumn survey, including four adults and no cygnets in Yellowstone. We were unable to survey Riddle Lake, the Firehole, and Madison Rivers due to dense fog; however, since swans are closely monitored throughout the breeding season we are confident that a pair of swans present on Riddle Lake were not included in the count, and that swans were not present on the Firehole and Madison Rivers. During the breeding season we found two pairs of nesting swans, one on Grebe Lake and the other on Riddle Lake; however, both nests failed during the incubation stage for unknown reasons. Due to the low population and productivity in YNP all areas where swans currently nest or any area where a pair of swans is observed early in the breeding season that may indicate future nesting will be closed until August 15.

We surveyed colonial nesting birds on the Molly Islands, including 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 fledged 54 young, while double-crested cormorants fledged 30 young. However, nest initiation and success by Caspian terns and California gulls are decreasing on the islands, with neither species initiating nests during 2009. Common loons were surveyed at 11 historically occupied sites during late July and August. We counted 12 adults at six of the lakes surveyed and four loonlets at three of the lakes. The number of adults observed in YNP remains stable; however, nesting pairs and fledglings have decreased since 1987.

We surveyed three routes for the breeding bird survey, which is an international survey designed to index bird population trends over time. We observed 79 species and 1844 individual birds across the three routes during 2009. We also continued a three-year field study of willow-songbird relationships initiated by Montana State University to establish a long-term songbird dataset and fill a gap in the knowledge of songbird bird communities in the park.

We began new surveys in areas that had recently experienced forest fire. Given possible affects 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 3–5 years after a burn.

The YNP bird program participated in the first Bioblitz to occur in YNP which was held in August. Participants recorded 80 species across the survey region during the 24-hour event.

Finally, notable birds observed in YNP this year included a hooded warbler, Vaux's swift, Ross's goose, and white-winged dove—all of which were far outside of their normal range.

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Introduction

Over 300 species of bird have been observed in Yellowstone National Park (YNP) over the last 20 years, roughly half of those recorded as regular breeders. YNP is surprisingly rich in bird diversity given the harsh environmental conditions experienced here. The variation in elevation and broad array of habitat types found within YNP contributes to the region's relatively high diversity. The YNP bird program monitors a small portion of its breeding bird species with the broad goal of gathering information (e.g. reproduction, abundance, habitat use) on multiple species from a wide variety of avian taxonomic groups as well as to maintain long-term datasets (>20 years) for several species. Maintenance of long-term monitoring efforts will help inform us of any climate change effects on YNP's bird community and may guide future management decisions in mitigating the effects of climate change to conserve avian resources in the park. The bird program is 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 woodpecker monitoring program.

Bald eagle, peregrine falcon, and osprey are monitored by 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 monitoring obligations outlined in the US Fish and Wildlife Service (USFWS) post-delisting monitoring plans, per the Endangered Species Act.

The trumpeter swan, common loon, and colony nesting species, including the double-crested cormorant and American white pelican, are included in the wetland bird monitoring program. The trumpeter swan is of particular concern in YNP due to low population and reproductive success during the last several decades and is studied through collaborative efforts with Montana State University and Eastern Kentucky University to help establish causal factors for observed declines.

The breeding bird survey, willow-bird survey, and the newly added forest-burn survey are part of the passerine and woodpecker monitoring program. This program was recently expanded to fill the gap in knowledge regarding passerine and woodpecker abundance and habitat use in YNP since species in this group represent the majority of species found within YNP. This report summarizes data gathered for these programs during 2009.

2009 Breeding Season Weather

Average monthly temperatures from April through August were consistent with the 30-year average monthly temperatures (Figure 1). Monthly precipitation was also consistent with the 30-year average for most months except during April and June when precipitation was 118% and 143% greater than normal (Figure 2). Date of ice break-up on Yellowstone Lake occurred on May 27, a week earlier than during 2008, but was consistent with the 30-year average date of May 23. Maximum Yellowstone Lake water levels occurred on July 2, consistent with the 30-year average date of maximum water level of June 29.

Figure 1. Monthly temperatures for the Lake weather station during the core breeding season (April–August). Data provided by Snowcap Hydrology, Bozeman, Montana.

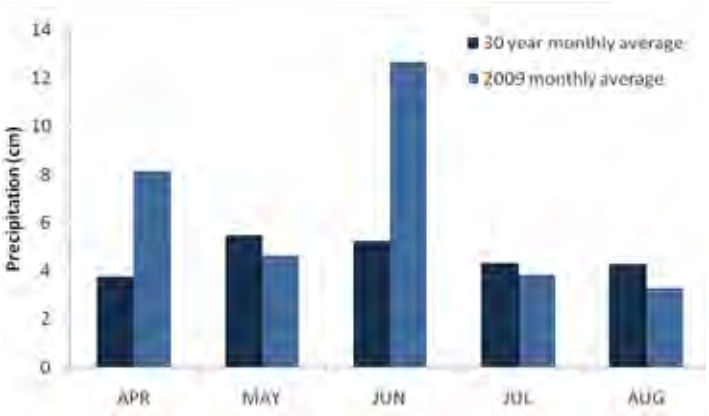

Figure 2. Monthly precipitation for the Lake weather station during the core breeding season (April–August). Data provided by Snowcap Hydrology, Bozeman, Montana.

Climate Change

Dramatic changes in global climate caused by anthropogenic activities during the last century is undisputable. Earth surface temperatures have increased above and beyond that expected under natural climate change. In the Rocky Mountain region warmer temperatures have led to reduced winter snowpack, increased winter precipitation falling as rain (Barnett et al, 2008), earlier (Stewart et al., 2005) and greater (Lins and Slack, 1999) peak stream flows, and changes in the phenology of flowering plants (Cayan et al, 2001). Within YNP however, it is largely unknown how climate change has affected 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 bioindicators of climate change because of their sensitivity and relatively rapid response to shifts in seasonal weather patterns. For example, climate change has been shown to influence migration patterns, population size and distribution, and the timing of reproduction and nest success (Crick, 2004). Furthermore, climate change is expected to increase the frequency and intensity of extreme climatic events that may lead to increases in outbreaks of avian disease vectors such as mosquitoes and viruses like West Nile Virus.

Of particular concern are alpine and wetland bird species since these habitat types are expected to diminish as temperatures increase. Approximately 30% of bird species that breed in YNP depend on wetland habitat. The trumpeter swan and common

loon are two wetland-dependant species that have experienced declines in population (swans) and reproduction in recent decades that may be attributed to climate change. While YNP has long-term reproduction information for several species, there is little data on nesting chronology, an important indicator of climate change and a component that will be added to future monitoring efforts. However, simply monitoring bird species for abundance, reproduction, and nesting chronology is insufficient for establishing if variation in those parameters is the result of climate change or other factors. Rigorous studies that establish cause and effect are necessary to reveal bird response to climate change in YNP.

Since 2005 Douglas W. Smith has tracked spring arrivals for 19 species in the Gardiner/Mammoth area to assess variation in migration that may be linked to climate change. These efforts represent observations of one person and will be expanded in future years but mean arrival date and first sighting are recorded in Appendix A.

Besides spring migration, changes during fall migration are also expected. Early October temperatures in 2009 were unseasonably cold (<20° F) during the songbird migration. A normal influx of Wilson's warbler's along with some orange-crowned and yellow-rumped warblers were caught and observed foraging amongst frozen and ice-covered vegetation which likely did not re-charge their body reserves for continuing migration. Whether this resulted in mortality is not known, but the cold was significant and surely reduced available food supplies, which may also be part of global climate change.

Raptor Monitoring Program

Visiting Raptor Ecologist

From May 1–17 and from July 2–6, we were privileged to have Joel "Jeep" Pagel, PhD. share his knowledge and expertise on peregrine falcon ecology and monitoring here in Yellowstone National Park. Jeep, a raptor ecologist, has over 25 years experience watching and handling peregrine falcons in the Pacific Northwest, California and Nevada and has numerous publications on conservation and management of endangered, threatened, and delisted bird species. He graduated with a M.S. in wildlife management at the University of Wisconsin–Stevens Point in 1988 and received a Ph.D. in 2006 at the University of California–Davis, where his focus was in endangered species recovery. He is currently a raptor ecologist for USFWS in the Carlsbad, CA office and a research affiliate for The Bird Group, University of California–Santa Cruz.

The peregrine falcon was removed from the Federal List of Endangered and Threatened Wildlife and Plants on August 25, 1999. Its recovery is credited to restrictions on organochlorine pesticides in the United States and Canada, and implementation of various management actions, including protection of habitat near nest sites, as well as the release of approximately 6,000 captive-reared falcons to augment the population. Subsequent to delisting, the USFWS drafted a monitoring plan to ensure the peregrine falcon maintains its recovered status (USFWS 2003). The goals of the post-delisting monitoring plan were to gather information on territory occupancy, nesting success, and productivity at three-year intervals from 2003 through 2015.

Since this year was an official monitoring year, the primary objective of Jeep's visit was to locate and document peregrine falcon nest ledges or eyries in YNP and to provide training to personnel for this and future monitoring efforts. During his time in YNP, Jeep spent numerous hours in the field alone and with NPS staff locating, observing, and documenting peregrine activity. In a concerted multi-agency effort, we were able to assess territory occupancy, nest success, and productivity at 23 locations, and completed rapid assessment surveys at several other cliffs this year; a marked improvement over the previous year.

We intend to continue this interagency alliance by developing future projects designed to assess not only nest site occupancy, reproductive success, and trends in nesting substrate, but also to contribute to the evaluation of the overall health of the peregrine population in our area of the Northern Rockies. Collecting, and analyzing eggshell thickness and contaminant levels are an important tool to accomplish this, and Jeep is exceptionally experienced in this kind of work. We look forward to cooperating on this and other projects in the future.

We would like to thank several people for making Jeep's visit possible. Dr. Mike Green, National Coordinator of the peregrine monitoring effort, USFWS Division of Migratory Birds Portland Office and Kevin Kritz, USFWS Division of Migratory Birds, Denver Office.

