Yellowstone Bird Program

2008 Annual Report

Willow Flycatcher

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Executive Summary

During 2008, we conducted two survey flights (mid-winter and autumn) for trumpeter swans in Yellowstone National Park (YNP), the Paradise Valley, and on Hebgen Lake, and monitored swans during the breeding season. We counted 321 swans total during the mid-winter survey, including 65 adults and seven cygnets in YNP. We counted 28 swans total during the autumn survey, including eight adults and two cygnets in YNP. We found two pairs of nesting swans in YNP, but only one pair fledged two cygnets. Continued decreases in the abundance of nesting trumpeter swans in YNP are cause for concern and currently under investigation.

Bald eagle surveys were conducted via fixed-wing aircraft and supplemented by ground observations. We found 19 bald eagle nests, 10 of which contained eggs or young and fledged a total of seven eaglets. This contrasts with 34 nesting pairs in 2007 that fledged 26 eaglets. The relatively low number of nests located during 2008 was primarily a result of insufficient documentation of nest locations during previous years. However, decreased reproductive success has been observed in recent years for eagles nesting in the Yellowstone Lake area, possibly due to reductions in cutthroat trout abundance, human disturbance, climate change, or unidentified variables. Weather conditions were also unfavorable for rearing of young as cold, wet conditions persisted into June possibly affecting recruitment.

Osprey surveys were conducted in conjunction with bald eagle surveys. We found a total of 42 osprey nests, 23 of which were active and fledged a total of 17 young. In contrast, 31 active nests were located in 2007 that fledged a total of 25 young.

Reproductive measures for osprey continue to decrease throughout Yellowstone, with decreases on Yellowstone Lake being more acute than in other areas of the park. The locations of all bald eagle and osprey nests detected in 2008 were recorded with a Global Positioning System (GPS) to minimize search time in 2009.

We searched for nine peregrine falcon eyries, but only located three. One eyrie failed, while the other two fledged a total of five young. Field work did not begin until mid-May, just two weeks after incubation generally begins, and searching for nest ledges is extremely difficult during this time. Also, there are no photographic or written records of nest ledges located during previous years. Thus, we have started a photographic record of eyrie locations to aid in future searches. Overall, measures of peregrine reproduction are increasing park-wide and higher than the nation's average.

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 13 young, while double-crested cormorants fledged 16 young. However, nest initiation and success by Caspian terns and California gulls are decreasing on the islands, with neither species initiating nests during 2008. The highest lake levels observed since 1997 flooded much of the islands and washed out many of the nests during the height of the breeding season in 2008. High water levels coupled with a late ice-off date created a short nesting season.

We surveyed three routes for the breeding bird survey, which is an international survey designed to index bird population trends over time. We observed 72 species and 4,429 individual birds across the three routes during 2008. We also continued a 3-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 communities in the park.

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Introduction

The Yellowstone bird program was initiated in 1987 and has been primarily concerned with monitoring species considered threatened, endangered, or of special concern. Raptor monitoring was conducted to collect information on the productivity of bald eagles (*Haliaeetus leucocephalus*), ospreys (*Pandion haliaetus*), and peregrine falcons (*Falco peregrinus*). Information was also collected on colonial-nesting birds on the Molly Islands, including American white pelicans (*Pelecanus erythrorhynchos*), double-crested cormorants (*Phalacrocorax auritus*), Caspian terns (*Sterna caspia*) and California gulls (*Larus californicus*). In addition, nesting pairs of trumpeter swans (*Cygnus buccinators*) and common loons (*Gavia immer*) were monitored, and adult population numbers of Harlequin ducks (*Histrionicus histrionicus*) were opportunistically surveyed. The bird program also conducted breeding bird, Christmas bird, migratory bird, raptor migration, and mid-winter bald eagle surveys in some years.

A subset of the above-mentioned surveys was completed during 2008, including surveys of trumpeter swans, bald eagles, ospreys, peregrine falcons, colonial-nesting birds, and breeding bird surveys. In addition, we continued a 3-year graduate study monitoring songbird responses to increased willow growth in the northern portion of Yellowstone National Park (YNP). This report summarizes results from the 2008 breeding season and interprets these results in the context of historical trends.

2008 Breeding Season Weather

During the month of April temperatures were approximately 2 degrees Celsius cooler than the 30-year average (1970-2000; Figure 1). April precipitation was below average, but snow pack was 114% of average (Figures 2 and 3). Cool April temperatures and higher than average May precipitation, much of it falling as snow, resulted in greater than average (126%) May snow pack. June precipitation was also above average (122%), but May and June temperatures were relatively normal. Snow persisted into middle to late June, even at lower elevations, and many lakes and ponds were frozen late into the season. Ice-off for Yellowstone Lake occurred on June 2, three weeks later than in 2007. July and August were warmer than average and infrequent afternoon thundershowers made for a dry summer with lower than average precipitation (30 and 33% of average).

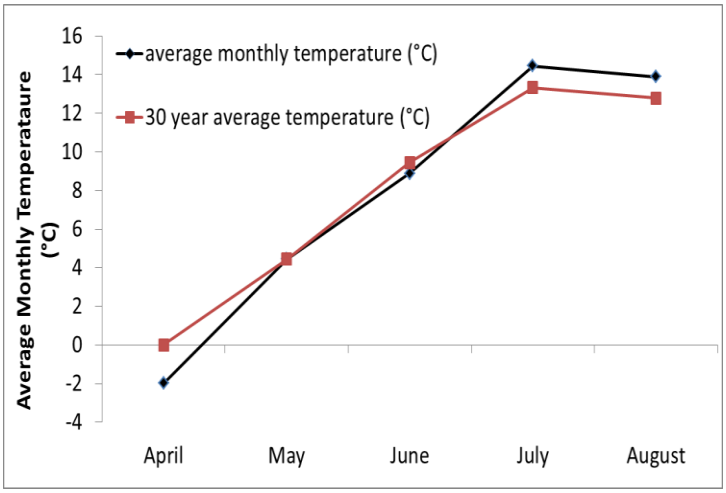

Figure 1. Average monthly temperature (°C) and 30-year average temperature (1970-2000) in YNP during April through August 2008 (data provided by Snowcap Hydrology, Bozeman, Montana).

Trout Lake after a spring snow storm

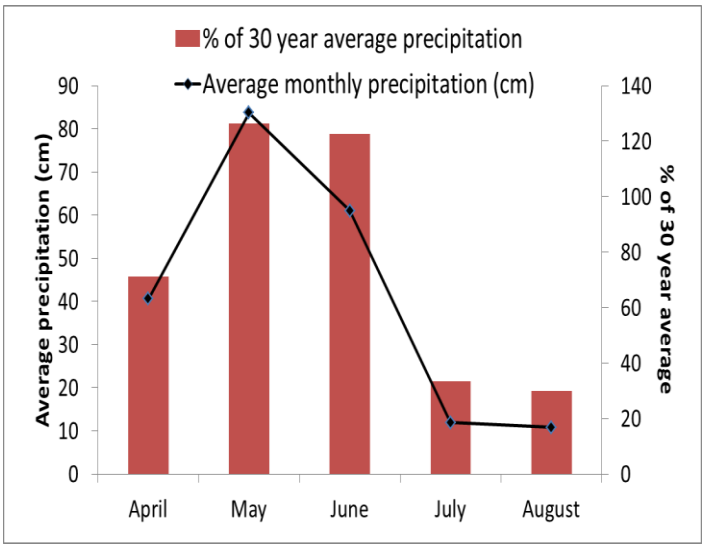

Figure 2. Average monthly precipitation (cm) and 30-year average precipitation (1970-2000) in YNP during April through August 2008 (data provided by Snowcap Hydrology, Bozeman, Montana).

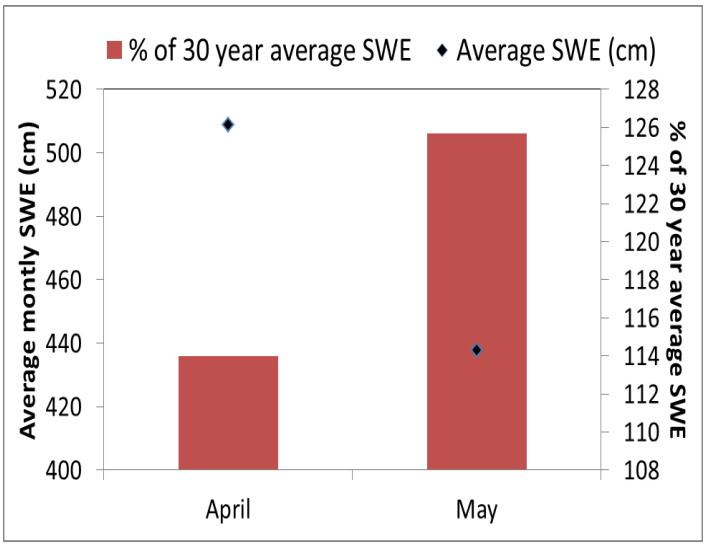

Figure 3. Average monthly snow water equivalent (SWE) and 30-year average SWE (1970-2000) in YNP for April and May 2008 (data provided by Snowcap Hydrology, Bozeman, Montana).

Trumpeter Swans

Trumpeter swans in the United States are divided into an Interior, Pacific and Rocky Mountain population. 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 4).

