American Peregrine Falcon Monitoring along the Upper Yukon River, Alaska, 2006

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EXECUTIVE SUMMARY

American peregrine falcons along the upper Yukon River, Alaska, have been monitored almost continuously since 1973. This and other local populations in interior Alaska have increased steadily since the late 1970s, following the ban of DDT in the United States in 1972, and their listing as endangered in 1973 under the Endangered Species Act. In August 1999, the American peregrine falcon was removed from the list of Threatened and Endangered Wildlife. Section 4(g)(1) of the Endangered Species Act requires that all species which have recovered and have been removed from the list are monitored for not less than five years following delisting. 2004 was the last year of this five-year monitoring program initiated by the Air Force, U.S. Fish and Wildlife Service, and National Park Service. In 2003, the upper Yukon River peregrine falcon population was identified as one of two index populations in Alaska for long-term monitoring beyond 2004 (USFWS 2003), and in 2005 by the Central Alaska Network (as part of the NPS Vital Signs Inventory and Monitoring Program) as an important vital sign in determining ecosystem health (MacCluskie and Oakley 2005). A monitoring protocol was prepared (Ambrose et al. 2005) following standards of Oakley et al. (2003), which is currently in the peer review process.

In 2006, 265 kilometers of the upper Yukon River were surveyed. Forty-eight nesting territories were occupied by American peregrine falcons (46 pairs and 3 single adults on territories). Twenty-seven of 46 pairs (58.7%) were successful, and produced 60 nestlings. Productivity was 1.30 nestlings per total pair and 2.22 nestlings per successful (≥ 1 nestling observed) pair. Between 1975 and 2006, the number of total and successful pairs nesting along the upper Yukon

River has been steadily increasing, though the percentage of total pairs nesting successfully has been declining. This may be attributable to increased competition for resources due to increased density and birds moving into sub-optimal territories (i.e. territories with insufficient resources and cover from predators).

Recent contaminants analyses of Peregrine Falcon eggs from YUCH suggest that mercury is currently at levels that may affect reproduction, and trends suggest that mercury levels may be increasing (Ambrose et al. 2000). Mercury is a persistent compound which bioaccumulates at high trophic levels causing toxic effects (similar to DDT). Additionally, DDT and other pesticides are still being used in wintering grounds, which may cause continued risk to the population. In response to these threats, addled eggs and nestling feathers are collected. In 2006, two addled eggs were collected from one failed eyrie for contaminants analyses. Nestling feathers and buccal swabs were collected from two nestlings from the same successful eyrie for contaminants and genetics analyses. In addition, a cracked egg-shell fragment from a failed eyrie and two shed, adult feathers from different territories were collected for genetic analysis.

INTRODUCTION

American Peregrine Falcons (*Falco peregrinus anatum*) are medium-sized raptors that prey almost entirely on birds. Their breeding range extends from Mexico north to the tree-line in Canada and Alaska. In Alaska, they occur in the forested interior, nesting primarily on cliffs along the major rivers. In the northern parts of its range, the American peregrine falcon is highly migratory, wintering as far south as Brazil and Argentina.

Beginning in the late 1940s, the use of persistent organochlorine pesticides greatly affected American peregrine falcons in North America. These pesticides affected mortality and behavior, and caused birds to lay thin-shelled eggs that often failed to hatch and consequently lowered productivity. Peregrine falcons were classified as endangered in 1973 under the Endangered Species Act. In interior Alaska, peregrine falcons declined to approximately 20 percent of historical levels by the mid-1970s. In 1972, the United States restricted the use of persistent organochlorine pesticides, and since 1978, peregrine falcons in interior Alaska have been increasing.

Though population numbers have increased, recent evidence suggests that American peregrine falcons are still threatened by environmental contaminants. Analyses of peregrine falcon eggs from the upper Yukon River suggest that mercury, a persistent compound which bioaccumulates at high trophic levels causing toxic effects (similar to DDT), is currently at levels that may affect reproduction, and trends suggest that mercury levels may be increasing (Ambrose et al. 2000). High levels of mercury are made biologically available through industrial processes such as mining and waste incineration, and will likely increase with global industrialization. Additionally, DDT and other pesticides are still being used on wintering grounds, which may cause continued risk to the population.