Peregrine Falcon

Recovery of the peregrine falcon from near extirpation west of the Mississippi River, to re-population throughout North America has been an endangered species success story. 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 five-year period. Since that time the number of nesting pairs has steadily increased from one pair in 1984 to 32 pairs in 2007. This resurgence has been associated with increased surveys, and also looking at smaller substrate (i.e. total cliff height). The number of peregrines fledged from active eyries has also risen, with 50 peregrines fledged from 30 eyries in 2006. Their high nest success (82%) and productivity (1.9) over the last 26 years indicate that YNP is a growing population and a source for which to re-populate other areas in Idaho, Montana and Wyoming, and, depending on dispersal distances, other western states and provinces. YNP can now be considered a stronghold for peregrines, and provide baseline information to compare against other U.S. populations due to the relatively pristine conditions offered in the park. Continued monitoring is essential, not only for comparisons with other populations, but also because peregrine falcons and other raptors have proven to be robust indicators of environmental change that provide insights to land managers and the public into how organochlorine contaminants and climate change influence YNP's resources.

Monitoring Peregrine Falcons

Since de-listing of the peregrine falcon in 1999, Wyoming Game and Fish (WG&F) has traditionally contacted YNP with a list of 10 randomly selected territories to monitor within park boundaries each year. Most years, effort was expanded to monitor all known territories and to locate new territories. Continuing to monitor as many territories as possible each year will increase the success in re-finding eyries during official, post-delisting monitoring years. Also, these data will contribute to YNP's long-term dataset for this sensitive and bellwether species. Data from each

official monitoring year has become part of the Rocky Mountain region's dataset and has been combined with regional and national data to determine trends in territory occupancy, nest success, and productivity. These data will inform USFWS management decisions regarding peregrine falcon recovery, and NPS management decisions over habitat protection and long term trends with avifauna in YNP.

During 2009 we monitored an additional 13 territories over the 10 required by WG&F and USFWS in Yellowstone for a total of 23 territories; one of which was monitored by the Montana Peregrine Institute. Observer effort totaled 360 hours of monitoring during the breeding season with an average of 16 observer hours spent per territory. Some nest sites required substantively more time due to access and 're-finding' difficulties. Future surveys may take less time due to staff becoming familiar with access routes and individual characteristics of each territory. The addition of a seasonal staff member, many volunteer hours by Katy Duffy (Old Faithful Interpretation), and visiting raptor ecologist, Joel Pagel Ph.D., made the success of this year's monitoring effort possible.

Peregrine Falcon Reproduction

Nineteen of the 23 monitored territories were occupied by a breeding pair (Table 1). Fourteen of these (78%) were successful, fledging a total of 28 young (Figure 3). For comparison, the 26-year average nest success is only slightly higher at 82%. Brood size averaged two young per successful nest and productivity averaged 1.56 young per nesting female during 2009 (Figure 4). The 26-year average brood size (2.32) and productivity (1.9) indicate a stable or increasing peregrine population for Yellowstone. One of the occupied territories was observed too late in the season to be sure of nesting status and was recorded as unknown. Four of the 23 monitored territories were considered unoccupied after at least two, four-hour visits where either a single adult or no falcons were observed.

Potential Future Peregrine Falcon Research

While organochlorines in peregrine falcon eggshell fragments and feather samples have significantly declined since restrictions were placed on use in the U.S. and Canada (USFWS, 2003), several studies reveal that compounds within the family of brominated flame retardants (BFRs), particularly polybrominated diphenly ethers (PBDEs) are emerging as new threats to peregrine falcons and other birds of prey (Law et al., 2003; Herzk et al., 2005; Vorkamp et al., 2005; Chen et al., 2008; Fernie et al., 2009). PBDEs, developed in the 1970s, have been used in electronic equipment, textiles, paints, carpets, clothing, and a host of other common products to minimize the risk of fire. These chemicals easily leached into the environment putting both wildlife and humans at risk (Alaee et al., 2003).

From 1986–2003 PBDE concentrations have increased threefold in peregrine falcon eggshells from Greenland (Vorkamp et al., 2005) and even higher concentrations were found in peregrine falcon eggs from the northeastern U.S. (Chen et al., 2008), and most recently at the highest recorded levels in any animal from peregrines in urban habitat in California (Park et al. 2009). Biologically significant PBDEs were also found in the eggshells of ospreys, golden eagles, merlins, and white-tailed sea eagles in Norway (Herzke et al., 2005). The current concentration of PBDEs in the tissues of birds of prey has been found to adversely affect their reproductive biology. An experimental study revealed that environmentally relevant PBDE concentrations in the tissues of American kestrels, a smaller endemic falcon species once ubiquitous in north America, caused reduced and inappropriately timed copulation events, poorer egg quality, lower fertility, and reduced fledging success (Fernie et al., 2009).

Although there is growing evidence that PBDEs have accumulated in the tissues of peregrine falcons and other birds of prey and that this could adversely affect reproductive success and long

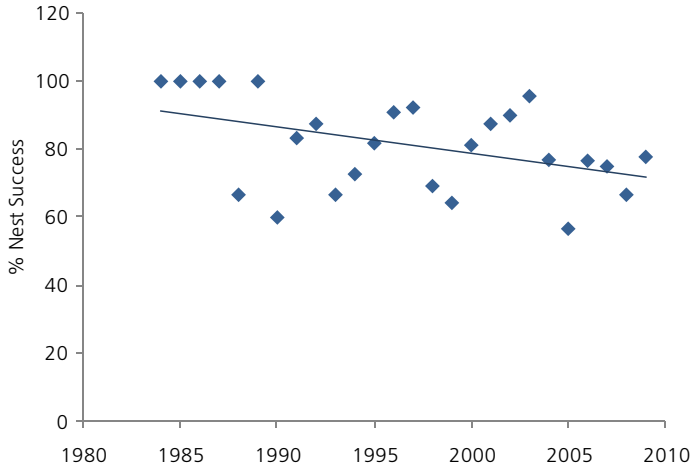

Figure 3. Peregrine falcon nest success in YNP during 1984 to 2009.

Figure 4. Peregrine falcon productivity and brood size in YNP during 1984 to 2009.

Occupied Territories	**19(8)**
Successful	14 (6)
Failed	4 (2)
Unknown	1 (0)
Young Fledged	28 (14)
Unoccupied Territories	**4 (2)**
Total Territories Monitored	**23 (10)**

Table 1. Summary of peregrine falcon monitoring results during the 2009 nesting season. Numbers read: total eyries monitored (WG&F randomly selected eyries).

Mated pair of bald eagles near the Mammoth area.

Aerial view of a bald eagle nest with eaglets.

term population resurgence, few studies of chemical contamination for North American peregrines exist, despite the fact that the U.S. is the world's largest producer and consumer of PBDE laden products (Alaee et al., 2003). YNP's peregrine population is an ideal candidate for obtaining baseline measures of PBDE concentrations to compare to other populations now and in the future because of its protected area status and long history of population monitoring. It is the mandate of the USFWS to identify potential and existing threats to peregrine falcons during the 15-year post-delisting assessment period and information collected from eggshell fragments and addled eggs in YNP could yield important information that may affect recovery and management plans. While we do not currently collect eggshell fragments and addled eggs in YNP for chemical analysis, we hope to add this important non-invasive component to YNP's peregrine falcon monitoring effort in the future.

Bald Eagle

Bald Eagle Monitoring

Bald eagle nests were located and monitored via fixed wing aircraft from April through July of 2009. Each of the five flights averaged approximately 4–5 hours; however, flight time was also devoted to osprey, trumpeter swan, and common loon monitoring. We monitored 15 bald eagle nests, 6 more nests than in 2008. Two of the nests observed in 2008 blew down during the winter prior to monitoring; however, despite extensive searching new nests in these areas were not found.

Bald Eagle Reproduction

Nest success averaged 40% parkwide, lower than the 60% nest success observed in 2008; however, 40% is within the range of natural variation observed for YNP (Figure 5). Average productivity was 0.53 young per nesting female and brood size was 1.33 young per successful nest (Figure 6). The 26-year average productivity and brood size is 0.68 and 1.42 respectively. Bald eagle populations are considered growing when productivity is at or above 1 and are stable at a productivity of at least 0.7 (Swenson et al., 1986). The 26-year average productivity of 0.68 is slightly lower than expected for a stable and healthy population. The harsh environment of YNP, especially during the early breeding season from February through April may account for low productivity here. Lower elevation nest sites may be sources from which YNP is populated. An alternative hypothesis is that declining cutthroat trout in Yellowstone Lake caused by non-native lake trout predation is partially responsible for declining bald eagle nest success and productivity for those birds nesting within the area influenced by lake trout. Nest success and productivity has declined on Yellowstone Lake since 1987 (Baril and Smith, 2008) and in 2009 all nine of the nests occurring on Yellowstone Lake failed; however, the remaining six nests occurring elsewhere in the park were successful.

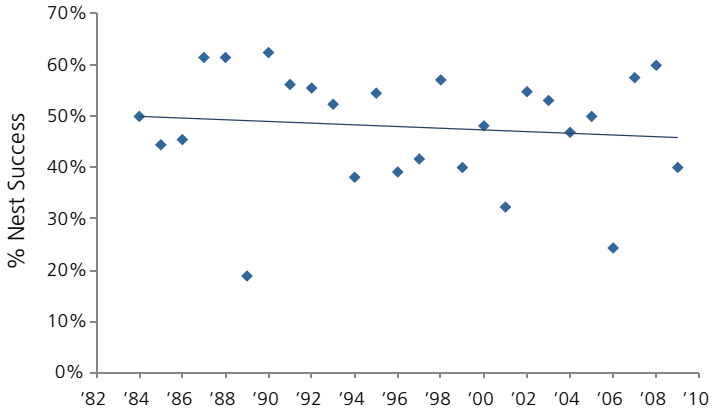

Figure 5. Bald eagle nest success in YNP during 1984 to 2009.