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 mid-winter survey in February is to determine the number of migrant swans wintering in the region. Paradise Valley was added to the autumn and mid-winter survey in 1989 and 1999 respectively while Hebgen Lake was added to the autumn and mid-winter 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, nest success (% of nests hatching young) as opposed to fledging success (cygnets surviving until September) which is accomplished via the autumn surveys.

Trumpeter swan pair near nest

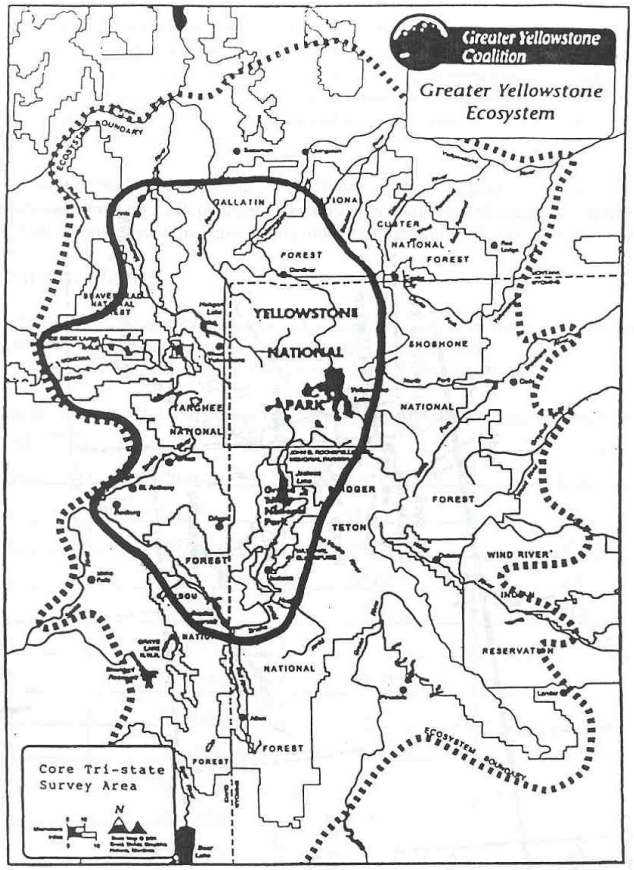

Figure 4. Map showing the core tri-state area trumpeter swan population in southeast Idaho, northwest Wyoming and southwest Montana within the Rocky Mountain population (provided by the Greater Yellowstone Coalition, Bozeman, Montana).

Monitoring Trumpeter Swans

Trumpeter swans were monitored in 2008 via fixed wing aircraft on February 14 and September 17 as part of the tri-state mid-winter and autumn surveys. Each flight was between 5.5 and 6 hours long. All areas of YNP, the Paradise Valley and on Hebgen Lake were surveyed during each flight. Swan locations were documented with a GPS and the numbers of observed adults and cygnets were recorded. During the breeding season (April-August), we surveyed YNP for nesting swans via fixed-wing aircraft (concurrent with surveys of bald eagles and ospreys). Information gathered during flights was supplemented with ground observations. We collected information on territory occupancy and nesting status in YNP. Nests were monitored until fledging or failure.

Winter Count of Trumpeter Swans

Three observers counted a total of 321 swans (293 adults and 28 cygnets) in YNP, the Paradise Valley, and on Hebgen Lake during the aerial mid-winter swan survey on February 14, 2008 (Table 1). Overall, this was the lowest number of swans counted in the YNP area since 2000 and represents a 47% decrease in the 7-year average swan count (excluding 2001; Figure 5). Over the last eight years, the average total number of swans counted was 572 (excluding 2001).

YNP swans accounted for 22% of all swans observed during the survey, a 57% decrease from 2007. The majority of swans (66%) were counted on Hebgen Lake, while the remaining 11% were counted in the Paradise Valley. These three areas are in close proximity and swans likely move from higher elevation sites in Yellowstone to lower elevation sites in Paradise Valley and Hebgen Lake as winter progresses and ice-free lakes and rivers in Yellowstone diminish. Thus, the number of swans observed in Yellowstone is highly dependent on year-to-year variations in winter weather conditions.

Table 1. Results of the mid-winter aerial surveys for trumpeter swans in YNP, the Paradise Valley, and on Hebgen Lake.

	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

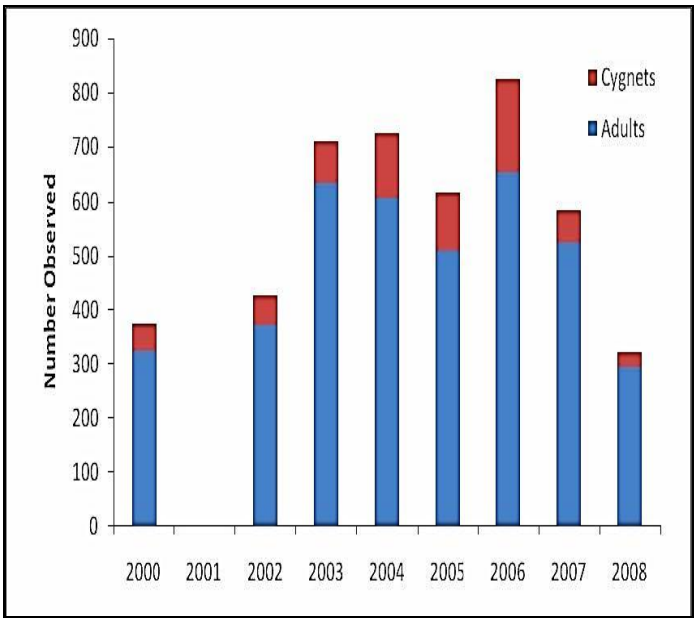

Figure 5. Summary of the total numbers of adult and cygnet trumpeter swans observed during midwinter, aerial surveys in YNP, the Paradise Valley and on Hebgen Lake during 2000-2008. Data from 2001 was censored because Hebgen Lake was not surveyed that year.

Trumpeter Swan Reproduction

During 2008, and for the second year in a row, only two nest attempts were made in YNP. One pair failed during the incubation stage, while the other hatched two cygnets (Figure 6). Overall, the number of nest attempts has decreased since 1987 and ranged from 2-10 with a mean of 5.9 per year. However, nest attempts have not exceeded four per year over the last eight years. The number of successful nests since 1987 has ranged from 0-5, with an average of 1.9 successful nests per year. The majority of nest attempts failing to hatch young in recent decades has been attributed to early season flooding and egg predation (T. McEneaney, National Park Service (retired), unpublished data).

Autumn Survey of Adult and Fledgling Cygnet Trumpeter Swans

All areas in YNP, the Paradise Valley and on Hebgen Lake were surveyed for trumpeter swans on September 17, 2008. A total of 26 swans were counted (18 adults and 8 cygnets; Table 2). In comparison, 20 adults and 11 cygnets were observed in the Paradise Valley and YNP during 2007, including 10 adults and zero cygnets in YNP (Figures 7 and 8). The population of adult swans in YNP peaked at 69 individuals in 1961 and decreased to a current population of eight resident swans (Figure 7). In 1954, 23 cygnets were counted in YNP, which is the largest cygnet count during the autumn surveys. In contrast, only two cygnets fledged in 2008. Though reasons for this decreased abundance remain uncertain, it is speculated that changing management practices in the Centennial Valley, which is an important recruitment area for swans, has reduced the number of swans available to migrate into YNP (McEneaney 2006). In addition, persistent drought conditions have reduced available nesting and foraging areas in YNP which, along with predation, has contributed to decreases in the number of cygnets fledged per year (T. McEneaney, National Park Service (retired), unpublished data).

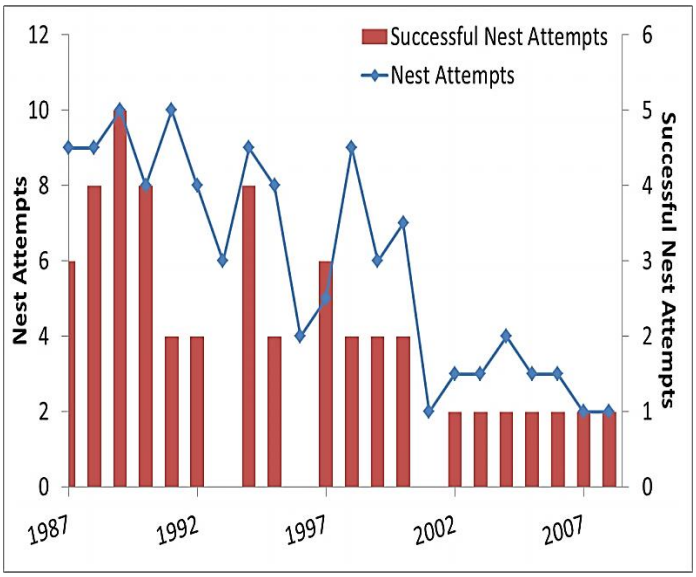

Figure 6. Numbers of nest attempts and successful nests of trumpeter swans in YNP during 1987-2008.

Table 2. Autumn 2008 survey results for trumpeter swans in YNP, the Paradise Valley and Hebgen Lake in Montana.

