Status of the Prairie Falcon (*Falco mexicanus*) in Alberta

Dale Paton

Alberta Wildlife Status Report No. 42

Alberta Conservation Association®

Funded by Alberta Anglers, Hunters, and Other Conservationists

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PREFACE

Every five years, the Fish and Wildlife Division of Alberta Sustainable Resource Development reviews the status of wildlife species in Alberta. These overviews, which have been conducted in 1991, 1996 and 2000, assign individual species "ranks" that reflect the perceived level of risk to populations that occur in the province. Such designations are determined from extensive consultations with professional and amateur biologists, and from a variety of readily available sources of population data. A primary objective of these reviews is to identify species that may be considered for more detailed status determinations.

The Alberta Wildlife Status Report Series is an extension of the general statusing exercises (1996 *Status of Alberta Wildlife, The General Status of Alberta Wild Species* 2000*)*, and provides comprehensive current summaries of the biological status of selected wildlife species in Alberta. Priority is given to species that are potentially at risk in the province ("At Risk," "May Be At Risk"), that are of uncertain status ("Undetermined"), or those considered to be "At Risk" at a national level by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Reports in this series are published and distributed by the Alberta Conservation Association and the Fish and Wildlife Division of Alberta Sustainable Resource Development. They are intended to provide detailed and up-to-date information which will be useful to resource professionals for managing populations of species and their habitats in the province. The reports are also designed to provide current information which will assist the Alberta Endangered Species Conservation Committee to identify species that may be formally designated as "Endangered" or "Threatened" under Alberta's *Wildlife Act*. To achieve these goals, the reports have been authored and/or reviewed by individuals with unique local expertise in the biology and management of each species.

EXECUTIVE SUMMARY

The prairie falcon (*Falco mexicanus*) is ranked "Sensitive" in Alberta because of long-term population declines and the need for specific management. This report summarizes information on the prairie falcon in Alberta, as a step in updating its status in the province.

Prairie falcons appear to have maintained their distribution throughout the prairie habitats of Alberta. There was a 34% reduction in the occupancy of territories from 1958 to 1968, with the population stabilizing in the mid-1970s. Recent small-scale surveys showed a reduction of successful breeding pairs in local areas and past status reports indicated that prairie falcon populations are possibly stable with local reductions in the number of breeding pairs. Nesting cliffs located near a sufficient prey base are a finite resource and are essential to prairie falcon populations. The persistence of prairie falcons in Alberta hinges on the conservation of prairie habitat, the availability of suitable cliff nest sites, and an adequate prey base.

The loss of prairie grasslands to cropland agriculture, urban and industrial developments threatens the prairie falcon's future in the province.

ACKNOWLEDGEMENTS

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INTRODUCTION

The prairie falcon (*Falco mexicanus*) is a large, pale brown raptor that occupies arid hills and grasslands of western North America (Taverner 1934, Wheeler and Clark 1995). It is the only indigenous North American falcon. A review of the literature indicates that the population trends for this species appear to be stable in many parts of its range (Steenhof 1998). Kirk and Banasch (1996) report the prairie falcon to be stable with possible local declines in Alberta. This species may also be experiencing increases in Colorado (Leslie 1992), as well as declines in Texas and southwest Idaho (Steenhof 1998).

According to *The General Status of Alberta Wild Species 2000* (Alberta Sustainable Resource Development 2001), the prairie falcon is considered "Sensitive" because of concerns about adequate ground squirrel prey base and availability of secure nest sites in southern Alberta, as well as a reported reduction in its northern range.

This report provides a review of historic and recent information on the prairie falcon in an effort to update its status in the province.

HABITAT

Prairie falcons primarily inhabit dry environments of the southern Alberta prairies where clay, sandstone or rock cliffs and outcrops occur, particularly along rivers and streams (Semenchuk 1992). They use a variety of habitats such as grasslands, canyons, cultivated prairies, alpine tundra, foothills and dry mountain valleys for foraging and/or breeding (Bent 1961, Godfrey 1966, Beebe 1974, Marti and Braun 1975, Semenchuck 1992). Landscapes with a few trees may be used, but extensive forests are usually avoided. The foraging habitat of prairie falcons consists of open prairies with low vegetation containing ground squirrels (*Spermophilus* sp.) and small to medium-sized birds (Squires 1986, Steenhof 1988, Hunt 1993, Steenhof 1998). During winter, prairie falcons exploit habitat with little or no snow, particularly those areas used by horned larks (*Eremophila alpestris*) and other prey species. An important component of all prairie habitat is the availability of perch sites such as snags, fence posts, rock faces, utility poles and hay bales.