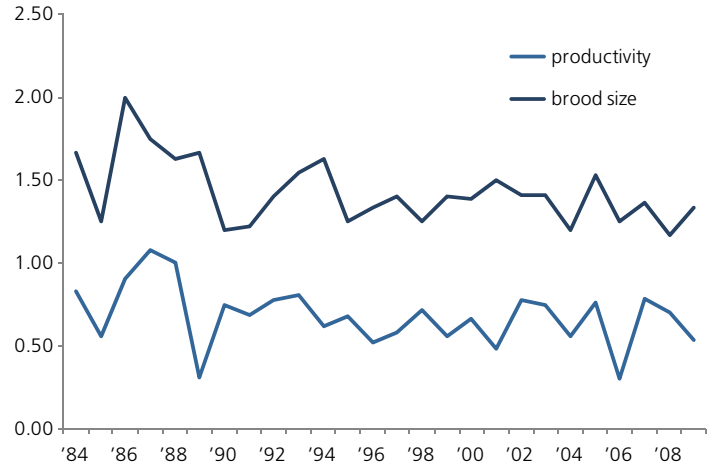

Figure 6. Bald eagle productivity and brood size in YNP during 1984 to 2009.

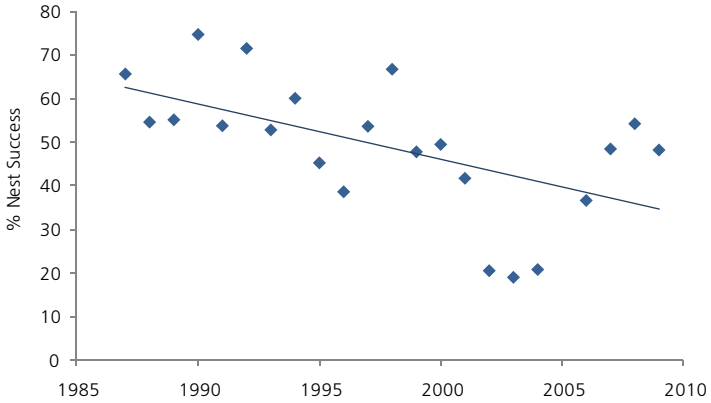

Figure 7. Osprey nest success in YNP during 1987 to 2009.

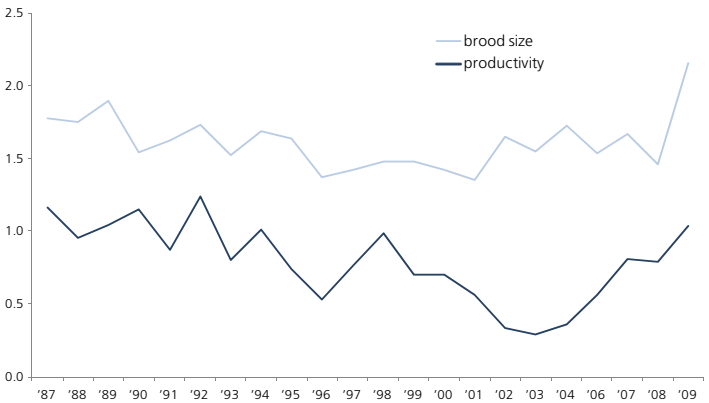

Figure 8. Osprey productivity and brood size in YNP during 1987 to 2009.

Osprey

Osprey Monitoring

We monitored 27 osprey nests in 2009 from mid-May through mid-August, three more nests than in 2008. With one exception, all nests active in 2008 were active this year also. Most osprey nests were monitored via fixed wing aircraft from May through August. Each of the four flights averaged approximately 4–5 hours; however, flight time was also devoted to bald eagle, trumpeter swan, and common loon monitoring. The remaining nests were ground checked due difficulty in observations from the plane.

Osprey Reproduction

Osprey nest success averaged 48% parkwide in 2009. The 23-year average nest success is 50%, slightly higher than this year's average, although overall nest success has declined significantly (Baril and Smith 2008). The lowest nest success observed parkwide occurred in 2003 with only 19% success but nest success has increased in recent years (Figure 7). Productivity and brood size averaged 1.04 and 2.15 respectively (Figure 8). By contrast, the 23-year average brood size and productivity was 1.56 and 0.78 respectively. Osprey productivity between 0.95–1.30 is representative of a stable population (Swenson, 1979); however, YNP's 23-year average is slightly below this threshold which would suggest population stability. YNP's harsh climate may limit productivity though other factors, such as the declining cutthroat trout population, may also play a significant role. This year only four pairs of osprey nested on Yellowstone Lake and none were successful. This represents not only a decline in reproductive measures for birds nesting on Yellowstone Lake, but also for nest attempts on the Lake.

Osprey and Bald Eagle Research

Previous analyses have shown that the osprey population in YNP has significantly decreased in all reproductive measures since 1987 (Baril and Smith, 2008). However, these declines have been more acute for ospreys nesting on Yellowstone Lake compared to elsewhere in YNP since 2003. This could be due to the availability of suitable sized fish available to osprey. We have also shown that while bald eagle nest success, productivity and brood size remain stable parkwide, the Yellowstone Lake population has declined significantly in both nest success and productivity since 1987 (Baril and Smith, 2008). Reductions in the abundance of native cutthroat trout in Yellowstone Lake due to non-native lake trout predation have likely contributed to decreases in osprey and bald eagle reproduction parameters. We are testing this hypothesis using historical visitor angler report cards and osprey and bald eagle reproductive measures. Results of this study will be submitted to a relevant peer reviewed journal for publication in the spring of 2010. This is a collaborative research effort between YNP's bird and fisheries programs.

Other Raptors

Other raptor species in YNP are not as intensively monitored, mostly because they are common and/or our capability to inventory and monitor them is limited. Casual observations of common raptors such as golden eagles and red-tailed hawks indicate that their populations are probably stable. A USFWS golden eagle monitoring flight occurred over the park this summer and saw no eagles compared to lower elevation areas where eagles are more abundant. Although it is hard to make conclusions from one overflight across the park (from the east entrance to West Yellowstone), it probably indicates that golden eagle density in YNP is low. Red-tailed hawk nests that are opportunistically monitored have produced young the last few years.

Other raptors that were frequently sighted were Swainson's hawk, northern harrier, sharp-shinned hawk, prairie falcon, kestrel and late each year after they migrate in from the north rough-legged hawks. Considered a rare sighting but also observed in 2009 were merlin, Cooper's hawk, northern goshawk, ferruginous hawk, and turkey vulture. Owl species recorded in 2009 were great horned owl, great gray owl, long-eared owl, boreal owl, northern saw-whet owl, and northern pgmy-owl.

Most of the species listed here represent the spectrum from very common to rare and little is known about actual population size or trend. Such a diverse raptor community is worthy of more investigation.

Wetland Bird Monitoring Program

Trumpeter Swans

Trumpeter swans in the United States are divided into Interior, Pacific, and Rocky Mountain populations. The Rocky Mountain population extends from western Canada, south to Wyoming and Nevada (U.S. Fish and Wildlife Service (USFWS) 2007). Swans in YNP are part of the tri-state subpopulation located within the Rocky Mountain population in the area surrounding the junction of Idaho, Montana, and Wyoming (Figure 9). Once considered an imperiled species, the trumpeter swan population in North America is healthy, and is increasing at a regional scale in the Rocky Mountains. The tri-state sub-population also remains stable; however, the YNP portion of the sub-population is declining. Reasons for declines in YNP are unclear, but it is speculated that wetland loss as a result of extended drought, reduced immigration, competition with wintering migrants, and predation are contributing factors (Proffitt 2008).

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 interagency effort coordinated by the 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, while Hebgen Lake was added to the autumn and midwinter count in 2005 and 2000. Data for previous autumn counts on Hebgen Lake could not be located. In addition, YNP has conducted biweekly 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, nest success (nests hatching young) as opposed to fledging success (cygnets surviving until September) which is accomplished via the autumn surveys.

Year	Hebgen Lake		Paradise Valley		YNP	
	Adults	Cygnets	Adults	Cygnets	Adults	Cygnets
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

Table 2. Results of the midwinter aerial surveys for trumpeter swans in YNP, the Paradise Valley, and on Hebgen Lake.

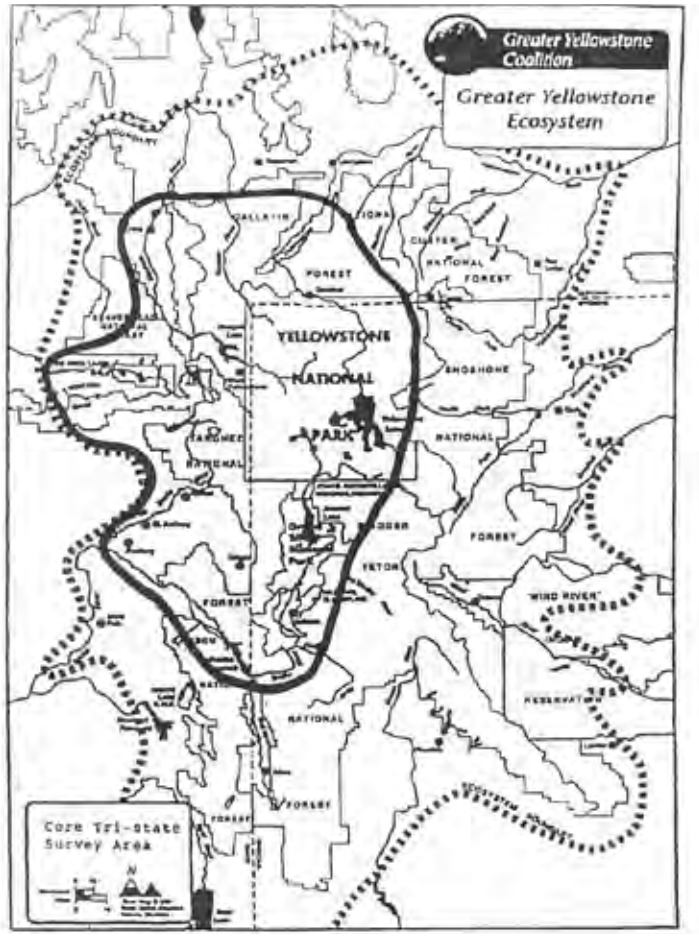

Figure 9. Map showing the core tri-state area trumpeter swan population in southeast Idaho, northwest Wyoming, and southwest Montana within the Rocky Mountain population (provided by the Greater Yellowstone Coalition, Bozeman, Montana).