Location	Adults	Cygnets
Paradise Valley	11	6
Yellowstone National Park	6	2
Hebgen Lake Area	1	0
Total	**18**	**8**

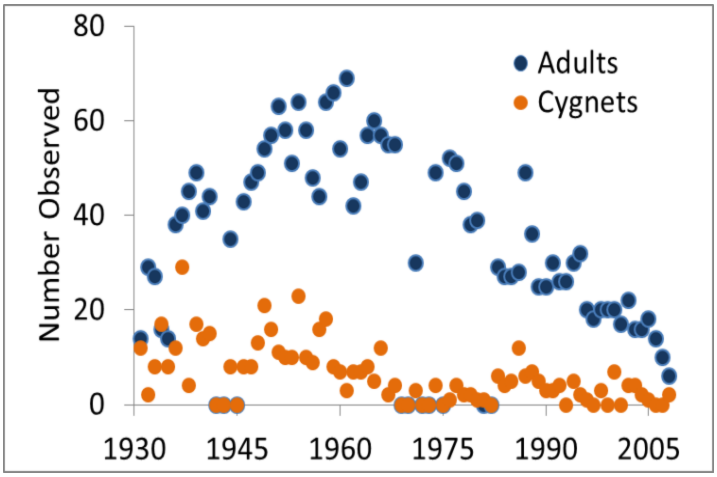

Figure 7. Autumn counts of trumpeter swans in YNP during 1931-2008.

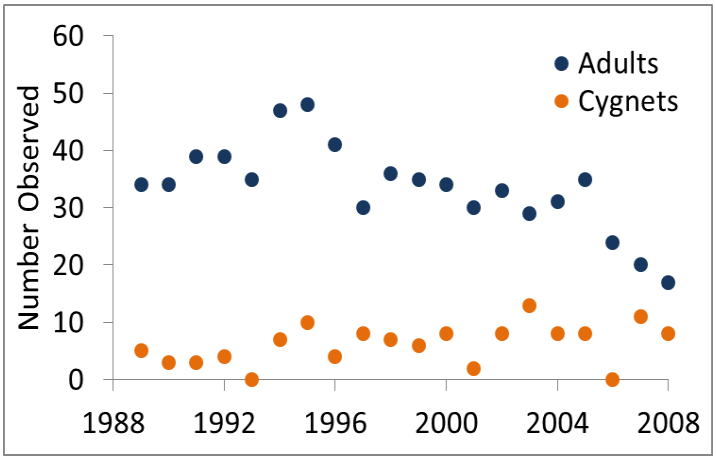

Figure 8. Autumn counts of trumpeter swans in YNP and the Paradise Valley during 1989-2008.

Summary

The swan population in Yellowstone has been decreasing for the last 40 years. Territory occupancy, nesting success, and fledging success have all decreased over this period, raising serious concerns over the viability of the Yellowstone swan population. Wetland area appears to be a key factor in swan productivity in YNP (K. Proffitt, Montana State University, unpublished data). It is speculated that a warmer and drier climate has contributed to a decrease in wetlands in YNP. An important next step in evaluating factors responsible for swan declines is to evaluate change in wetlands over time. Yellowstone has access to a time series of aerial photos starting in the 1960's that cover most of the park. These photos could be used to estimate landscape changes in swan habitat over time.

Bald Eagles

The USFWS removed the bald eagle from the List of Endangered and Threatened Wildlife and Plants on August 8, 2007 following extensive recovery efforts nation-wide. The post-delisting plan requires the monitoring of nesting territories at 5-year intervals over a 20-year period. The goal of the plan is to detect a 25% change in occupied bald eagle nests. If a decrease is detected, then the USFWS will attempt to determine the cause(s) and implement remedial measures as appropriate. At the end of the 20-year period, the bald eagle population status in the contiguous 48 states will be re-evaluated and recommendations will be made based on these results. The first official monitoring year will take place in 2013-14.

YNP collected bald eagle reproduction data in most years since 1960. Since that time 50 bald eagle territories have been identified in YNP. Prior to 1987, data was collected by a number of different observers, which may partly explain the observed high variation in nest attempts. However, this period also coincides with spraying of DDT in the park and surrounding public lands to combat spruce budworm (*Choristoneura fumiferana*) infestations

which may also have caused variations in nest attempts (Figure 9). Since 1984, the number of nesting pairs in YNP has increased substantially, 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 (McEneaney 2006).

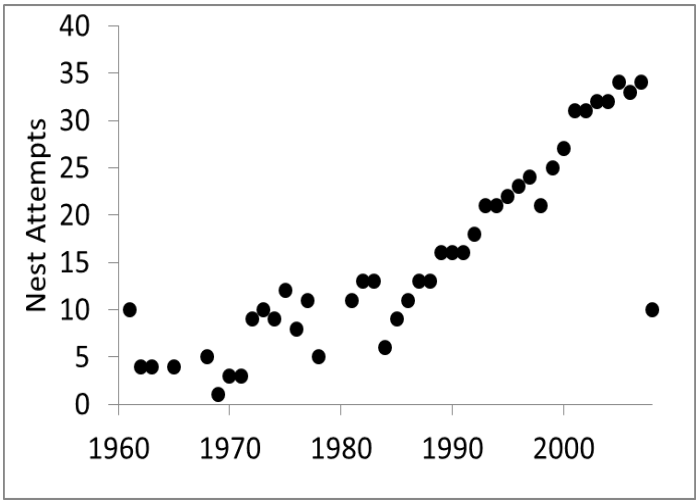

Figure 9. Total bald eagle nest attempts observed per year in YNP during 1961-2008.

Monitoring Bald Eagles and Ospreys

We censused bald eagle and osprey nests via aerial surveys. Three flights focused primarily on nest searches, but some searches were combined with flights conducted by the wolf project. These combined flights totaled approximately 20 hours. Bird survey flights took place on May 16, June 19, and June 28 of 2008. When possible, we also made ground checks to determine status. Since exact locations of nest sites were not previously documented, we flew over territories where bald eagles have nested in the past based on site names given by T. McEneaney (National Park Service, retired) and the memory of the pilot (R. Stradley, Gallatin Flying Service- Belgrade, Montana) that has traditionally flown these surveys. Once a nest was located, its coordinates were recorded using a GPS, and the nest was identified as active, occupied, or unoccupied based on definitions outlined in the 2007 USFWS draft post-delisting monitoring plan (Appendix A). Occupied nests were considered active except when the only behaviors observed were a pair at the nest and/or evidence of nest repair (i.e., the pair may not have actually laid eggs). An unoccupied nest was one in which none of the criteria diagnostic of an occupied nest were observed (note: nests must have been identified as active in previous years to be labeled unoccupied).

Active nests were assigned a unique nest identification number. We did not give inactive or unoccupied nests a nest identification number. All territories that were active in 2007 were visited at least once in an attempt to locate nests during the 2008 breeding season. GPS coordinate locations collected during flights were digitized and separated into shapefiles of active nests and inactive nests. A third shapefile with the general locations of historic nesting territories was also constructed to guide future observers to zones requiring area searches for active nests.

Adult bald eagle in Lamar Valley

Nesting Bald Eagles

We found and mapped 19 bald eagle nests in YNP during 2008, 10 of which were active when discovered. Another five nests contained recently added green plant material and were categorized as

occupied, but not active, because no eggs or young were observed in the nest during the breeding season. These nests may have been active, but failed early in the breeding season prior to our surveys. A Yellowstone Lake nest designated as occupied blew down later in the season and another nest on Yellowstone Lake blew down over the winter. The remaining four nests were inactive and could be alternate nests. At least one mature eagle was observed near or at three of four inactive nests, indicating territory occupancy. No eagles were observed at the fourth nest, indicating an unoccupied territory. However, this nest was apparently active during the previous four years. Of the 10 active nests, four failed to produce young and six successfully produced a total of seven eaglets.

Two major reasons may account for the low number of active nests observed this year. The first is that this was the first year in 20 years that surveys were conducted by new observers. Given that nests prior to this year were not marked using a GPS, nests were difficult to relocate and it is likely that many were missed. This is being remedied by constructing a geo-database of all nests located and linking the location when possible to historical data on nest productivity but will likely take several additional seasons before all nests can be successfully located and monitored. Second, adverse weather conditions early in the season likely caused many nest failures before nesting activity could be determined. Bald eagles begin egg laying as early as late February in the lower elevations and the first aerial survey typically takes place during the last week in April, however the first survey did not take place until May 16 this year. As a result, nests failing early in the season would have been mistaken for occupied or unoccupied nests when they were actually active. If this was the case, then the number of active and failed nests would increase to 15 and 9 respectively. Still, this represents very low numbers compared with past years. In 2007, there were 34 nesting pairs fledging 26 young and in 2006 there were 33 nesting pairs fledging only 10 young primarily as a consequence of adverse weather conditions.

Madison Nest Closure

Since 2002, a bald eagle pair has nested in a burned snag located approximately six miles east of West Yellowstone and less than 60 meters from the road. This tree blew down in a storm during 2007, and the eagles chose to rebuild their nest in an adjacent tree closer to the road. Such proximity to the road afforded the opportunity to the large number of visitors entering and exiting YNP via the west entrance to view nesting bald eagles and their eaglets. Despite the number of visitors and traffic issues, this pair managed to fledge nine young over the past seven years, with only one weather related nesting failure in 2004.