Prairie falcons breeding in Alberta and the United States prefer secure cliff nest sites and native prairie, which support a ground squirrel prey base (Hunt 1993, Marzluff et al. 1997, Banasch and Barry 1998, Steenhof 1998, Steenhof et al. 1999). Nest sites are frequently adjacent to a flowing river or a large water body where the falcons are able to use nearby uplands to hunt (Semenchuk 1992, Hunt 1993). Streamside cliff habitat is often unused because of the lack of an adjacent food source or a suitable cliff-nesting site (Oliphant et al. 1976). Some breeding occurs at higher elevations in the montane and subalpine regions, but known core breeding areas are at lower elevations on the prairies (Marti and Braun 1975, Johnsgard 1990, Biodiversity/Species Observation Database 2000). Prairie falcons prefer cliffs with an overhang that shelters a nest site in which they lay their eggs in a scraped out depression of fine debris or sand (Bent 1961, Edwards 1968). Prairie falcons will also use abandoned common raven (*Corvus corax*), golden eagle (*Aquila chrysaetos*) and ferruginous hawk (*Buteo regalis*) nests, as well as man-made holes or ledges dug into cliffs lacking natural nests (Bent 1961, Hickman 1971, H. Armbruster, pers. comm.). Some typical nest location records include the ledge of a building (Nelson 1974a), a tree (MacLaren et al. 1984), a subterranean cave entrance (Haak 1995), and transmission towers (Roppe et al. 1989, Steenhof et al. 1993).

Habitats used during migration are predominantly grasslands (Schmutz et al. 1991, Steenhof 1998). However, Dekker (1984)

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* See Appendix 1 for definitions of selected status designations.

observed prairie falcon migration through alpine, subalpine and montane areas of Alberta. If prey are available and the winter is mild, adult prairie falcons winter throughout their southern Alberta breeding range while juveniles typically migrate south to the United States and northern Mexico (Schmutz et al. 1991). There have even been reports of a few falcons over-wintering in cities as far north as Edmonton (Nelson 1974b, H. Armbruster, pers. comm., G. Court, pers. comm.).

CONSERVATION BIOLOGY

The prairie falcon, like many North American falconiformes, displays reversed sexual dimorphism; the adult female is larger (mean of 863g) than the adult male (mean of 554g) (Enderson 1964, Beebe 1974). Age of sexual maturity is usually two years, although some prairie falcons have been reported to breed after one year (Platt 1981, Palmer 1988, Tesky 1994). Courtship and mate selection occurs on the breeding grounds several weeks before laying (Fyfe et al. 1969, Tesky 1994). In Alberta, establishment of breeding territories usually begins in March, with egg laying occurring in mid to late April. Fyfe (1990) noted prairie falcon pairs on territories along the Oldman River as early as the fourth of February. If mild weather conditions prevail, some territories may be occupied throughout the winter (Young et al. 1986a, Fyfe 1990, H. Armbruster, pers. comm.).

Prairie falcons raise only one brood per year (Semenchuck 1992). If the first clutch is removed or destroyed early in the incubation, a second clutch is usually laid at an alternate nest site within 20 to 25 days (Edwards 1973, Snow 1974, Allen et al. 1986). Most nestlings are fledged by the third or fourth week of June (Fyfe 1992).

Prairie falcon clutch sizes range from two to six eggs, with four to five being the most common (Johnsgard 1990, Steenhof 1998). In Alberta, the mean number of eggs produced for the Oldman River was 4.5 eggs/clutch (n=53) (Fyfe 1992) and the mean number of eggs/clutch was 4.6 (n=19) along the Bow River (Edwards 1973). Incubation begins when laying of the clutch nears completion and lasts 29 to 33 days (Webster 1944, Enderson 1971). Eggs hatch over a period of 36 to 48 hours and young typically fledge at 36 to 41 days (Enderson 1964). Female prairie falcons do most of the incubation, while males provide food for the female at the nest, and occasional relief from incubation when she feeds, preens, and bathes (Holthuijzen 1989, Hunt 1993, H. Armbruster, pers. comm.). When the eggs hatch, both adults provide food for the young, but, the male provides the majority of the food throughout the young-rearing period (Holthuijzen 1990, Hunt 1993). Polygamy is a rare occurrence; however, R. Fyfe observed two incidences of one male prairie falcon providing food to two nesting females. Of the four females, only one raised young successfully (R. Fyfe, pers. comm.).