Monitoring Trumpeter Swans

Trumpeter swans were monitored in 2009 via fixed wing aircraft on February 3 and September 15 as part of the tri-state midwinter and autumn surveys. Each flight was between 5.5 and 6 hours long. All areas of YNP, the Paradise Valley, and Hebgen Lake were surveyed during each flight. Swan locations were obtained with a geographic 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 and osprey. Information gathered during flights was supplemented with ground observations. Nests were monitored until fledging or failure.

Winter Count of Trumpeter Swans

One observer counted a total of 144 swans (130 adults and 14 cygnets) in YNP, the Paradise Valley, and on Hebgen Lake during the aerial midwinter swan survey on February 3, 2009 (Table 2). Overall, this was the lowest number of swans counted in the YNP area since 2000 and represents a 73 % decrease in the nine-year average swan count (excluding 2001; Figure 10). The average total number of swans counted over the last nine years was 525 (excluding 2001).

YNP swans accounted for 62% of all swans observed during the survey, a 25% increase from 2008. Hebgen Lake swans accounted for only 3% of the total, while the remaining 35% were

Trumpeter swans fly over the Yellowstone river, near Fishing Bridge.

counted in the Paradise Valley. These three areas are in close proximity and likely represent a single wintering population. As winter progresses and ice-free lakes and rivers in YNP diminish, swans likely move from higher elevation sites in Yellowstone to lower elevation sites in Paradise Valley and Hebgen Lake. Thus, the number of swans observed in YNP is highly dependant on year-to-year variations in winter weather conditions.

Trumpeter Swan Reproduction

During the 2009 breeding season, and for the third year in a row, only two nest attempts were made in YNP. Both nest attempts failed during the incubation stage for unknown causes, thus no cygnets were produced this year. During April and May a single adult swan was observed moving between Floating Island Lake and Trumpeter Lakes, but was not seen thereafter. A pair of adult swans was observed moving between Beula Lake, Tern Lake, and the wetlands between Delusion Lake and Flat Mountain Arm (all historic nesting locations) several times throughout the breeding season; however, the pair did not attempt to breed. Trumpeter swans often establish pair bonds several years prior to breeding and this pair may attempt to breed in the future once a suitable territory has been selected.

Overall nest attempts in YNP have declined since 1987, ranging from 2–10 per year; however, since 2001 nest attempts have not exceeded 4 per year. The number of successful nests since 1987 has ranged from 0–5, with an average of 1.8 successful nests per year. The majority (53%) of nest attempts failing to hatch young in recent decades has been attributed to early season flooding and egg predation (Proffitt, 2008).

Autumn Trumpeter Swan Count

The annual autumn trumpeter swan count was conducted on September, 15 via fixed-wing aircraft. The survey area included the Paradise Valley, YNP, and Hebgen Lake. We counted 24 (17 adults and 7 cygnets) swans in the survey area (Table 3). The majority of swans were counted in the Paradise Valley and no swans were counted on Hebgen Lake. In YNP we counted 4 swans, 1 pair on Cascade Lake and the second on Beula Lake; however, areas of dense fog prevented surveying Riddle Lake, the Firehole River, and portions of the Madison River. Because swan locations are monitored throughout the breeding season, we are confident that we missed 2 adult swans that attempted a nest on Riddle Lake and that swans were not present along the Firehole and portions of the Madison Rivers that we were unable to survey. The trumpeter swan count in YNP was similar to 2008 and represents the lowest swan count since surveys began in 1931 (Figure 11).

Location	Adults	Cygnets
Paradise Valley	13	7
Yellowstone NP	4	0
Hebgen Lake Area	0	0
Total	**17**	**7**

Table 3. Autumn 2009 survey results for trumpeter swans in YNP, Paradise Valley, and on Hebgen Lake in Montana.

Trumpeter Swan Management

Trumpeter swans are particularly sensitive to human disturbance. Given the low population and reproductive success observed in YNP in recent years all measures to protect nesting areas and occupied territories (potential nesting locations occupied by a pair of swans) will be made. The Riddle Lake nesting area is part of a bear management area (BMA) closed from April 30–July 14. We recommend extending the closure to August 15 for any off-trail access to the lake (i.e. visitors would be able to access the lake via the trail, but not walk around it). The BMA closure would allow cygnets to reach approximately 30 days old

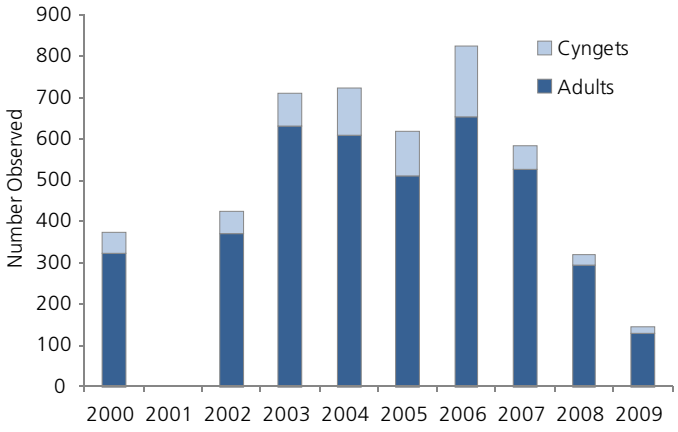

Figure 10. Summary of the total numbers of adult and cygnet trumpeter swans observed during midwinter, aerial, surveys in YNP, the Paradise Valley, and on Hebgen Lake during 2000-2009. Data from 2001 was censored because Hebgen Lake was not surveyed that year.

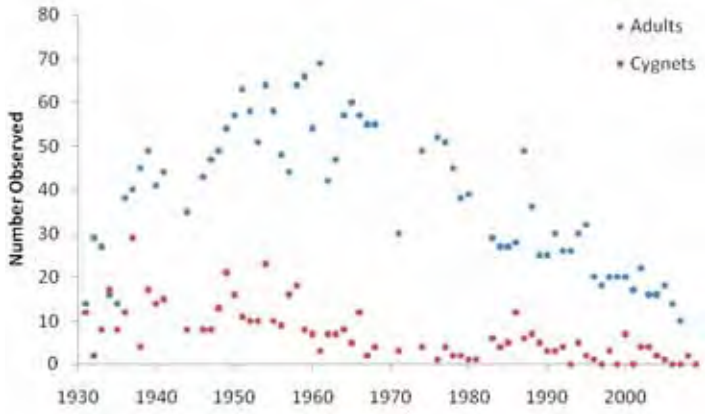

Figure 11. Autumn counts of trumpeter swans in YNP during 1931-2009.

in the absence of human disturbance, while the extension of the closure would limit human disturbance while cygnets continue to mature. The Grebe Lake nesting complex includes Grebe, Cascade, Wolf, and Ice Lakes. In recent years a pair of swans has nested on Grebe Lake. To protect nesting swans in this the complex the lake that swans initiate a nest on will be closed to the public (including trail access) from May 1–August 15. A 100 meter buffer area surrounding the lakes will ensure swans will not be disturbed by human foot traffic. The Tern Lake nesting complex, a historically productive site, is located within the Mirror Plateau BMA and is closed to overnight camping, but is open to day use from May 15 through November 10. The closure should be extended for the area surrounding Tern Lake if swans are observed utilizing the area at any time during the breeding season (April through August) to eliminate human disturbance. All other areas where swans are observed during the nesting season will be closed on a case by case basis to protect potential nesting swans and encourage nesting.

Trumpeter Swan Research

Habitat suitability is an important aspect of territory occupancy and nesting success for trumpeter swans, and wetland area, in particular, appears to be a key factor in swan productivity in YNP (Proffitt, 2008). It is speculated that a warmer, drier climate has reduced the quality and quantity of suitable wetlands in the region but the extent of these changes has not been quantified. This year YNP began funding Eastern Kentucky University masters student, Laura Cockrell, to examine factors influencing territory occupancy and nesting success in YNP over a two-year period (2009–2010). Her objective is to produce a habitat model using historic and current swan nesting locations to predict potential quality habitat in and around YNP using Landsat satellite imagery, a GIS, and field measurements of habitat quality. During June and July 2009 Cockrell sampled 16 lakes in YNP where she collected vegetation, soil, and water quality samples. Fieldwork for this project will continue in 2010 with expected completion of the project in 2011. This study will improve our understanding for the reasons behind the declining swan population in YNP, and may inform future management decisions in the region.

Colony Nesting Birds

The Molly Islands collectively refer to two small islands (Rocky and Sandy) located in the southeast arm of Yellowstone Lake. Annual surveys of colonial nesting birds on these islands have been conducted since 1977. However, the data goes back as far as 1890 for some species. Species that currently or have previously nested on the Molly Islands include American white pelican, double crested cormorant, California gull, and Caspian tern.

Monitoring Colonial Nesting Birds

In 2009, the Molly Islands were censused four times during mid-May through early August via fixed-wing aircraft. We used aerial photos from each survey period to later count the number of nests and chicks on the islands. Because of poor photo quality, the number of nests could not be determined; however, we were able to count the number of each species reaching fledging age.

A pelican colony on one of the Molly Islands.