Traditionally, a closure has been placed around the nest and staff has controlled traffic. However, limited personnel did not allow for staffing at the nest site in 2008. Instead, a closure was placed on all areas around the nest and a “no stopping zone” was designated along a 0.25-mile stretch of road on either side of the nest. The majority of visitors obeyed the no stopping rule and observed the nest from a distance. The nest caused some traffic issues which were resolved as they occurred. The 6-mile pair fledged one eaglet this year.

Madison bald eagle nest with adult and 1 eaglet

Trends in Bald Eagle Reproduction

We looked for trends over time in bald eagle nesting success, productivity and brood size during 1987-2008. Though information on bald eagle

reproduction exists prior to 1987, differences in data collection methods may confuse trends over time. Thus, we excluded those years for the purposes of the analyses. Nest success was defined as the percentage of all nesting attempts that fledged at least one young in a given year. Productivity was defined as the average number of young produced per nesting female, and brood size was defined as the average number of young fledged per successful nest.

From 1987-2008, park-wide nesting success averaged 48% and ranged from 19-63% (Figure 10). Trends in nesting success park-wide appear to be stable over the 22 year period. Average brood size was 1.4 young per active nest park-wide and ranged from 1.17 to 1.75 young per active nest (Figure 11). It is not surprising that brood size has not changed significantly over time. Bald eagles typically lay two eggs per nest and usually only one chick will fledge successfully, so variation over time is small. Since 1987, bald eagle productivity across YNP has been relatively stable (Figure 12). Park-wide, bald eagle productivity averaged 0.68 young per nesting female and ranged from 0.30 to 1.08 over the total period. All three measured indicate a stable population for bald eagles in YNP.

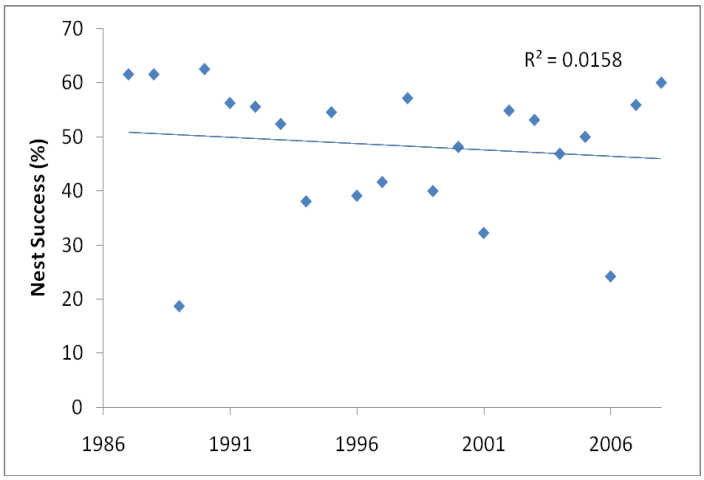

Figure 10. Bald eagle nest success in YNP during 1987-2008.

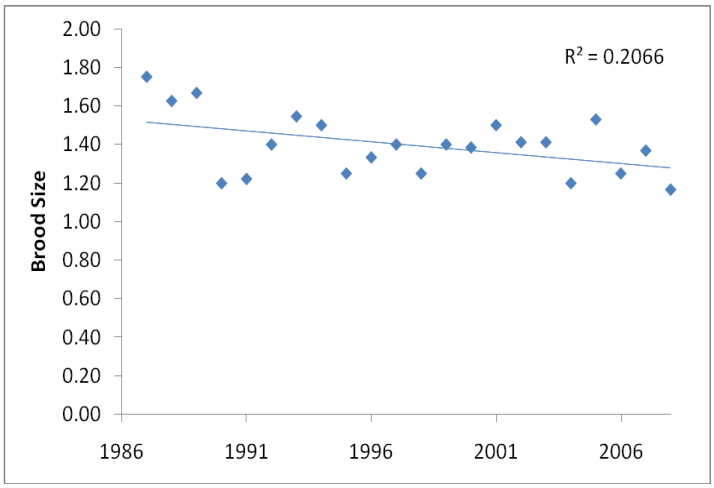

Figure 11. Bald eagle brood size in YNP during 1987-2008.

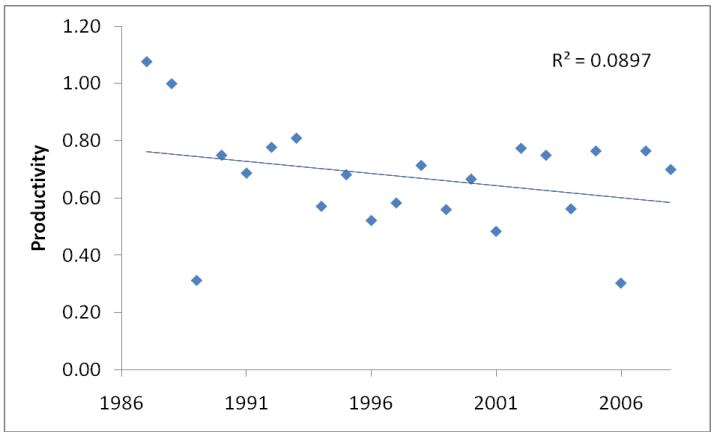

Figure 12. Annual bald eagle productivity for all active nests in YNP during 1987-2008.

Ospreys

Nesting Ospreys

The number of nesting attempts by ospreys in YNP has decreased since 2001, with an overall range of 27-100 from 1987-2008 and a mean of 68 nesting attempts per year (Figure 13). During 2008, a total of 42 osprey nests were located and mapped park-wide via ground and aerial surveys. Twenty-four of these nests were active, but we were unable to revisit one remote nest to determine final productivity. Fifty-seven percent of the remaining

23 active nests were successful, fledging a total of 19 young. Ospreys often build alternate nests, especially following an unsuccessful nest attempt, but will sometimes build new nests even after a successful breeding attempt. It is likely that several of the inactive nests, especially those in close proximity to active nests, were alternate nests of the actively breeding pair. Eight fewer active nests were found in 2008 than in 2007. Because of the large number of total nests found (regardless of activity) the lower number of active nests during 2008 was likely due to decreased attempts.

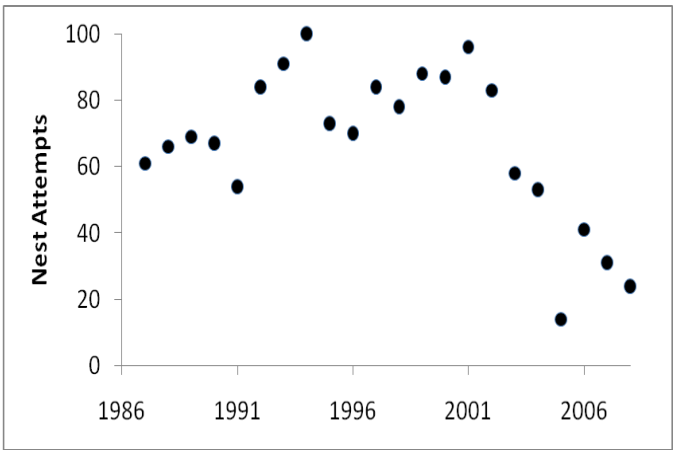

Figure 13. Osprey nesting attempts in YNP during 1987-2008.

A pair of juvenile ospreys on a nest (J. Good)

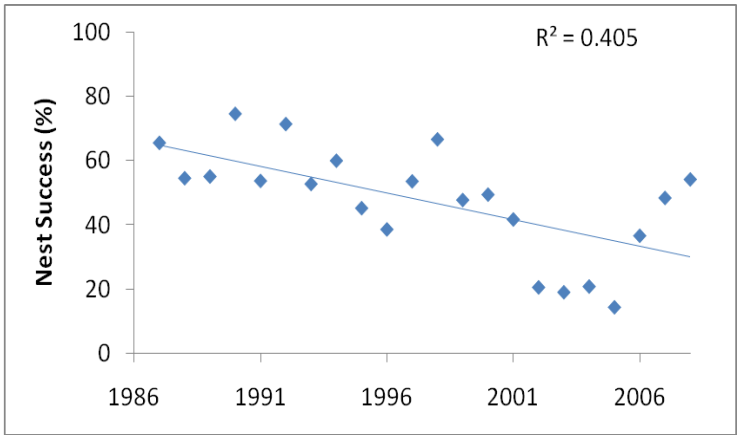

Figure 14. Osprey nesting success across YNP during 1987 to 2008.

Trends in Osprey Reproduction

Since 1987, osprey nesting success has declined park-wide. Mean nesting success was 48% over the 22-year period, and ranged from a high of 75% in 1990 to a low of 19% in 2003 (Figure 14). Brood size has not changed appreciably park-wide since 1987 (Figure 15), however productivity has been decreasing park-wide since 1987. Values ranged from 0.29 young per female in 2003 to 1.24 young per female in 1992, with a mean of 0.77 (Figure 16).

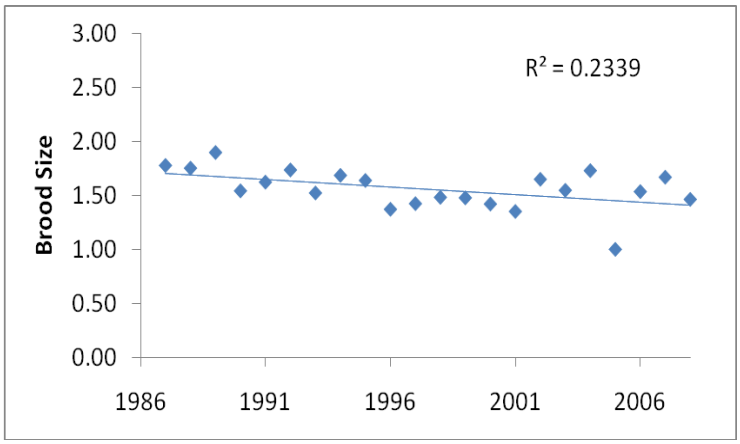

Figure 15. Osprey brood size across YNP during1987-2008.