Juvenile prairie falcon mortality rate estimates are quite high, ranging from 65% (Denton 1975) to 85% (Runde 1987). In comparison, estimates of adult mortality rates are from 19% (Runde 1987) to 35% (Denton 1975). Life spans of prairie falcons could be as long as 20 years; the longest known banding recovery is 17 years and three months (Patuxent Wildlife Research Center Bird Banding Laboratory 2000). Runde (1987) calculated the prairie falcon life expectancy to be 15.6 years, but the estimated life expectancy for breeding adults ranges from 2.4 (Shor 1975) to 4.9 years (Runde 1987).

Prairie falcon nest sites are found on a variety of cliff substrates and are located at a wide range of heights (Bent 1961). Edwards (1973) found nest sites in his Alberta study area to be from 4.5 m to 9.0 m above the base of the cliff (n= 8). Runde and Anderson (1986) pooled nest site data (n=418) from numerous studies and found that the average nest site height was in the upper two-thirds of the cliff (mean of 29.3 m, range 2.1-154.4 m, from the bottom of the cliff).

Prairie falcons tend to return to the same nesting territory year after year. Studies in Alberta, Colorado and Wyoming have shown greater than 88% (n=115) of prairie falcons returned to the same territory used in the preceding year (Runde 1987). Cliff territories may have more than one nest site, which can be used alternately over a number of years by the breeding pair. Fidelity rates were highest in Alberta/Saskatchewan (96%) (n=70) and lower than 60% (n=unavailable) at the Snake River Birds of Prey National Conservation Area in Idaho (Runde 1987, Steenhof 1998, Snake River BPNCA 2000). Enderson (1964) suggested areas that have high nest fidelity, such as Alberta, usually have low breeding densities. One explanation for the lower site fidelity rate at Snake River BPNCA might be that an abundance of adults and nest sites along the Snake River might reduce the need for an individual to return to a previous territory (Steenhof 1998).

Nest sites or nesting territories that are used repeatedly are called traditional sites. There are six traditional sites in southern Alberta which have been occupied by prairie falcons for a minimum of 10 of the 26 years of monitoring (Fyfe 1997, Paton 1999a). One nest site has been used for 23 of the 26 years (undoubtedly not by the same falcons). Even though prairie falcons appear to exhibit a strong preference for certain nesting sites, they may be able to disperse to other nearby regions as long as suitable nesting and foraging habitats are available (Kirk and Banasch 1996). In Alberta and Saskatchewan, Runde (1987) calculated mean breeding dispersal distance for five banded adult prairie falcons to be 3.2 km and mean natal dispersal distance to be 51.4 km (n=64, range of 0-225.3 km).

Both sexes will vigorously defend the nest site, but prairie falcons tend to have undefended, although well-defined, hunting ranges (Haak 1982, Squires 1986, Hunt 1993). When prey are plentiful, the hunting ranges are relatively small, yet falcons have been tracked by radio telemetry hunting at least 20 km from the nest (Hunt 1993). Hunt (1993) estimated that the average minimum home range size for individual radio-tagged nesting prairie falcons (n=11) at the Bow River study site was 72 km^2. Home range estimates varied from 31 km^2 to 192 km^2 (minimum convex polygon). For a few of the pairs, the core foraging area was 26 km^2 to 40 km^2 and these core areas overlapped (38-100%) between adjacent territorial pairs (n=5). In the Bow River study (Hunt 1993), the native range with ground squirrel habitat was proportionately higher than expected within 15 km of the nest site (Wilcoxon paired sign-rank, $z=-1.82$, $p<0.05$). These data suggest that the availability of a ground squirrel prey base could be important to the distribution of prairie falcon home ranges (Hunt 1993, Steenhof 1998). The habitat use of 98 radio-tagged prairie falcons in an Idaho study (Marzluff et al. 1997) confirmed the conclusions of Hunt (1993), that prairie falcons use distinct core areas of native grassland within the foraging territory.