Colonial Nesting Birds Reproduction

Productivity by colonial nesting birds on the Molly Islands was low this year although greater than in 2008 (Table 4). For the fifth year in a row no Caspian terns nested on either island. California gulls have not nested there since 2006. American white pelicans fledged 54 chicks and double crested cormorants fledged 30 chicks. Late spring weather patterns observed the last two years are likely responsible for the low productivity. This year, low fledging success may be attributed to high June precipitation,

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	No data	No data	0	No data
2008	0	13	0	16
2009	0	54	0	30

Table 4. Chicks of colonial-nesting birds fledged on the Molly Islands during 1989-2008.

A loon and loonlet.

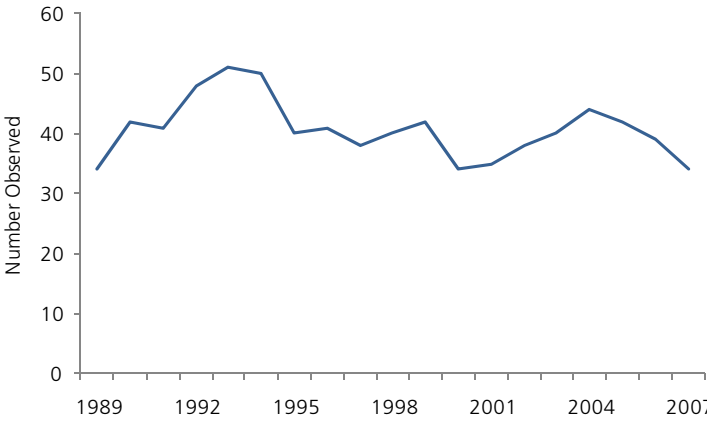

Figure 12. Adult common loon observation in YNP during 1989 to 2007.

(143% above average). Since all species are obligate piscivores, the declining cutthroat trout population may also be partially responsible for reduced nest and fledging success on the Molly Islands.

Common Loon

Common Loon Monitoring

During 2009, we monitored common loons for site occupancy and productivity via fixed wing aircraft (in conjunction with other surveys) and ground surveys in a subset of eleven historically occupied sites. Aerial surveys were conducted during the last week of July and ground surveys were conducted during the first week of August.

Common Loon Survey Results

Six of the eleven historically occupied sites contained a pair of loons for a total of 12 adult loons (Table 5). Three sites contained loonlets for a total of four loonlets. The number of adult loons observed in YNP during 1989–2007 ranged from 34–50 individuals per year and appears to be relatively stable (Figure 12); however, both nest attempts and fledglings have declined over the 18 year period (Figure 13). This suggests that factors within YNP are responsible for declines in nest attempts and fledglings since the number of adults returning each year has not changed significantly. Factors responsible for declines in nest attempts and fledglings is unknown; however, may be the result of warmer, drier temperatures observed in the region which could reduce the availability of suitable nest sites.

Site Name	Adults	Loonlets
Riddle Lake	2	1
Cygnet Lakes	2	1
Heart Lake	2	2
Grebe Lake	2	0
Ranger Lake	0	0
Lilypad Lake	0	0
Grizzly Lake	0	0
Lake of the Woods	0	0
Obsidian Lake	0	0
Peal Island	2	0
Flat Mountain Arm	2	unk
Total	**12**	**4**

Table 5. Common Loon occupancy and productivity during 2009.

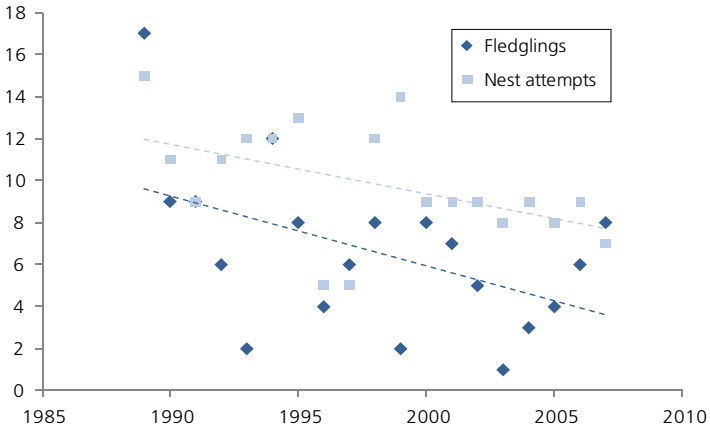

Figure 13. Common loon nest attempts and fledglings in YNP during 1986 to 2007. Data was not gathered in 2008 and only a subset of lakes were surveyed in 2009 and so was not included.

In future years, loon site occupancy and productivity data will be collected through aerial surveys conducted for other species during June and July (i.e. ospreys and bald eagles). Loons are a species of special conservation concern in Wyoming and throughout much of the United States and Canada because of habitat loss and wetland contamination. The loon population in YNP represents one of the most southerly breeding populations in North America and one of the only populations breeding in Wyoming. Since 1987, YNP has been collecting data on common loon site occupancy and productivity and the continuation of monitoring will contribute to this long-term data set.

Common Raven

A wildlife biology class from the University of Washington worked with park staff to estimate the raven population occupying the northern range. This population estimate covered the area from Gardiner through Mammoth extending out across the northern part of the park through Round Prairie, excluding the Cooke City area. Ravens were counted in the developed areas (Gardiner, Mammoth), along the road (breeding bird survey points), and at carcasses. Carcasses were aerially photographed during a wolf flight to compare with ground data to develop a correction factor for known carcasses not observable from the ground, and

typically more birds are seen from the ground than in an aerial photograph.

The total population estimate was 244–496 ravens: 59 in developed areas, 62 along roads, and 123–375 at wolf kill sites. This wide range represents unknown variability in raven numbers at wolf kills after several days and will be refined in future estimates. For example, the day wolves make a kill a large number of ravens visit the kill site (mean = 36 ravens/kill on day 1), and our population estimate assumed this number of ravens used the kill for three days. It is likely that fewer ravens use the kill on days two and three, thus inflating the population estimate. By day two ravens are leaving a kill from day one and searching out new feeding opportunities so future estimates will likely be closer to the lower number in our population estimate.

This common raven displays a malformed beak. Photo by Franz Camenzind.

Passerine and Woodpecker Monitoring Program

Willow–Songbird Study

In response to several studies indicating that willow (*Salix* spp.) has increased in height in some locations across the northern portion of YNP (Ripple and Beschta 2003, Groshong 2004), Montana State University began a three-year (2005–2008) collaboration with the National Park Service to examine songbird responses to increases in willow across this area (L. Baril and A. Hansen, unpublished data). Increased willow could have important consequences for bird diversity in this portion of the park because willow communities are a rare, but an extremely important habitat type for several bird species in the region. Also, songbirds are often indicators of climate change effects.

Willow–Songbird Monitoring

Songbirds were sampled in three willow growth conditions during 2005–2008: 1) unsuppressed, previously tall; 2) recently released; and 3) short, suppressed. Previously tall willows generally average >1.5 meters and experience little browsing. Previously tall sites were located in Willow Park and Tom Miner Basin (outside the boundary of YNP). Released willows are those that were formerly height suppressed. Released willows are similar in height and density to previously tall willows, but are generally lower in overall canopy cover. Released sites were located along Blacktail Deer Creek, upper Slough Creek, and a section of Soda Butte Creek near the confluence with the Lamar river. Suppressed willows experience heavy browsing and are generally < 1 meter tall. Suppressed willows were located in two sites along Soda Butte Creek. In 2008 and 2009, a subset of the willow stands surveyed in past years to establish a long-term dataset and monitor trends over time (Table 6). Previously tall sites formed the basis of comparison for bird responses to released willow sites, so we restricted our sampling to these willow conditions. We sampled 12 plots in Willow Park, eight plots along Blacktail Deer Creek, and eight plots along Slough Creek. Nine plots were sampled in the Slough Creek site in previous years; however, a change in geomorphology of that site made one plot inaccessible this year.

Stand Type	No. sample plots established by Montana State Univ.	No. plots surveyed by YNP in 2008
Unsuppressed	17	12
Released	25	16
Suppressed	23	0
Total	**65**	**28**

Table 6. Summary of willow stands surveyed in YNP.

Two rounds of point counts were conducted for each sample plot from June 15 through July 30, 2009, beginning at 05:30 and

Species	Released	Previously Tall
American crow	0.03	0.00
American robin	0.44	0.50
Brown-headed cowbird	0.00	0.21
Cedar waxwing	0.03	0.00
Common yellowthroat	0.63	1.17
Fox sparrow	0.00	0.33
Gray catbird	0.19	0.00
Lincoln's sparrow	1.38	1.54
MacGillivray's warbler	0.06	0.00
Northern flicker	0.09	0.00
Red-winged blackbird	0.28	0.08
Savannah sparrow	0.69	0.21
Song sparrow	0.34	0.38
Warbling vireo	0.47	0.33
White-crowned sparrow	0.16	0.33
Willow flycatcher	0.50	0.46
Wilson's warbler	0.00	1.08
Yellow warbler	1.47	1.83
Average abundance	**6.9**	**8.6**
Average richness	**6.7**	**7.9**

Table 7. Summary of mean abundance for each species observed in unsuppressed and released willow stands in YNP during 2009.

ending at 10:00 hours. Each count lasted 10 minutes and observed birds were identified to species. We also recorded information on distance from the observer, time observed, sex, and behavior (e.g., singing, carrying food or nesting material). We used richness and abundance indices to examine differences in birds between willow growth conditions. Richness is the average number of species observed growth condition, while abundance is the average number of individuals observed per growth condition. We also calculated average abundance per species per growth condition.