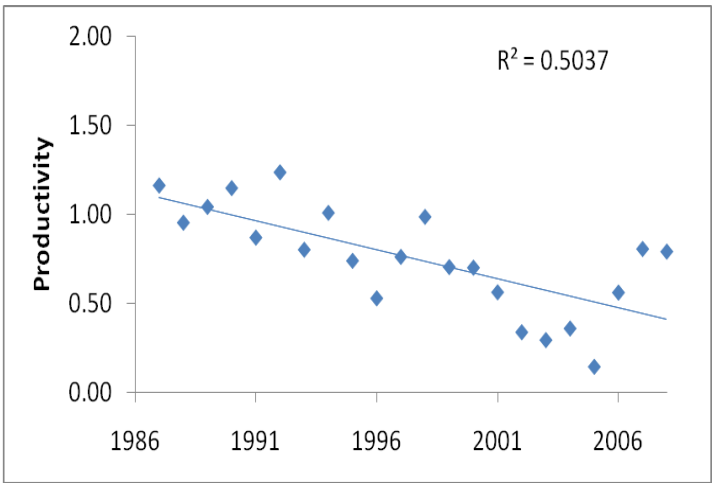

Figure 16. Osprey productivity across YNP during 1987-2008.

Bald Eagle and Osprey Research

In YNP the introduction of exotic lake trout (*Salvelinus namycush*) to Yellowstone Lake has resulted in dramatic declines in native Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*) raising concerns regarding the potential cascading effects for species associated with this resource in the region (Stapp and Hayward, 2002). Ospreys are obligate piscivores whose diet consists almost exclusively of cutthroat trout (Swenson, 1978) and although bald eagles in the Yellowstone Lake ecosystem are less dependent on piscine prey fish comprise approximately 28% of the items consumed, nevertheless representing an important component of their diet (Swenson et al., 1986).

The declines in cutthroat trout in Yellowstone Lake since lake trout introductions may negatively affect reproductive parameters for ospreys and to a lesser extent, bald eagles. Thus we examined trends in nest success, brood size and productivity for both species in a lake trout influenced system (i.e. all nests associated with Yellowstone Lake) and a non-lake trout influenced system (i.e. nests located elsewhere in YNP that are unaffected by the recent lake trout introduction).

Results

Bald Eagles

Nest success on Yellowstone Lake decreased while nest success in the Non-Lake population remained relatively stable (Figure 17). Nest success in the Lake population averaged 45% while the Non-Lake population averaged 52%. Trends in bald eagle brood size were similar between Yellowstone Lake (mean = 1.37) and all other areas in YNP (mean = 1.28) (Figure 18). Productivity on Yellowstone Lake has declined since 1987 while productivity for the Non-Lake population has increased slightly (Figure 19). Mean productivity for the Lake population was 0.63 and 0.69 for the Non-Lake population.

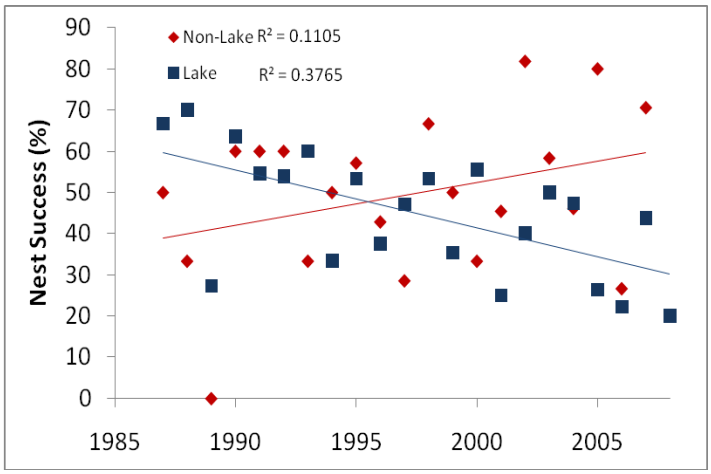

Figure 17: Bald eagle nest success in the Lake and Non-Lake populations during1987-2008.

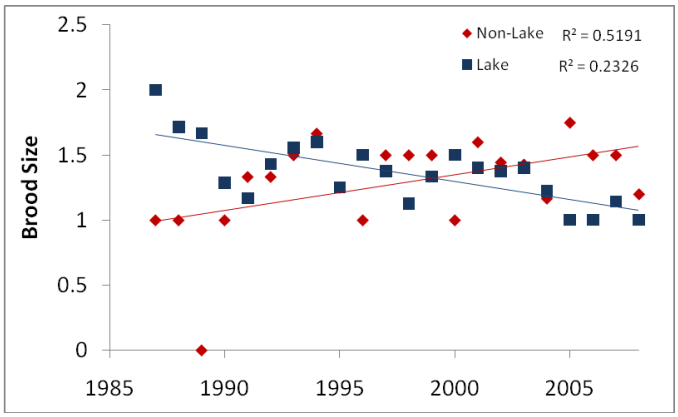

Figure 18. Bald eagle brood size in the Lake and Non-Lake populations during1987-2008.

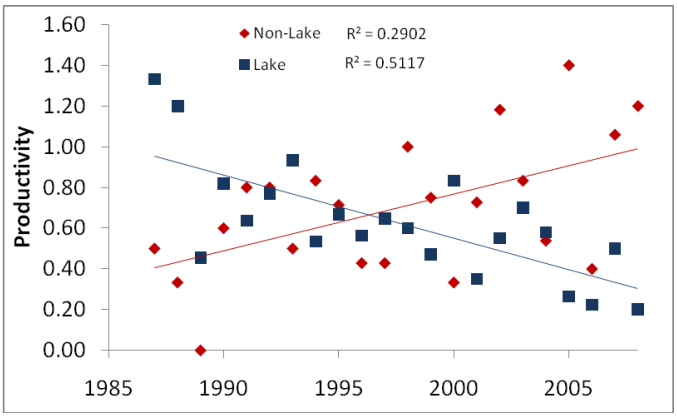

Figure 19. Bald eagle productivity in the Lake and Non-Lake populations during1987-2008.

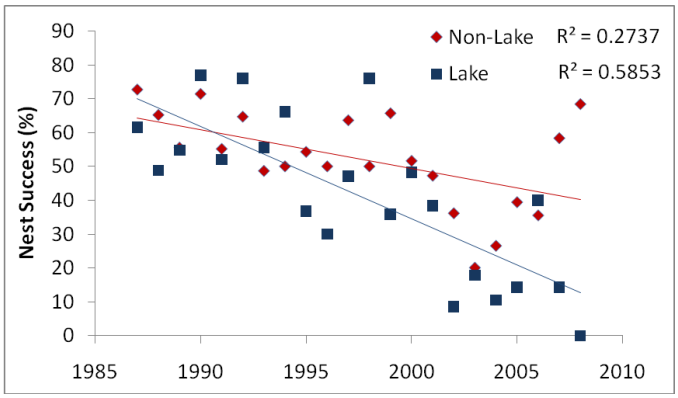

Figure 20. Osprey nest success in the Lake and Non-Lake populations during 1987-2008.

Ospreys

Nest success over the 22 year period averaged lower (41%) on Yellowstone Lake than elsewhere in YNP (52%) (Figure 20). Although both populations have experienced declines, nesting success for ospreys not nesting at Yellowstone Lake has increased over the last six years from a low of a 20% in 2003 to 68% in 2008. This is the highest nest success rate observed since 1990 for that population. Both populations exhibited similar trends in brood size and appear to be stable over time. Average brood size for the Lake population was 1.4 while the Non-Lake population averaged slightly higher at 1.68 (Figure 21). Similar to nest success osprey productivity has declined in both populations, however declines have been more acute for the Lake population (mean=0.62) than for the non-lake population (mean=0.87) (Figure 22). In addition productivity has increased from a low of 0.37 in 2003 to 1.00 in 2008 for ospreys not nesting at Yellowstone Lake.

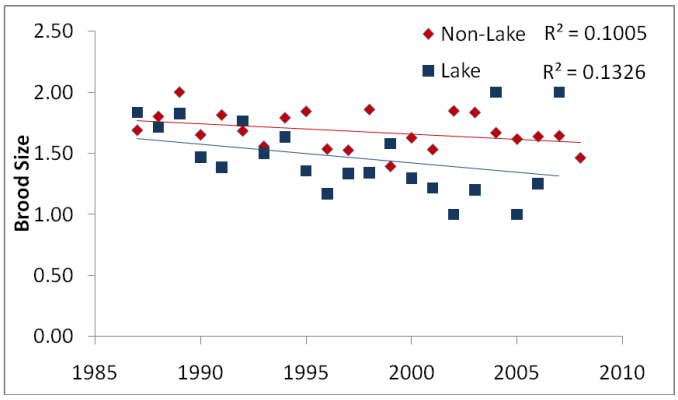

Figure 21: Osprey brood size in the Lake and Non-Lake populations during 1987-2008.