Peregrine Falcons in the upper Yukon River corridor, within and adjacent to Yukon-Charley Rivers National Preserve (YUCH), have been identified by the National Park Service as an important vital sign within the Central Alaska Inventory and Monitoring Network (CAKN). *Fauna Distribution and Abundance* was identified as one of CAKN's highest priority vital signs, and Peregrine Falcons were specifically identified because they are top trophic level predators that are indicators of persistent bioaccumulative contaminants. Additionally, the upper Yukon River study area was identified as 1 of 2 index areas for Alaska in the National *Monitoring Plan for the American Peregrine Falcon* (U.S. Fish and Wildlife Service, 2003). A monitoring protocol which incorporates national and network objectives was prepared (Ambrose et al. 2005) following standards of Oakley et al. (2003), which is currently in the peer review process.

The upper Yukon River, from the Alaska-Yukon Territory border to Circle, Alaska, provides excellent cliff-nesting habitat for American peregrine falcons as well as an abundant variety of prey species. The majority of this habitat lies within YUCH, with peregrine falcon protection being one of the primary reasons for the Preserve's establishment in 1980. YUCH's enabling legislation, Alaska National Interest Lands Conservation Act (U.S. Congress, 1980), states that:

"*the preserve shall be managed for the following purposes… to protect habitat for, and populations of, fish and wildlife, including but not limited* ***to peregrine falcons*** *and other raptorial birds, …"*

The peregrine falcon population breeding within the upper Yukon River valley is believed to be one of the densest populations in North America, for which we have a continuous 30 year dataset documenting the populations recovery from 11 pairs in 1973 (Ritchie 1976) to 52 pairs in 2004 (Ambrose and Florian 2003,

Ambrose and Florian 2002). The number of total and successful pairs nesting along the upper Yukon River has been steadily increasing, though the percentage of total pairs nesting successfully has been declining. This may be attributable to increased competition for resources due to increased density and birds moving into sub-optimal territories (i.e. territories with insufficient resources and cover from predators). Further monitoring is necessary to understand the natural variation of a "healthy" peregrine falcon population, which will allow us to later detect population change that is beyond normal limits of variation.

OBJECTIVES

The three primary objectives for the peregrine falcon monitoring program in the upper Yukon River study area are:

1. To monitor temporal trends in the breeding performance of peregrine falcons within YUCH. This includes annual measures of territory occupancy, nest success and productivity.

2. To monitor levels of contaminants in eggs produced by peregrine falcons breeding in YUCH. This includes repeated analyses of eggs for persistent organic pollutants (e.g. DDT and polychlorinated biphenyls (PCBs)) and heavy metals (e.g. mercury and cadmium); contaminants found in eggs reflect contaminants that the birds were exposed to at wintering grounds and along migration routes.

3. To monitor levels of contaminants accumulated in feathers of nestling peregrine falcons on the breeding grounds within YUCH. This includes repeated analyses of nestling feathers for heavy metals (e.g. mercury and cadmium); contaminants found in nestling feathers reflect natal area contaminants exposure.

STUDY AREA

The study area is located on a section of the Yukon River between the Alaska-Yukon Territory border and Circle, Alaska, a distance of 265 km. The study area is limited to 0.5 km on either side of the river (Figure 1). The river elevation varies from 260 m (865 ft) above sea level at the Alaska – Yukon Territory border to 170 m (560 ft) at Circle, Alaska. Cliffs, rock outcrops, and dirt banks are common along the river, ranging from 8 m to 600 m above the river. The area's diverse topography, frequent wildfires, discontinuous permafrost, and climate interact to create a complex mosaic of taiga and tundra

within the subarctic boreal forest zone (National Park Service 1993). Spruce/hardwood forest, wet meadows, tussock tundra, shrub thickets, and sparsely vegetated gravel bars dominate. Black spruce (*Picea mariana*) forest occurs in poorly drained areas on north facing slopes, low terraces and floodplains. White spruce (*P. glauca*), paper birch (*Betula paperifera*), quaking aspen (*Populous tremuloides*), and/or balsam poplar (*P. balsamifera*) are common at well drained sites along riparian areas, steep drainages, and south facing slopes.

METHODS

Refer to the *American Peregrine Falcon Monitoring Protocol for Yukon-Charley Rivers National Preserve* (Ambrose et al. 2005) prepared for the Central Alaska Network Monitoring Program, NPS, for a detailed description of methods.