Willow–Songbird Monitoring Results

We observed a total of 428 individuals from 18 species across released and previously tall sites. Released sites contained 221 individuals from 10 species and previously tall sites contained 207 individuals from 13 species. Average species richness and abundance was higher in previously tall than in released sites (Table 7). Yellow warblers were the most common species observed in both sites, followed by Lincoln's sparrow and common yellowthroat. All three species were more abundant in previously tall than in released sites. Willow flycatcher abundance was similar between both released and previously tall willows, but was higher in released willows this year than in 2008. While Wilson's warblers were common in previously tall sites, they were absent in released sites; however, we did observe a single singing male at the Slough Creek released site, but not within our sample plots. Wilson's warblers are obligate willow specialists requiring high horizontal cover and tall willows. Although only a single observation, it may mark the beginning of Wilson's warbler recolonization there. MacGillivray's warblers have not been recorded during any of the previous willow surveys in Yellowstone and are typically associated with dense, woody understory vegetation (Baril, personal observation); however, for the first time in the five years of sampling, a MacGillivray's warbler was observed in the Blacktail Deer Creek site. The warbler was recorded on the first visit this year and may have still been selecting a territory. It was not observed on the subsequent visit.

Breeding Bird Surveys

Breeding bird surveys (BBS) are a North American bird censusing program coordinated by the US Geological Survey and the Canadian Wildlife Service's Research Center. YNP participates in this survey having three established routes: Mammoth area, Northeast Entrance area (Tower–Round Prairie), and the interior (Dunraven Pass through Hayden Valley and Yellowstone Lake). Details and history of the surveys are presented in last year's Bird Annual Report (Baril and Smith 2008) and data are available on the BBS website http://www.pwrc.usgs.gov/bbs/.

Breeding Bird Survey Results

Dates of the surveys were as follows: Mammoth–10 June, Yellowstone–14 June, and the NE Entrance–23 June. Along these three routes we detected a total of 1844 individuals of 79 different species. The Mammoth route had the highest diversity of species, while the Yellowstone route had the highest number of individuals counted (Figure 14). The Northeast entrance route had both the lowest diversity of species and lowest number of individuals counted. This year was the lowest total individual

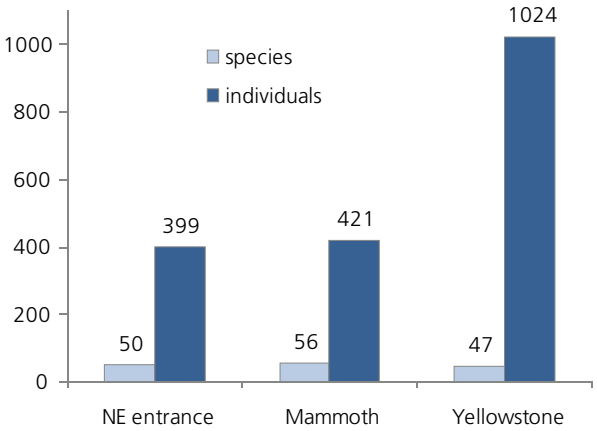

Figure 14. Summary of 2009 breeding bird survey data in YNP.

count on record but not the lowest diversity. A complete list of all the individuals and species observed can be found in Appendix D.

Although not statistically analyzed, visual inspection of the data show a few trends. On the NE Entrance and Mammoth routes cliff swallow numbers are fewer, especially the last couple of years for the Mammoth route. Whether this is due to missing birds flying away from their colonies on some survey points or actually represents fewer birds is unknown. Counts on vesper sparrows on the NE Entrance route also seem down.

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 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 frequency 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. The objectives of this pilot survey were to 1) assess the distribution of birds utilizing two post-burn forests and 2) aid in developing future post burn monitoring guidelines for Yellowstone.

Forest Burn Monitoring Strategy

We conducted bird surveys along four transects, three of which were located in the East Fire burn along the northeast side of Yellowstone Lake, and one in the LeHardy burn north of the Lake Ranger Station (Figure 15). The LeHardy Fire burned a total of 9604 acres in 2008 and the East Fire burned a total of 17294 acres in 2003. Surveys began between 05:30 and 06:00 hours and ended by 10:00 hours during July 8–12. Transects were

Figure 15. Maps depicting the four transects for the 2009 burn surveys. Burned areas are shown in tan and transects are shown in maroon.

Species	East T1	East T2	East T3	LeHardy	Nesting Guild
American Kestrel	1				CA
American Robin	8	8	7	9	OP
Bald Eagle				1	OP
Black-Backed Woodpecker				1	CA
Brown-Headed Cowbird	1				PA
Cassin's Finch		3	1		OP
Chipping Sparrow		4	4		OP
Clark's Nutcracker			2		OP
Common Raven				1	OP
Dark-eyed Junco	3	11	11	4	OP
Hairy Woodpecker	1	1	1	1	CA
Hermit Thrush		2	2		OP
Lincoln's Sparrow	5	2	1		OP
Mountain Bluebird	1	2			CA
Mountain Chickadee		2	4		CA
Northern Flicker	1		2	2	CA
Pine Siskin	1	1			OP
Red-breasted Nuthatch			1		CA
Ruby-crowned Kinglet		1	7	5	PE
Spotted Towhee			1		OP
Townsend's Solitaire				1	OP*
Tree Swallow	4	4		1	CA
Three-toed Woodpecker				2	CA
Unknown Flycatcher				1	OP
White-crowned Sparrow	1	7	1		OP
Western Wood-Pewee	2				OP
Yellow-rumped Warbler	1	1	2	4	OP
Total Abundance	**30**	**49**	**47**	**33**	
Total Richness	**13**	**14**	**15**	**13**	

Table 8. Total bird richness and abundance across the four burn survey transects.

* Also nests in cavities (Nesting Guild: CA = cavity, OP = open, PA = nest parasite, PE = pendant);(Foraging Guild: AI = aerial insectivore, AO = aerial omnivore, BI = bark insectivore, FI = foliage insectivore, foliage omnivore = FO, FS = foliage seeds, GI = ground insectivore, GS = ground seeds, GO = ground omnivore, OM = omnivore)

surveyed once each. Observers walked a specific transect recording birds seen and/or heard along with other supplemental data.

Forest burn monitoring results

Nine (33%) of the 27 species observed across all transects are obligate cavity nesters; four of these are woodpeckers that excavate their own nest cavities while the remaining species are secondary cavity nesters (Table 8). The LeHardy fire contained all four woodpecker species, but only one of the secondary cavity nesters. Because surveys were done only one year after the fire, sufficient nest cavities have not been excavated for which secondary cavity nesters can occupy. In contrast, the older East Fire contained all five secondary cavity nesters, but only two of the woodpecker species. Three-toed and black-backed woodpeckers were observed in the recently burned LeHardy Fire transect, but were absent in the East Fire transects. Both are species of conservation concern in the region and are typically associated with recently burned forests (Saab et al., 2007). The majority (59%) of species belonged to the open-cup nesting guild. The East Fire contained 12 of the 16 (75%) open-cup nesters while the LeHardy Fire contained only seven (44%). Furthermore, only three species (American robin, dark-eyed junco, and

yellow-rumped warbler) were present in both the East and LeHardy transects.

These results should be interpreted with caution since we surveyed each transect only once and had uneven sampling effort between the two burns. Future monitoring efforts will be expanded stratifying forest fires by burn severity and age since burn with a relatively even number of replicates within each strata for analytical purposes. If possible, each transect will be surveyed twice during early June through mid-July. Results from continued monitoring could provide valuable data on bird response to natural fire in YNP, whereas many studies to date focus on bird response to prescribed fire in the region. This survey was conducted solely by NPS employees who volunteered their time. We'd like to thank David True (Old Faithful Interpretation), Mark Donahue (Mammoth carpenter shop), Tonja Opperman (fire cache, Mammoth), and Karen Vandzura (Lake Hospital, Lake).

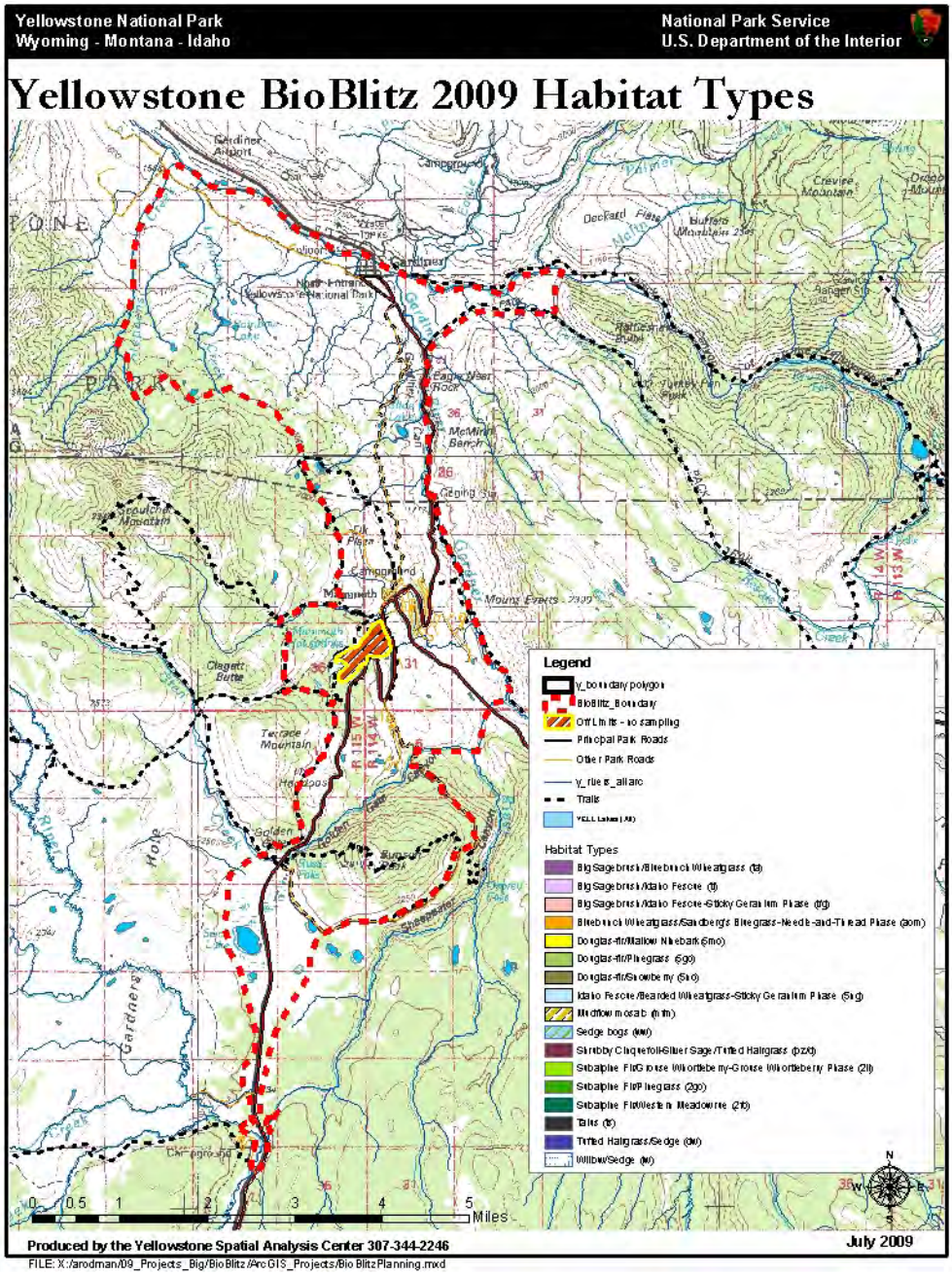

Figure 16. 2009 Bioblitz survey area and included habitat types in Yellowstone National Park.