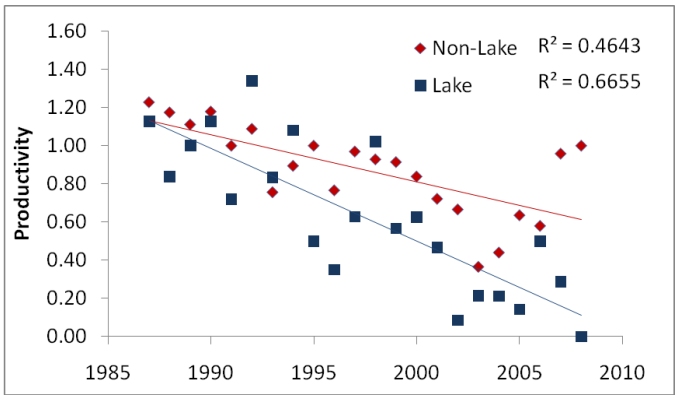

Figure 22: Osprey productivity in the Lake and Non-Lake populations during 1987-2008.

A pair of adult ospreys on a nest

Summary

Bald eagles have declined in both nest success and productivity for the lake population, but not for the Non-Lake population which appears stable or has slightly increased. Ospreys exhibited declines in nest success and productivity for both populations, however declines have been more acute for the Yellowstone Lake population than the Non-Lake population. The Non-Lake population has actually increased since 2001. Brood size appears to be stable for both species and similar between the Lake and Non-Lake populations.

While a decrease in the abundance of cutthroat trout is likely a contributing factor for declines in bald eagle reproduction, it is probably not the primary cause of nest failures for bald eagles because a previous study showed that cutthroat trout constituted 23% of eagle diets in YNP, while the majority of their diet was non-piscivorous birds (Swenson et al. 1986). In other words, bald eagles are not reliant on fish, nor do the waterfowl they consume rely on a fish diet. Rather, bald eagles are dietary generalists and will take a variety of prey items. However the reductions in the abundance of native cutthroat trout in Yellowstone have likely contributed to decreases in osprey reproductive parameters. Osprey fecal samples show that 93% of their diet consists of cutthroat trout (Swenson 1978). While this explanation is plausible for Yellowstone Lake, it does not explain decreases elsewhere in the park or the recent increases since 2003.

In addition to trout density, ospreys and bald eagles may also be affected by human disturbance. Osprey nests in close proximity to campsites on Yellowstone Lake failed more frequently than nests farther from campsites (Swenson 1979). However, after campsites around Yellowstone Lake were closed, measures of reproduction were comparable to other areas in YNP.

An alternate explanation is that increasing average spring temperatures could be causing earlier nest initiation dates. If birds are initiating nests earlier in the season, then variability in spring weather conditions could be contributing to increased nest failures on Yellowstone Lake. Nests in this region average higher than in other areas of YNP and would be affected more severely by spring storms than nests at lower elevations.

Yet another possibility is that fires have reduced the availability of suitable nesting trees, and nest failures are primarily the result of toppling trees during the breeding season. However, since the number of bald eagle nest attempts has increased over time it is unlikely this is a significant cause for decreases in eagle reproduction. Attempting to explain decreases in reproductive parameters on Yellowstone Lake will be important to advance our understanding of the Yellowstone ecosystem and in guiding future management decisions.

Peregrine Falcons

The peregrine falcon was removed from the List of Endangered and Threatened Wildlife and Plants on August 25, 1999 due to its recovery following restrictions on organochlorine pesticides in the United States and Canada, and implementation of various management actions, including the release of approximately 6,000 captive-reared falcons. Subsequent to delisting, the USFWS drafted a post-delisting monitoring plan to ensure the peregrine falcon maintains its recovered status (USFWS 2003). The goals of the post-delisting monitoring plan are to gather information on territory occupancy, nesting success, and productivity at 3-year intervals during 2003 through 2015 (Appendix B). Data from each official monitoring year will be analyzed and combined with previous data to determine trends in these parameters and inform management decisions regarding peregrine falcon recovery.

Wyoming Game and Fish has traditionally contacted YNP with a list of 10 randomly selected eyrie locations to monitor within park boundaries each year, though in most years all known territories were monitored and an effort to locate new eyries was made. Continuing to monitor as many eyries as possible every year will increase the chance of success in finding eyries during official, post-delisting, monitoring years. Also, these data

will contribute to YNP's long-term dataset for this sensitive species.

Beginning in 1983, 36 peregrine falcons were released in several hack sites in and around YNP over a 5-year period. Since that time the number of nesting pairs has steadily increased from one pair in 1984 to 32 pairs in 2007 (Figure 23). The number of peregrines fledged from active eyries has also risen, with 50 peregrines fledged from 30 eyries in 2006.

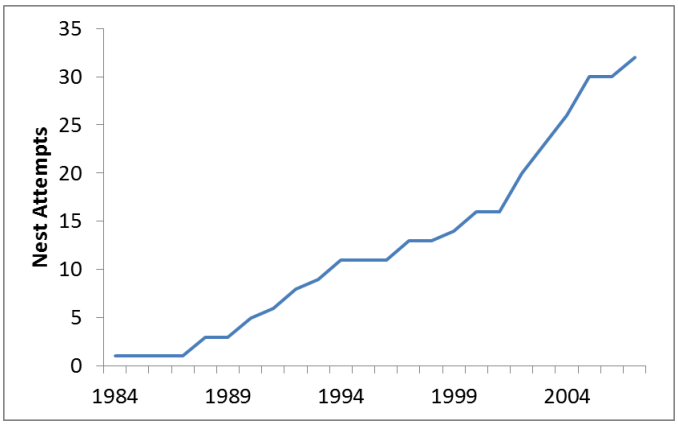

Figure 23. Peregrine Falcon nesting pairs in YNP during 1984-2007.

Monitoring Peregrine Falcons

Two observers spent a total of 70 hours searching for peregrine eyries in nine different territories. Territories were observed for 1-12 hours per visit. Information on adults observed, evidence of breeding behavior, number of chicks, and number of fledglings was recorded. Active eyries were observed until fledging or failure. If no evidence of breeding or occupancy was observed for a given territory, then these sites were not revisited. We photographed all active nest ledges to establish a record of nest locations and to reduce nest searching time in the future.

Nesting Peregrine Falcons

Five of the nine eyries observed were designated as occupied (i.e., a pair observed or evidence of breeding behavior). Three eyries in occupied territories were active in 2008. Two of the eyries fledged a total of five young, while the third eyrie failed to produce any young. Four territories were considered unoccupied, but one peregrine was observed briefly at one of these sites. While no peregrines were observed at two other sites, observer time was minimal (less than 2 hours) and peregrines may have been missed. Territory occupancy was not calculated for previous years because it is unclear from the data which territories were unoccupied versus unchecked for occupancy.

Trends in Peregrine Falcon Reproduction

Average peregrine nest success since 1984 was 82%, but this value is misleading because during the first four years of monitoring there was only one eyrie that fledged successfully each year; thereby negatively skewing trends in nesting success (Figure 24). When these four data points were censored, nesting success was relatively constant across years and averaged 78% (range = 57-100). Nesting success in YNP over the 20-year period averaged greater than the 74% and 71% nest success for region 6 and for the nation, respectively (data from the 2003 USFWS official monitoring year).

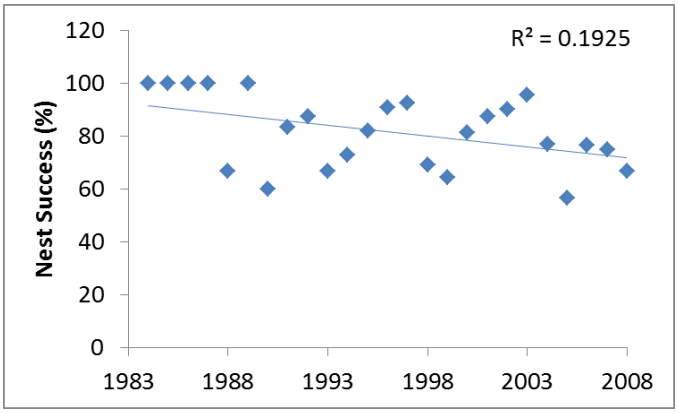

Figure 24. Peregrine Falcon nesting success in YNP during 1984-2008.

Annual productivity ranged from 1 to 3 young produced per nesting female, with a mean of 1.93 over the 25 year period (Figure 25). However, only one eyrie was monitored during the first four years of monitoring. When these four years are censored,

average productivity was 1.72 young fledged per female (range = 1-2.36) and remained relatively constant across years. Productivity in YNP over the 21-year period was greater than for region 6 (1.49) and the nation (1.64) (data from the 2003 USFWS official monitoring year). Brood size, or the number of young fledged per successful nest, also remained relatively stable with a mean of 2.33 since 1984 and 2.21 since 1988 (Figure 25).