Twenty-five days were spent in the study area in 2006, 20 May to 2 June, and 6 July to 15 July. The early survey (May and early June) located occupied nesting territories; the trip in July determined breeding success and productivity. Surveys were conducted using a 21-ft river boat launched from Circle. For each field visit, the field crew motored up the river to the Alaska-Yukon Territory border, and returned to Circle. During the first survey, all potential nesting territories along the river were observed from shoreline or islands using binoculars and spotting scopes. Observations were conducted for a minimum of 4 hours at each potential nesting territory. When possible, campsites were chosen for their proximity to potential nesting territories to extend survey periods. During the second survey, all occupied territories were observed using binoculars and spotting scopes in order to determine the number and age of nestlings. Additionally, 4 eyries were entered using standard rock climbing techniques to count the number of young when difficult to do from shore, check prey remains, and collect un-hatched eggs and feather samples from nestlings. Each survey was conducted by a crew of 3. See Table 1 for a list of participants.

Nesting territories were noted on U.S. Geological Survey topographic maps (1:63,360), and latitude and longitude from GPS units were recorded for new territories. Nest occupancy data and nest site characteristics were entered onto Alaska Raptor Observation Record Cards (Feb. 1989). Narrative descriptions of behavior, nest site locations, and other observations were kept in field notebooks. Terminology and definitions followed that described in the National Wildlife Federation's Raptor Management Techniques Manual (1986) (Appendix I).

The following information was collected:

1. Number of nesting territories occupied by a pair;
2. Number of nesting territories occupied by a single adult;
3. Number of pairs attempting to breed;
4. Number of pairs with nestlings;
5. Number of nestlings reaching 2 to 4 weeks of age; and
6. Age of nestlings at time of nest visit.

Nesting phenology was calculated based on seven days for clutch completion, 33 days for incubation (with incubation beginning after the third egg), and 40 days from hatching to first flight (Cade et al. 1996). Ages of nestlings were estimated during nest visits using photographs of known-age nestlings (Cade et al. 1996).

The following nest site information was collected for each new occupied eyrie and/or territory (previously used sites were documented in past years):

1. Cliff height (primary rock surface area, m);
2. Cliff height above river (talus slope or forested area below cliff, m);
3. Cliff length (km);
4. Nest height on cliff (relative to rock surface area, m); and
5. Nest height above river (m).

RESULTS

Forty-eight nesting territories were occupied by American peregrine falcons along the upper Yukon River in 2006 (46 pairs and 3 single adults on territory). Extra adults were observed at 11 territories occupied by pairs. Twenty-seven of the 46 pairs (58.7%) were successful, and produced 60 nestlings in 2006. Productivity was 1.30 nestlings per total pair and 2.22 nestlings per successful pair (Tables 2 and 3, Figures 2 and 3). Of the 4 eyries entered in 2006, two addled eggs were collected from one failed eyrie for contaminants analyses. Nestling feathers and buccal swabs for contaminants and genetics analyses were collected from two nestlings at a successful eyrie. In addition, a cracked egg-shell fragment from a failed eyrie and two shed, adult feathers from different territories were collected for genetic analysis (Table 4).

Nesting Phenology. American peregrine falcons generally arrive in interior Alaska in late April and initiate courtship almost immediately. Egg-laying usually begins in early May and fledging occurs in late July or early August. Phenology in 2006 is presented in Table 5. The mean dates for nesting events

in 2006 were approximately the same as the mean for previous years in the study period, 1975 – 2005 (Ambrose and Florian 2003).

DISCUSSION

Local American peregrine falcon populations in interior Alaska probably began to decline soon after the use of DDT became widespread in the 1950s, and subsequently began to rebound following the United States ban on DDT in 1972. The upper Yukon River population has increased steadily from 12 total pairs in 1977 to 50 total pairs in 2005. From 1975 to 1985, when density was the lowest in the study area, most occupied territories produced nestlings. In subsequent years as the number of occupied territories steadily increased, a lower percentage of the population was producing nestlings, though the number of pairs with nestlings and the total number of nestlings produced in the study area continued to increase (Figure 2). This lower proportion of successful pairs may be attributable to increased competition for resources due to increased density and birds moving into sub-optimal territories (i.e. territories with insufficient resources and cover from predators). The number of nestlings per successful pair also showed no significant change from 1975 – 2006 (Figure 3), indicating no density affect on those pairs able to successfully fledge young. The population seems to be continuing to increase at a steady rate, though a lower percentage of pairs are producing nestlings.