Bioblitz

On August 28 and 29, YNP hosted its first Bioblitz, an area-wide 24-hour inventory of organisms. Developed by Edward O. Wilson, Ph.D., Bioblitz is designed to bring real world biology to citizens as well as provide valuable data on species not well studied in selected regions. The Bioblitz study area was located in the northeastern portion of YNP chosen to include a variety of habitats (Figure 16). Members of the Montana Audubon Society, students of Rocky Mountain College, NPS employees, and knowledgeable area birders participated in the event.

Owl Surveys

We surveyed for five species of owls (great gray, great horned, long-eared, northern pygmy, and saw-whet owls) along two trails: Bunsen peak road and Beaver ponds trail from approximately 2000 hours to 2400 hours on August 29th. Observers used the call-back technique whereby previously recorded vocalizations are played for each of the five species in turn while listening for a response from that species. Observers documented all species played and whether or not a response was elicited. For each response, the approximate direction and distance from the observer was recorded along with a UTM and time for each stop location.

Diurnal bird surveys

We surveyed for diurnal birds along several trails throughout the survey region on August 28 from 11:30 to 17:30 hours and on August 29 from 06:30 to 12:00 hours. Observers documented all birds heard and/or seen along trails, time observed, approximate distance, and the habitat type each was observed in.

Survey results

Owls: Observers recorded six owls from two species along both routes: great horned (5) and long-eared (1). Two of the great-horned owls were documented along the Beaver Ponds trail while the other three were documented along Bunsen peak road. The long-eared owl was identified along the Beaver Ponds trail. Information on owl distribution in Yellowstone is limited and difficult to obtain due to the nocturnal nature of most owls and safety concerns regarding surveying at night; however, this is a

Species Observed During Bioblitz 8/28–8/29

American Coot
American Dipper
American Goldfinch
American Kestrel
American Robin
American Three-toed Woodpecker
Barrow's Goldeneye
Black-billed Magpie
Black-capped Chickadee
Blue-winged Teal
Brewer's Blackbird
Brewer's Sparrow
Brown Creeper
Cassin's Finch
Chipping Sparrow
Cinnamon Teal
Clark's Nutcracker
Common Raven
Common Yellowthroat
Cooper's Hawk
Cordilleran Flycatcher
Dark-eyed Junco
Downy Woodpecker
Dusky Flycatcher
Dusky Grouse
Eared Grebe
Gadwall
Golden Eagle
Golden-crowned Kinglet
Gray Jay
Great Horned Owl
Green-winged Teal
Hairy Woodpecker
Hammond's Flycatcher
Hermit Thrush
House Wren
Lazuli Bunting
Lesser Goldfinch
Lesser Scaup
Lincoln's Sparrow
Long-eared Owl
Mallard
Merlin
Mountain Bluebird
Mountain Chickadee
Northern Flicker
Northern Harrier
Northern Shoveler
Orange-crowned Warbler
Osprey
Pine Siskin
Red Crossbill
Red-breasted Nuthatch
Redhead
Red-naped Sapsucker
Red-tailed Hawk
Red-Winged Blackbird
Ruby-crowned Kinglet
Sage Sparrow
Sandhill Crane
Savannah Sparrow
Solitary Sandpiper
Song Sparrow
Sora
Spotted Sandpiper
Steller's Jay
Swainson's Hawk
Swainson's Thrush
Townsend's Solitaire
Townsend's Warbler
Vesper Sparrow
Warbling Vireo
Western Tanager
White-breasted Nuthatch
White-crowned Sparrow
White-throated Swift
Williamson's Sapsucker
Wilson's Snipe
Wilson's Warbler
Yellow Warbler
Yellow-headed Blackbird
Yellow-rumped Warbler

group of raptors that may be opportunistically studied using call-back surveys while on other backcountry trips as well as along roads in appropriate habitat with the goal being a coarse distribution map of owl species throughout YNP.

Diurnal Birds: Observers recorded 1540 individuals belonging to 80 species across all survey routes (above). Notable species include merlin, solitary sandpiper, cordilleran flycatcher, lesser goldfinch, and sage sparrow. While cordilleran flycatchers breed within YNP, they are rare.

2009 Noteworthy Birds

Every year unusual birds are sighted in YNP, particularly during spring and fall migration and this year was no exception. On May 25, a male Hooded Warbler was observed near the Mammoth Visitor's Center and photos were taken by NPS employee, Jennifer Whipple. Hooded warblers typically breed in the eastern U.S. and Yellowstone is far outside of their normal range. A white-winged dove was observed north of the YNP boundary in Gardiner, MT by a knowledgeable park employee. White-winged doves are typically found in the south and southwestern part of the U.S. and is also an unusual YNP sighting. John Parker and Mark Donahue, both park employees and avid birders, spotted a Vaux's swift in Gardiner near the north entrance. John has the previous two years (2007 & 2008) reported seeing a pileated woodpecker in the Mammoth area.

A hooded warbler photographed outside the Albright Visitor's Center in Mammoth Hot Springs. Photo by Jennifer J. Whipple.

We also received reports of a red-headed woodpecker, greater scaup, scarlet tanager, purple finch, white-faced ibis, rose-breasted grosbeak, lark sparrow, boreal owl, white-throated sparrow, Ross's goose, solitary sandpiper, ferruginous hawk and a large flock of American avocets. The Ross's goose and solitary sandpipers were both confirmed by photos; however, the other species were unconfirmed. All bird sightings of note are forwarded to the Wyoming rare bird committee who is responsible for assessing the reliability of rare or unusual bird sightings for the state.

A western tanager.

Dr. Joel "Jeep" Pagel, PhD., visiting raptor ecologist.

Acknowledgments

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Appendix A. Spring Arrivals in the Mammoth/Gardiner Area

Species	2005	2006	2007	2008	2009	Mean
Osprey		6-Apr	23-Mar	8-Apr	19-Apr	11-Apr
Red-tailed Hawk		4-Apr	12-Apr	3-Apr		28-Mar
American Kestral		4-Apr		14-Apr	30-Apr	13-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			13-May	14-May		13-May
Tree Swallow		28-Apr	8-Apr	13-Apr	2-May	20-Apr
Ruby-crowned Kinglet		28-Apr	29-Apr	21-Apr	3-May	28-Apr
Mountain Bluebird	8-Mar	4-Mar	18-Mar	29-Mar	12-Mar	14-Mar
American Robin	20-Mar	14-Apr	7-Mar	28-Mar	21-Mar	24-Mar
Swainson's Thrush				12-Mar		12-Mar
Yellow Warbler	18-May	12-May	13-May	19-May	17-May	16-May
Yellow-rumped Warbler		28-Apr	29-Apr	20-Apr	9-May	29-Apr
Vesper Sparrow		3-May	13-May	4-May	6-May	6-May
White-crowned Sparrow				1-May	1-May	1-May
Song Sparrow		20-Apr	24-Mar			5-Apr
Western Meadow Lark		3-Apr	5-Apr	14-Apr	8-Apr	10-Apr
Red-winged Blackbird	10-Mar	16-Mar	18-Mar	8-Apr	17-Mar	20-Mar

Appendix B. Bald Eagle/Osprey Nesting Terminology

Breeding Area (Nesting/Breeding Territory/Site): An area that contains or that was previously known to contain one or more nests within the territorial range of a mated pair of eagles.

Nest: A structure, composed largely of sticks, built by bald eagles for breeding.

Active Nest (Breeding): A nest where eggs have been laid. Activity patterns are diagnostic of breeding eagles (or those with an "active" nest). This category excludes non-nesting territorial pairs or eagles that may go through the early motions of nest building and mating, but without laying eggs. From egg-laying to hatching, incubation typically lasts 35 days.

Alternate Nest: One of several nest structures within a breeding area of one pair of eagles. Alternate nests may be found on adjacent trees, snags, man-made towers, or on the same or adjacent cliffs. Depending on the size of the breeding territory, some alternate nests can be a few miles away.

Occupied Nest: Any nest where at least one of the following activity patterns was observed during the breeding season:

- a recently repaired nest with fresh sticks or fresh boughs on top
- one or two adults present on or near the nest;
- one adult sitting low in the nest, apparently incubating;
- one adult and one bird in immature plumage at or near a nest; if mating behavior (display flights, nest repair, coition) was observed;
- eggs were laid (detection of eggs or eggshell fragments);
- any field sign that indicate eggs were laid or nestlings hatched; young were raised.