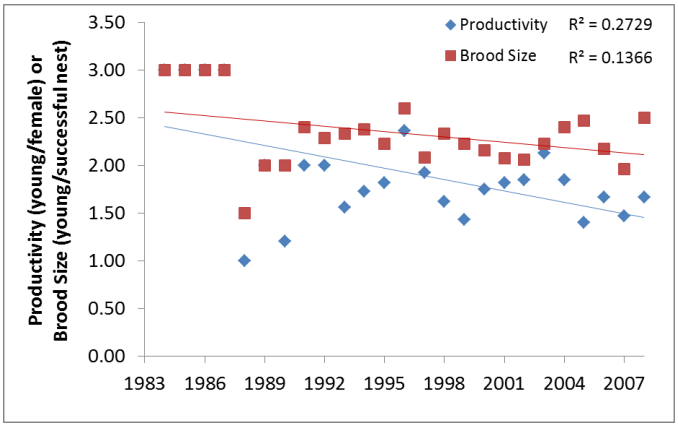

Figure 25. Peregrine falcon productivity and brood size in YNP during 1984-2008.

Colonial Nesting Birds

The Molly Islands collectively refer to two small islands (i.e. Rocky, Sandy) located in the southeast arm of Yellowstone Lake. Annual surveys of colonial nesting birds on these islands have been conducted since 1977. However, data has been collected intermittently for some species since 1890. Species nesting on the Molly Islands include American white pelican, double-crested cormorant, California gull, and Caspian tern.

Monitoring Colonial Nesting Birds

In 2008, the Molly Islands were censused four times during mid-May through mid-September via fixed-wing aircraft. To survey the islands effectively, we used aerial photos from each survey period to later count the number of nests and chicks on the islands.

Colonial Nesting Birds Reproduction

Productivity by colonial nesting birds on the Molly Islands was low (Table 3). No California gulls nested and, for the third year in a row, Caspian terns did not nest on either island. American white pelicans managed to fledge only 13 chicks, while Double-crested cormorants fledged 16 chicks; however these are minimum counts since photo quality was poor in some cases. Maximum lake water level during 2008 occurred on July 6 and was 20% higher than the 30-year average (1970-2000). This high water nearly covered both islands and washed out many of the nests early in the season, resulting in very low fledging success. In addition, ice-off on Yellowstone Lake occurred three weeks later than last year on June 6, 2008; thereby delaying nest initiation and available forage for adult birds.

Table 3. Number of chicks of colonial-nesting birds fledged on the Molly Islands during 1989-2008

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

Breeding Bird Surveys

The breeding bird survey was established in 1966 as a joint effort between the Patuxent Wildlife Research Center of the U.S. Geological Survey and the Canadian Wildlife Service's Research Center to monitor the status and trends of breeding birds throughout North America. All breeding bird survey data is available to the public at <http://www.pwrc.usgs.gov/bbs/>. Yellowstone has maintained three survey routes (Mammoth, Yellowstone, Northeast entrance) since 1982 (Figure 26). The Mammoth route goes 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.

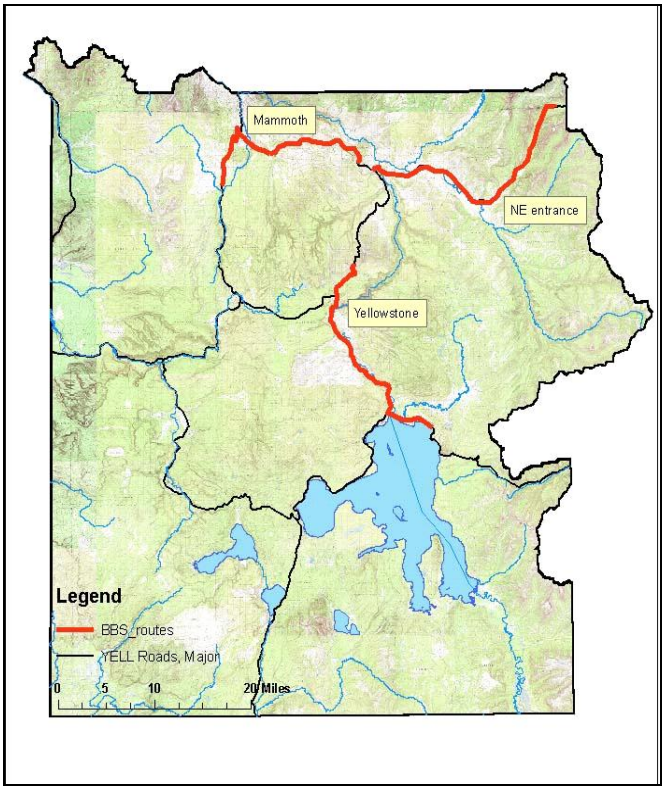

Figure 26. Breeding bird survey routes in YNP.

Conducting the Breeding Bird Survey

The Mammoth, Yellowstone, and the Northeast entrance routes were surveyed on June 16, June 17, and June 23, 2008, respectively. One observer spent approximately 20 hours surveying and driving the routes. An additional 20 hours was spent scouting the route and updating GPS coordinates before the actual survey. Data was entered in the online breeding bird survey database and later reviewed for accuracy.

Breeding Bird Survey Results

We observed 4,429 individuals of 72 species along the three survey routes during 2008. The Mammoth route was the most diverse route with 52 species observed. However, both the Yellowstone and Northeast entrance routes were only slightly lower in total species observed (Figure 27). The Yellowstone route exhibited the highest number of individuals, mostly as a result of large flocks of Canada geese on the Yellowstone River. A complete list of birds seen on the breeding bird surveys and YNP in general is provided in Appendix C.

In total, over 72,000 individual birds have been counted across the three breeding bird survey routes since 1982 (Table 4). The Mammoth route has been the most diverse, while the Yellowstone route contains the highest number of individual birds with just three species (Canada goose, cliff swallow, bank swallow) accounting for 48% of all individuals seen or heard.

Chipping sparrow

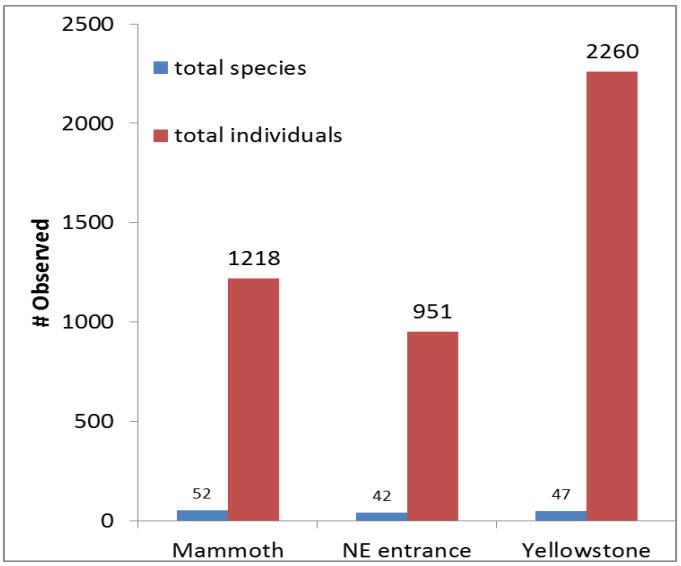

Figure 27. Summary of 2008 breeding bird survey data in YNP.

Table 4. Summary of breeding bird survey data in YNP during 1982-2008.

Route	Total Species	Total Individuals
Mammoth	127	22534
NE Entrance	117	12900
Yellowstone	115	36634
Total	**NA**	**72068**

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 3-year (2005-2007) 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 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 communities during 2005-2008: 1) unsuppressed, tall stands; 2) recently released stands; and 3) short, suppressed stands. Unsuppressed stands generally average >1.5 meters tall and experience little browsing. Unsuppressed stands were located in Willow Park, an exclosure near Mammoth, and an exclosure in the Lamar Valley. Released stands are those that were formerly height suppressed. Released stands are similar in height to unsuppressed stands, but are generally less dense with lower overall canopy cover. Released stands were located along Blacktail Deer Creek, upper Slough Creek, and portions of the Lamar River. Suppressed stands experience heavy browsing and <1 meter tall. Suppressed willows were located along portions of the Lamar River and Soda Butte Creek. In 2008, a subset of the willow stands surveyed in past years was sampled to establish a long-term dataset and monitor trends over time (Table 5). Unsuppressed stands formed the basis of comparison for bird responses to released willow stands, so we restricted our sampling to these stand types. We sampled 12 plots in Willow Park, nine plots along Slough Creek, eight plots along Blacktail Deer Creek, and four plots along the Lamar River. Actual survey time was 5.5 hours, but travel time increased the total to approximately 40 hours.

Table 5. Summary of willow stands surveyed in YNP

Stand Type	MSU plots	# plots surveyed in YNP in 2008
Unsuppressed	17	12
Released	25	21
Suppressed	23	0
Total	**65**	**33**

Two rounds of point counts were conducted for each sample plot from June 7 through July 17, 2008, beginning at 0530 and ending at 1000 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 stand types. Richness is the average number of species observed per stand type, while abundance is the average number of individuals seen per stand type. We also calculated average abundance per species per stand type.

Willow-Songbird Monitoring Results

A total of 20 species were detected across released and unsuppressed stands. Nineteen species occurred in released stands, while 16 species were found in unsuppressed stands. Average bird abundance was greater in released stands than in unsuppressed stands, while species richness was slightly greater in unsuppressed stands (Table 6). Fox sparrows were only observed in unsuppressed stands, while brown-headed cowbirds, Brewer's blackbirds, gray catbirds, northern flickers and red-naped sapsuckers were only observed in released stands. The following species are considered willow-riparian specialists in the region and were the focus of this study. Abundances for song sparrow, warbling vireo, Wilson's warbler, and yellow warbler were greater in unsuppressed stands than in released stands, while abundances for common yellowthroat, Lincoln's sparrow, and willow flycatcher were greater in unsuppressed willow stands.