The upper Yukon River study area has territories of varying quality, though many of the occupied territories are considered high quality relative to those used throughout interior Alaska. As the population increased within the study area, pairs have begun to use sub-optimal territories. These sub-optimal territories are interspersed among high quality territories with a long history of use, and seem to be more easily accessible, and therefore provide less shelter from predators. As the population continues to grow it will be important to follow the success of the sub-optimal sites, and to periodically survey areas outside of the study area that were previously believed to be of lower quality. The success at sites outside of the study area, such as along the Kandik and Nation rivers or those some distance from any river, may provide the best indication of habitat saturation.

Intensive surveys for American peregrine falcons in interior Alaska were not conducted prior to the introduction and use of DDT in the late 1940s. As a result, little is known about nesting densities, breeding success, and productivity of a healthy peregrine falcon population. With continued surveys of this study area, we have the opportunity to better understand the breeding biology of a recovered population of American peregrine falcons.

RECOMMENDATIONS

1. Continue to annually monitor territory occupancy, breeding success, and productivity of American peregrine falcons along the upper Yukon River.

2. Continue to collect addled egg and nestling feather samples for contaminants monitoring, specifically for monitoring mercury contamination.

3. Conduct surveys in sub-optimal habitats that are in close proximity to the upper Yukon River study area (e.g. Nation, Kandik and Charley Rivers) every 3-5 years. As the population continues to increase, birds may begin to use more sub-optimal habitat.

4. Develop a protocol for measuring adult survivorship using photos to identify individuals. Mercury contamination may first affect adult survivorship.

5. Develop a Microsoft Access database for historic and ongoing data collection.

6. Collect shed adult feathers and nestling feathers, egg-shell fragments and buccal swabs from nestlings for genetic analyses.

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Table 1. Field crew members, their affiliations, and dates in the field, 2006.

Crew Member	Affiliation	Dates in Field
Skip Ambrose	Wildlife Biologist, Sandhill Company, Utah	20 May – 2 June
Chris Florian	Wildlife Biologist, Sandhill Company, Utah	20 May – 2 June
Nikki Guldager	Wildlife Biologist, Yukon-Charley Rivers National Preserve, NPS	20 May – 2 June 5 July – 11 July
Angela Matz	Contaminants Biologist, Assessment and Monitoring, USFWS	5 July – 16 July
Amanda Westphal	Local High-School Student Volunteer, Eagle, AK	3 July – 6 July
Melanie Wike	Biological Technician, Yukon-Charley Rivers National Preserve, NPS	5 July – 16 July
Steve Ulvi	Backcountry Planner, Yukon-Charley Rivers National Preserve, NPS	11 July – 16 July

Table 2. American peregrine falcons along the Upper Yukon River, Alaska, 2006.

Total Number of Adults:	106
Occupied Territories:	48
Pairs:	46
Single Adults:	3
Extra Adults at Terr. With Pairs:	11
Pairs with Nestlings:	27
Percent Pairs Successful:	58.7%
Nestlings:	60
Nestlings/Total Pair:	1.30
Nestlings/Successful Pair:	2.22

Table 3. American peregrine falcons along the Upper Yukon River, Alaska, 1975 – 2006.