Unoccupied Breeding Area/Territory/Nest: A nest or group of alternate nests at which none of the activity patterns diagnostic of an occupied nest were observed in a given breeding season. Breeding areas must be previously determined to be occupied before they can be recognized and classified as unoccupied.

Appendix C. Peregrine Falcon Nesting Terminology

Occupied Territory–a territory where either a pair of Peregrines is present (two adults or an adult/sub-adult mixed pair), or there is evidence of reproduction [e.g., one adult is observed sitting low in the nest, eggs or young are seen, or food is delivered into eyrie (nest site)]. Occupancy for a territory must be established for at least one of two, and possibly more, 4-hour site visits. Occupancy within a region is the number of occupied territories divided by the number of territories that were checked for occupancy.

Nest Success–the proportion of occupied territories in a monitoring region in which one or more young > 28 days old is observed, with age determined following guidelines in Cade et al. (1996).

Productivity - the number of young observed at 28 days old per occupied territory, averaged across a monitoring region. Typically productivity is determined when nestlings have reached at least 80% of average age of fledging (Steenhof 1987) – 34 days in the case of Peregrines, which fledge about 43 days after hatching. Determining the number of young in a nest with absolute certainty is often difficult unless observers actually visit the eyrie (*e.g.* when banding young). Thus, for measuring productivity, this plan encourages observers to spend the time necessary to count as many young as possible. This definition of productivity allows that some young might not be observed during the final nest visit, resulting in an underestimate of productivity. Nonetheless, productivity defined in this way remains a more informative index of breeding performance than nest success alone. We will continue to use all three measures, territory occupancy, nest success, and productivity to assess population health.

Appendix D. 2009 Bird Observations

Common Name	*Latin Name*
Common Loon	*Gavia immer*
Eared Grebe	*Podiceps nigicollis*
Pied-billed Grebe	*Podilymbus podiceps*
Western Grebe	*Aechmophorus occidentalis*
American White Pelican	*Pelecanus erythrorhynchos*
Double-crested Cormorant	*Phalacrocorax auritus*
American Bittern	*Botaurus lentiginosus*
Great Blue Heron	*Ardea herodias*
White-faced Ibis	*Plegadis chihi*
Trumpeter Swan	*Cygnus buccinator*
Canada Goose	*Branta canadensis*
Ross's Goose	*Chen rossii*
Wood Duck	*Aix sponsa*
Mallard	*Anas platyrhynchos*
Gadwall	*Anas stepera*
Northern Pintail	*Anas acuta*
American Wigeon	*Anas americana*
Northern Shoveler	*Anas clypeata*
Cinnamon Teal	*Anas cyanoptera*
Blue-winged Teal	*Anas discors*
Green-winged Teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Lesser Scaup	*Aythya affinis*
Harlequin Duck	*Histrionicus histrionicus*
White-winged Scoter	*Melanitta fusca*
Common Goldeneye	*Bucephala clangula*
Barrow's Goldeneye	*Bucephala islandica*
Bufflehead	*Bucephala albeola*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Ruddy Duck	*Oxyura jamaicensis*
Turkey Vulture	*Cathartes aura*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Northern Goshawk	*Accipiter gentilis*
Swainson's Hawk	*Buteo swainsoni*
Red-tailed Hawk	*Buteo jamaicensis*
Ferruginous Hawk	*Buteo regalis*
Rough-legged Hawk	*Buteo lagpus*
Golden Eagle	*Aquila chrysaetos*
Bald Eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*
Merlin	*Falco columbarius*
American Kestrel	*Falco sparverius*

Common Name	*Latin Name*
Prairie Falcon	*Falco mexicanus*
Peregrine Falcon	*Falco peregrinus*
Dusky Grouse	*Dendragapus obscurus*
Ruffed Grouse	*Bonasa umbellus*
Wild Turkey	*Meleagris gallopavo*
American Coot	*Fulica americana*
Sora	*Porzana carolina*
Sandhill Crane	*Grus canadensis*
Killdeer	*Charadrius vociferus*
American Avocet	*Recurvirostra americana*
Black-necked Stilt	*Himantopus mexicanus*
Greater Yellowlegs	*Tringa melanoleuca*
Lesser Yellowlegs	*Tringa flavipes*
Solitary Sandpiper	*Tringa solitaria*
Willet	*Catoptrophorus semipalmatus*
Spotted Sandpiper	*Actitis macularia*
Long-billed Curlew	*Numenius americanus*
Marbled Godwit	*Limosa fedoa*
Baird's Sandpiper	*Calidris bairdii*
Western Sandpiper	*Calidris mauri*
Semipalmated Sandpiper	*Calidris pusilla*
Least Sandpiper	*Calidris minutilla*
Wilson's Snipe	*Gallinago delicata*
Wilson's Phalarope	*Phalaropus tricolor*
Franklin's Gull	*Larus pipixcan*
Ring-billed Gull	*Larus delawarensis*
California Gull	*Larus californicus*
Caspian Tern	*Sterna caspia*
Common Tern	*Sterna hirundo*
Black Tern	*Chlidonias niger*
Mourning Dove	*Zenaida macroura*
White-winged Dove	*Zenaida asiatica*
Rock Dove	*Columba livia*
Long-eared Owl	*Asio otus*
Great Horned Owl	*Bubo virginianus*
Great Gray Owl	*Strix nebulosa*
Boreal Owl	*Aegolius funereus*
Northern Saw-whet Owl	*Aegolius acadicus*
Northern Pygmy-Owl	*Surnia ulula*
Common Nighthawk	*Chordeiles minor*
Vaux's Swift	*Chaetura vauxi*
White-throated Swift	*Aeronautes saxatalis*
Calliope Hummingbird	*Stellula calliope*
Rufous Hummingbird	*Selasphorus rufus*
Belted Kingfisher	*Ceryle alcyon*
Red-headed Woodpecker	*Melanerpes erythrocephalus*
Lewis's Woodpecker	*Melanerpes lewis*
Williamson's Sapsucker	*Sphyrapicus thyroideus*

Appendix D. 2009 Bird Observations (continued)

Common Name	*Latin Name*
Red-naped Sapsucker	*Sphyrapicus nuchalis*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Three-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*
Cordilleran Flycatcher	*Empidonax occidentalis*
Willow Flycatcher	*Empidonax traillii*
Hammond's Flycatcher	*Empidonax hammondii*
Dusky Flycatcher	*Empidonax oberholseri*
Western Kingbird	*Tyrannus verticalis*
Eastern Kingbird	*Tyrannus tyrannus*
Northern Shrike	*Lanius excubitor*
Warbling Vireo	*Vireo gilvus*
Steller's Jay	*Cyanocitta stelleri*
Gray Jay	*Perisoreus canadensis*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Clark's Nutcracker	*Nucifraga columbiana*
Black-billed Magpie	*Pica hudsonia*
Common Raven	*Corvus corax*
American Crow	*Corvus brachyrhynchos*
Horned Lark	*Eremophila alpestris*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Bank Swallow	*Riparia riparia*
Violet-green Swallow	*Tachycineta thalassina*
Tree Swallow	*Tachycineta bicolor*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Black-capped Chickadee	*Poecile atricapilla*
Mountain Chickadee	*Poecile gambeli*
Red-breasted Nuthatch	*Sitta canadensis*
White-breasted Nuthatch	*Sitta carolinensis*
Brown Creeper	*Certhia americana*
House Wren	*Troglodytes aedon*
Rock Wren	*Salpinctes obsoletus*
American Dipper	*Cinchus mexicanus*
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Mountain Bluebird	*Sialia currucoides*
American Robin	*Turdus migratorius*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
Gray Catbird	*Dumetella carolinensis*
Sage Thrasher	*Oreoscoptes montanus*

Common Name	*Latin Name*
European Starling	*Sturnus vulgarus*
American Pipit	*Anthus rubescens*
Cedar Waxwing	*Bombycilla cedrorum*
Orange-crowned Warbler	*Vermivora celata*
Yellow Warbler	*Dendroica petechia*
Yellow-rumped Warbler	*Dendroica coronata*
Townsend's Warbler	*Dendroica townsendif*
American Redstart	*Setophaga ruticilla*
MacGillivray's Warbler	*Oporornis tolmiei*
Common Yellowthroat	*Geothlypis trichas*
Wilson's Warbler	*Wilsonia pusilla*
Hooded Warbler	*Wilsonia citrina*
Western Tanager	*Piranga ludoviciana*
Scarlet Tanager *	*Piranga olivacea*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Lazuli Bunting	*Passerina amoena*
Spotted Towhee	*Pipilo maculatus*
Green-tailed Towhee	*Pipilo chlorurus*
Black-throated Sparrow	*Amphispiza bilineata*
Brewer's Sparrow	*Spizella breweri*
Chipping Sparrow	*Spizella passerina*
Savannah Sparrow	*Passerculus sandwichensis*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
White-throated Sparrow	*Zonotrichia albicollis*
White-crowned Sparrow	*Zonotrichia leucophrys*
Fox Sparrow	*Passerella iliaca*
Song Sparrow	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
Dark-eyed Junco	*Junco hyemalis*
Snow Bunting	*Plectrophenax nivalis*
Western Meadowlark	*Sturnella neglecta*
Brown-headed Cowbird	*Molothrus ater*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Brewer's Blackbird	*Euphagus cyanocephalus*
Red-winged Blackbird	*Agelaius phoeniceus*
Pine Grosbeak	*Pinicola enucleator*
Gray-crowned Rosy-finch	*Leucosticte tephrocotis*
Black Rosy-Finch	*Leucosticte atrata*
Cassin's Finch	*Carpodacus cassinii*
House Finch	*Carpodacus mexicanus*
Red Crossbill	*Loxia curvirostra*
White-winged Crossbill	*Loxia leucoptera*
Pine Siskin	*Carduelis pinus*
American Goldfinch	*Carduelis tristis*
House Sparrow	*Passer domesticus*

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Biological Science technicians Lisa Baril (above) and Leslie Henry (below) survey breeding birds on Yellowstone Lake.

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