A male Wilson's warbler (N. Bowersock).

Table 6. Summary of mean abundance for each species observed in unsuppressed and released willow stands in YNP during 2008 (see Appendix C for scientific names).

Species	Unsuppressed	Released
American robin	0.42	0.40
Brown-headed cowbird	0	0.05
Brewer's blackbird	0.04	0.17
Common yellowthroat	0.88	0.95
Fox sparrow	0.33	0
Gray catbird	0	0.12
Lincoln's sparrow	1.25	1.29
Northern flicker	0	0.24
Red-naped sapsucker	0	0.02
Red-winged blackbird	0.04	0.71
Savannah sparrow	0.33	0.64
Sora	0.08	0.12
Song sparrow	0.25	0.14
Spotted sandpiper	0.58	0.14
Warbling vireo	0.17	0.12
White-crowned sparrow	0.08	0.10
Willow flycatcher	0.38	0.55
Wilson's snipe	0.17	0.52
Wilson's warbler	0.54	0.10
Yellow warbler	1.46	1.43
Average abundance	**9.22**	**10.20**
Average richness	**5.27**	**5.19**

Acknowledgments

We thank H. Anderson, S. Dagg, K. Duffy, D. Hafey, S. Lykens, J. McAllister, and R. Raymond for assisting with the monitoring of birds in YNP. We appreciate interest in YNP birds and are open to input and volunteering to help with monitoring birds across YNP.

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Appendix A. Bald Eagle Nesting Terminology (also applies to Osprey)

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 B. Peregrine Falcon Nesting Terminology

Occupied Territory - a territory where either a pair of Peregrines is present (two adults or an adult/subadult 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 $\geq$28 days old is observed, with age determined following guidelines in Cade et al. (1996).

Productivity - the number of young observed at $\geq$ 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 C. 2008 Bird Observations

Species	Latin Name	Species	Latin Name
Canada goose	*Branta canadensis*	Killdeer	*Charadrius vociferus*
Trumpeter swan	*Cygnus buccinator*	Black-necked stilt	*Himantopus mexicanus*
Gadwall	*Anas strepera*	American avocet	*Recurvirostra americana*
American wigeon	*Anas americana*	Spotted sandpiper	*Actitis macularia*
Mallard	*Anas platyrhynchos*	Willet	*Tringa semipalmata*
Blue-winged teal	*Anas discors*	Long-billed curlew	*Numenius americanus*
Cinnamon teal	*Anas cyanoptera*	Marbled godwit	*Limosa fedoa*
Northern shoveler	*Anas clypeata*	Wilson's snipe	*Gallinago delicata*
Northern pintail	*Anas acuta*	Wilson's phalarope	*Phalaropus tricolor*
Green-winged teal	*Anas crecca*	California gull	*Larus californicus*
Canvasback	*Aythya valisineria*	Caspian tern	*Sterna caspia*
Redhead	*Aythya americana*	Rock pigeon	*Columba livia*
Ring-necked duck	*Aythya collaris*	Great horned owl	*Bubo virginianus*
Lesser scaup	*Aythya affinis*	Great gray owl	*Strix nebulosa*
Harlequin duck	*Histrionicus histrionicus*	Long-eared owl	*Asio otus*
Bufflehead	*Bucephala albeola*	Common nighthawk	*Chordeiles minor*
Barrow's goldeneye	*Bucephala islandica*	Calliope hummingbird	*Stellula calliope*
Common merganser	*Mergus merganser*	Rufous hummingbird	*Selasphorus rufus*
Ruddy duck	*Oxyura jamaicensis*	Belted kingfisher	*Ceryle alcyon*
Wild turkey	*Meleagris gallopavo*	Lewis's woodpecker	*Melanerpes lewis*
Ruffed grouse	*Bonasa umbellus*	Williamson's sapsucker	*Sphyrapicus thyroideus*
Blue grouse	*Dendragapus obscurus*	Red-naped sapsucker	*Sphyrapicus nuchalis*
Common loon	*Gavia immer*	Downy woodpecker	*Picoides pubescens*
Western grebe	*Aechmophorus occidentalis*	Hairy woodpecker	*Picoides villosus*
Pied-billed grebe	*Podilymbus podiceps*	American three-toed woodpecker	*Picoides dorsalis*
Eared grebe	*Podiceps nigricollis*	Black-backed woodpecker	*Picoides arcticus*
American white pelican	*Pelecanus erythrorhynchos*	Northern flicker	*Colaptes auratus*
Double-crested cormorant	*Phalacrocorax auritus*	Olive-sided flycatcher	*Contopus cooperi*
Great blue heron	*Ardea herodias*	Western wood-pewee	*Contopus sordidulus*
White-faced ibis	*Plegadis chihi*	Willow flycatcher	*Empidonax traillii*
Osprey	*Pandion haliaetus*	Hammond's flycatcher	*Empidonax hammondii*
Bald eagle	*Haliaeetus leucocephalus*	Gray flycatcher	*Empidonax wrightii*
Northern harrier	*Circus cyaneus*	Dusky flycatcher	*Empidonax oberholseri*
Sharp-shinned hawk	*Accipiter striatus*	Loggerhead shrike	*Lanius ludovicianus*
Cooper's hawk	*Accipiter cooperii*	Warbling vireo	*Vireo gilvus*
Ferruginous hawk	*Buteo regalis*	Gray jay	*Perisoreus canadensis*
Rough-legged hawk	*Buteo lagopus*	Steller's jay	*Cyanocitta stelleri*
Northern goshawk	*Accipiter gentilis*	Clark's nutcracker	*Nucifraga columbiana*
Swainson's hawk	*Buteo swainsoni*	American magpie	*Pica hudsonia*

Appendix C: continued

Red-tailed hawk	*Buteo jamaicensis*	American crow	*Corvus brachyrhynchos*
Golden eagle	*Aquila chrysaetos*	Common raven	*Corvus corax*
American kestrel	*Falco sparverius*	Horned lark	*Eremophila alpestris*
Peregrine falcon	*Falco peregrinus*	Tree swallow	*Tachycineta bicolor*
Prairie Falcon	*Falco mexicanus*	Violet-green Swallow	*Tachycineta thalassina*
Sora	*Porzana carolina*	Northern Rough-winged	*Stelgidopteryx serripennis*
American Coot	*Fulica americana*	Bank Swallow	*Riparia riparia*
Sandhill Crane	*Grus canadensis*	Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*	Western Tanager	*Piranga ludoviciana*
Black-capped Chickadee	*Poecile atricapillus*	Green-tailed Towhee	*Pipilo chlorurus*
Mountain Chickadee	*Poecile gambeli*	Chipping Sparrow	*Spizella passerina*
Red-breasted Nuthatch	*Sitta canadensis*	Brewer's Sparrow	*Spizella breweri*
White-breasted Nuthatch	*Sitta carolinensis*	Vesper Sparrow	*Pooecetes gramineus*
Brown Creeper	*Certhia americana*	Savannah Sparrow	*Passerculus sandwichensis*
Rock Wren	*Salpinctes obsoletus*	Fox Sparrow	*Passerella iliaca*
House Wren	*Troglodytes aedon*	Song Sparrow	*Melospiza melodia*
American Dipper	*Cinclus mexicanus*	Lincoln's Sparrow	*Melospiza lincolnii*
Golden-crowned Kinglet	*Regulus satrapa*	White-crowned Sparrow	*Zonotrichia leucophrys*
Ruby-crowned Kinglet	*Regulus calendula*	Dark-eyed Junco	*Junco hyemalis*
Mountain Bluebird	*Sialia currucoides*	Snow bunting	*Plectrophenax nivalis*
Townsend's Solitaire	*Myadestes townsendi*	Lazuli Bunting	*Passerina amoena*
Swainson's Thrush	*Catharus ustulatus*	Red-winged Blackbird	*Agelaius phoeniceus*
Hermit Thrush	*Catharus guttatus*	Western Meadowlark	*Sturnella neglecta*
American Robin	*Turdus migratorius*	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Sage Thrasher	*Oreoscoptes montanus*	Brewer's Blackbird	*Euphagus cyanocephalus*
European Starling	*Sturnus vulgaris*	Brown-headed Cowbird	*Molothrus ater*
American Pipit	*Anthus rubescens*	Black Rosy-Finch	*Leucosticte atrata*
Cedar Waxwing	*Bombycilla cedrorum*	Pine Grosbeak	*Pinicola enucleator*
Yellow Warbler	*Dendroica petechia*	Cassin's Finch	*Carpodacus cassinii*
Yellow-rumped Warbler	*Dendroica coronata*	House Finch	*Carpodacus mexicanus*
MacGillivray's Warbler	*Oporornis tolmiei*	Red Crossbill	*Loxia curvirostra*
Common Yellowthroat	*Geothlypis trichas*	White-winged Crossbill	*Loxia leucoptera*
Wilson's Warbler	*Wilsonia pusilla*	Pine Siskin	*Carduelis pinus*
		House Sparrow	*Passer domesticus*