Year	Occupied Terr.	Adults	Pairs	Pairs w/ Nestlings	Nestlings	% Pairs Successful	Nestlings/ Occupied Terr.	Nestlings/ Succ. Pr.
1975	12	24	12	9	17	75.0	1.42	1.89
1977	15	27	12	9	22	75.0	1.47	2.44
1978	19	35	16	12	28	75.0	1.47	2.33
1979	19	38	19	15	39	78.9	2.05	2.60
1980	20	37	17	16	44	94.1	2.20	2.75
1981	20	38	18	17	54	94.4	2.70	3.18
1982	25	48	23	16	40	69.6	1.60	2.50
1983	29	56	27	21	56	77.8	1.93	2.67
1984	27	52	25	21	48	84.0	1.78	2.29
1985	27	52	25	16	40	64.0	1.48	2.50
1986	27	54	27	18	48	66.7	1.78	2.67
1987	33	64	31	25	61	80.6	1.85	2.44
1988	34	67	33	24	57	72.7	1.68	2.38
1989	35	68	33	23	54	69.7	1.54	2.35
1990	36	71	35	28	76	80.0	2.11	2.71
1991	35	69	34	26	55	76.5	1.57	2.12
1992	40	75	35	18	41	51.4	1.03	2.28
1993	41	81	40	30	80	75.0	1.95	2.67
1994	43	85	42	24	55	57.1	1.28	2.29
1995	46	89	43	30	71	69.8	1.54	2.37
1996	45	86	41	26	66	63.4	1.47	2.54
1997	47	91	44	27	60	61.4	1.28	2.22
1998	46	98	45	33	75	73.3	1.63	2.27
1999	48	96	44	29	65	65.9	1.35	2.24
2000	46	98	45	17	35	37.8	0.76	2.06
2001	48	98	47	22	52	46.8	1.08	2.36
2002	48	98	47	32	67	68.1	1.40	2.09
2003	49	100	48	28	62	58.3	1.29	2.21
2004[a]	52	106	52	16	32	41.0	0.62	2.00
2005	50	102	48	31	70	64.6	1.46	2.26
2006	46	98	45	17	35	37.8	0.76	2.06

[a]Only 39 of 52 pairs were checked for success due to smoke in 2004.

Table 4. Summary of data collected at eyries entered in 2006.

Territory Name	KM from Border	Date	Data Collected
Boulder Creek	25.0	11 July	Age and number of nestlings (can't see in eyrie from river); eyrie failed; collected 2 addled eggs and one egg-shell fragment for contaminants and genetics analyses
Kathul East	124.0	14 July	Age and number of nestlings (can't see in eyrie from river); eyrie empty
Upper Middle Kandik	140.0	9 July	Age and number of nestlings (can't see in eyrie from river); eyrie empty
Sam Creek	166.0	15 July	Age and number of nestlings (can't see in eyrie from river); eyrie empty
22-Mile	231.0	6 July	Age and number of nestlings (can't see in eyrie from river); eyrie failed-predated; collected egg-shell fragments, prey remains, feces on rocks
7-Mile	254.0	16 July	Eyrie success-2 very young chicks; collected buccal swabs and nestling feathers from each chick for genetics

Table 5. Nesting phenology, American peregrine falcons, Upper Yukon River, Alaska, 2006.

	Mean	Range
Arrive Area	Mid to Late April	?
First Egg	8 May	30 April – 18 May
Start Incubation	15 May	7 May – 25 May
Hatch	17 June	9 June – 27 June
Fledged	27 July	19 July – 6 August
Leave Area	Early to Mid September	?

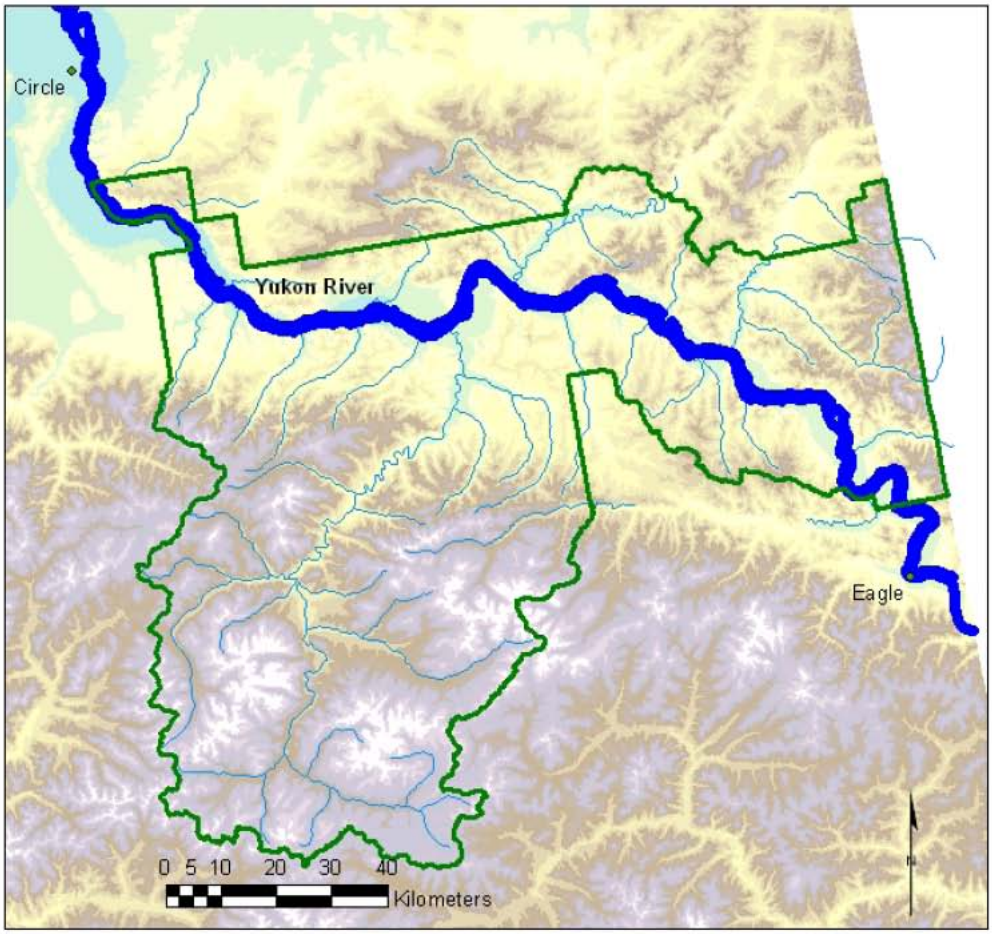

Figure 1. The Upper Yukon River study area includes all available habitat within 0.5 km of the section of the Yukon River between the Alaska – Yukon Territory border and Circle, Alaska. Yukon-Charley Rivers National Preserve is outlined in green.

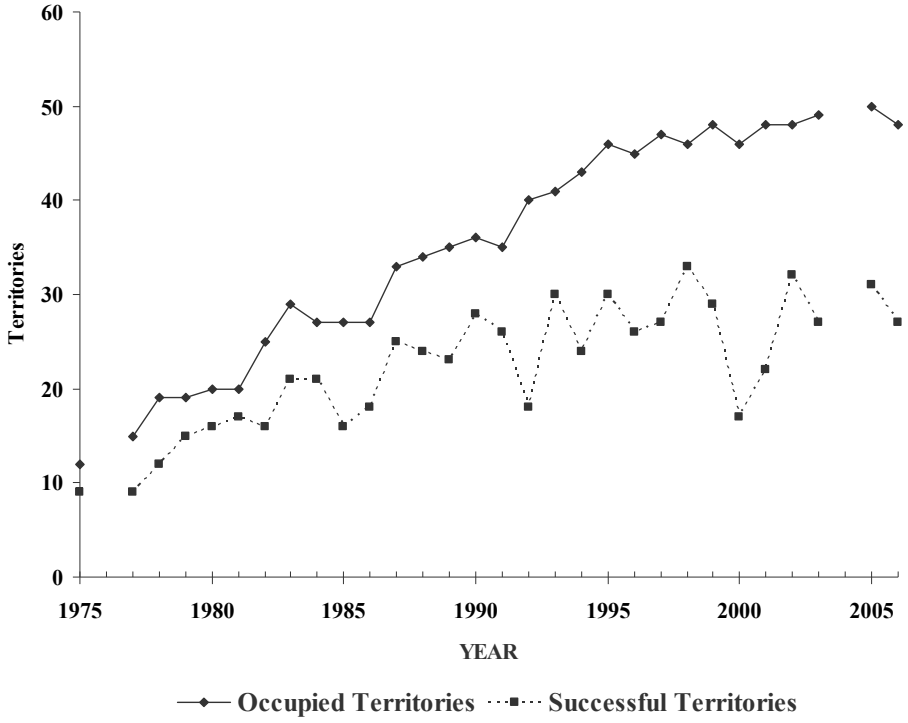

Figure 2. Number of occupied and successful (≥ 1 nestling) territories, Upper Yukon River, Alaska 1975 – 2006. In 2004, only 39 of the 52 pairs were checked for success and productivity due to smoke from forest fires, thus, these data were not included on the graph.

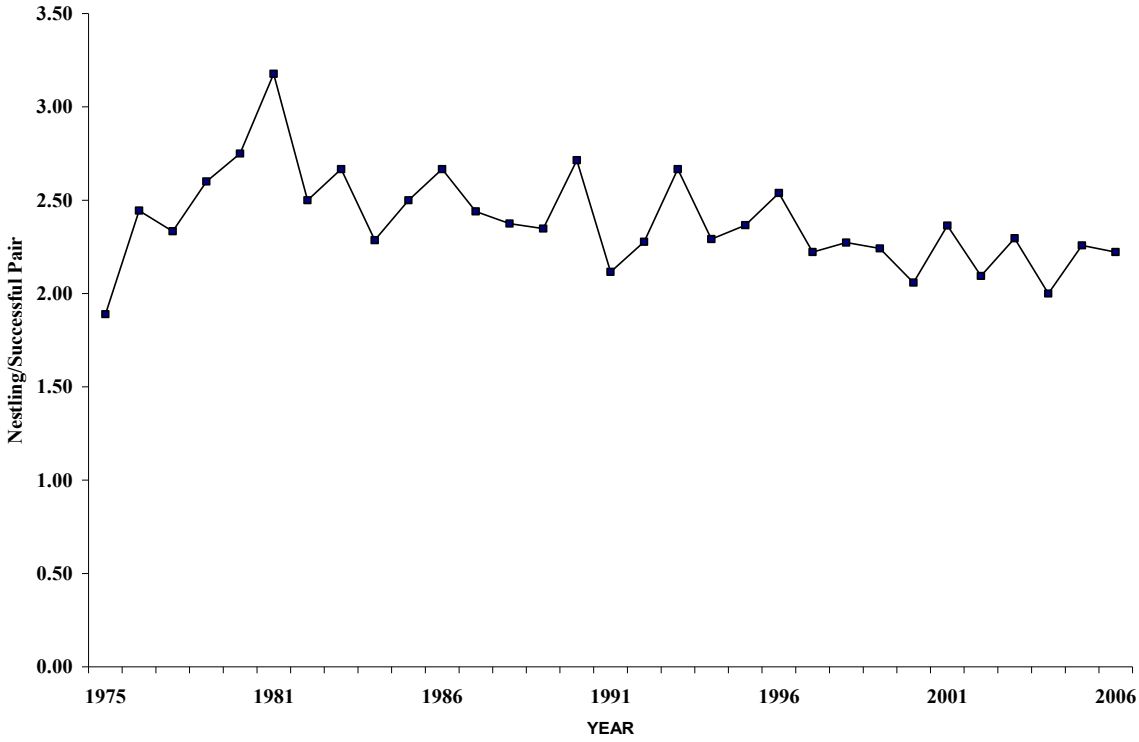

Figure 3. Peregrine falcon nestlings per successful pair, Upper Yukon River, Alaska, 1975 – 2006. In 2004, only 39 of the 52 pairs were checked for success and productivity due to smoke from forest fires.

Appendix I. Breeding Status Terminology for Raptor Observations

1. Unoccupied:

A nesting territory where no bird showing an affinity for the territory during the breeding season was observed (investigators must spend a minimum of 4 hours at the territory during the incubation period to make this determination).

2. Occupancy Unknown:

A nesting territory where no bird showing an affinity for the territory during the breeding season was observed but investigators spent less than 4 hours at the territory during the incubation period.

3. Occupied--Non-breeding:

A nesting territory where one or two birds showing an affinity for the nesting territory during the breeding season were observed but no eggs were laid (note: this category requires confirmation that no eggs were laid, therefore only those nests that were frequently observed can be assigned to this category).

4. Occupied--Breeding:

An occupied nesting territory where eggs were laid (evidence includes young in nest, eggs or eggshells, or adults seen incubating) but where final breeding success was not determined.

5. Occupied--Unsuccessful Breeding:

An occupied nesting territory where breeding was attempted but where no young reached 80% of its fledging age (for example, eggs destroyed or otherwise lost, eggs failed to hatch, or young hatched but died prior to fledging).

6. Occupied--Successful Breeding:

An occupied nesting territory where one or more young reached 80% of its fledging age.

7. Occupied--Breeding Status Unknown:

An occupied nesting territory where breeding or non-breeding could not be determined.

8. Occupied--Breeding Status Unknown, No Young Fledged:

An occupied nesting territory where breeding or non-breeding could not be determined but it was certain that no young fledged.