Very little is known about prey species and habitat use of post-breeding prairie falcons. Colorado researchers tracked 18 prairie falcons and noted that the minimum mean winter home ranges (30.2 km^2, range 3-38 km^2, n=10) appeared to be smaller than during the nesting season (Beauvais et al. 1992).

DISTRIBUTION

1. Alberta. - Prairie falcons breed in suitable cliff habitats along rivers or water bodies of the Grassland, Parkland and occasionally the Rocky Mountain Natural Region of Alberta (Semenchuck 1992) (Figure 1). Bird survey data and observation records show that the prairie falcon breeding range in Alberta occurs from Red Deer to the Alberta/Saskatchewan provincial boundary, south to the Canada/United States international border and west to portions of the foothills (Fyfe 1989, Semenchuk 1992, Wershler and Smith 1992, BSOD 2000, Campbell, unpubl. data). Nesting areas are primarily located in the

Figure 1. Prairie falcon distribution in Alberta.

Badlands, in riverbanks and coulees along the Bow, Red Deer, Milk, South Saskatchewan, and Oldman rivers and their tributaries. About 10 prairie falcon nest sites have been observed in the montane and mountain regions of the southwestern portions of the province (Nelson and Bauer 1980, Nelson 1987, J. Campbell, R. Fyfe, per. obsn.). One historic nesting record exists for the North Saskatchewan River southwest of Edmonton, and young were banded at this nest site near Devon (Semenchuck 1992, H. Armbruster, pers. comm.). There is no recent information to indicate that breeding occurrences continue this far north. As of 2000, a site just north of Red Deer is the most northern known breeding location (W. Nelson, pers. comm., G. Erickson, pers. comm.). There are also records of prairie falcon sightings at Beaverhill Lake (Dekker 1982), the Tonquin Valley in Jasper National Park and Kenelworth Lake west of Lloydminster (H. Armbruster, pers. comm.).

The prairie falcon's range extends over 94 000 km^2 of southern Alberta, with the core breeding population found in the Grassland Natural Region. Adults may winter in or near their breeding areas if prey are available, while hatch-year birds usually disperse from the breeding areas (Beebe 1974, Schmutz et al. 1991, Holroyd et al. 1995). From recovery data of banded falcons (n=96) Schmutz et al. (1991) determined that prairie falcons used two migration routes and wintering areas. One route was oriented in a southeasterly direction, migrating to Saskatchewan then south into the United States. The alternate route indicated that prairie falcons migrated southwesterly, passing over the Rocky Mountains to Washington, Idaho and Oregon.

2. Other Areas. – In Canada, a few nest sites are found in the dry south central interior of British Columbia (Cannings et al. 1987, Hooper 1997) as well as numerous sites in Saskatchewan (Godfrey 1966) (Figure 2). Occasionally, prairie falcon sightings have occurred in northern and eastern regions of western Canada such as Nulki Lake, British Columbia (Godfrey 1966, Campbell et al. 1990), St. Louis, Saskatchewan (Godfrey 1966), and Winnipeg, Manitoba (Koes 1989).

Prairie falcon breeding range outside of Canada includes the northern portions of North Dakota, western Nebraska and eastern Colorado, south to Baja California, southern New Mexico, western and northern Texas and as far south as northern and central Mexico (American Ornithological Union 1983, Johnsgard 1990, Lanning and Hitchcock 1991). Wintering birds are found south of Washington, Idaho and Oregon with some moving to the midwestern states or occasionally to the eastern seaboard. On the Pacific coast of the United States, prairie falcons migrate as far south as Mexico and Baja California.

POPULATION SIZE AND TRENDS

1. Alberta. - Prairie falcons that breed in Alberta are on the northern limit of their continental range, therefore their populations are small and vulnerable to environmental and habitat changes. Over the last 20 years, there has been a number of population estimates and assessments of prairie falcon population trends in Alberta. In a status report prepared for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Woodsworth and Freemark (1978) estimated that greater than 250 pairs nested in the province. Results from the Alberta Breeding Bird Atlas project led Semenchuck (1992) to believe that the Alberta population of prairie falcons was stable, or possibly increasing. In a 1996 COSEWIC report, Kirk and Banasch (1996) estimated the Canadian population to be 250 to 500 pairs.

The majority of the prairie falcon breeding population is located along the cliffs of the main river systems and their tributaries or adjacent canyons and coulees. Over the last 10 years, small scale surveys have been conducted in portions of the prairie falcon breeding range. The survey areas have been carried out in a consistent

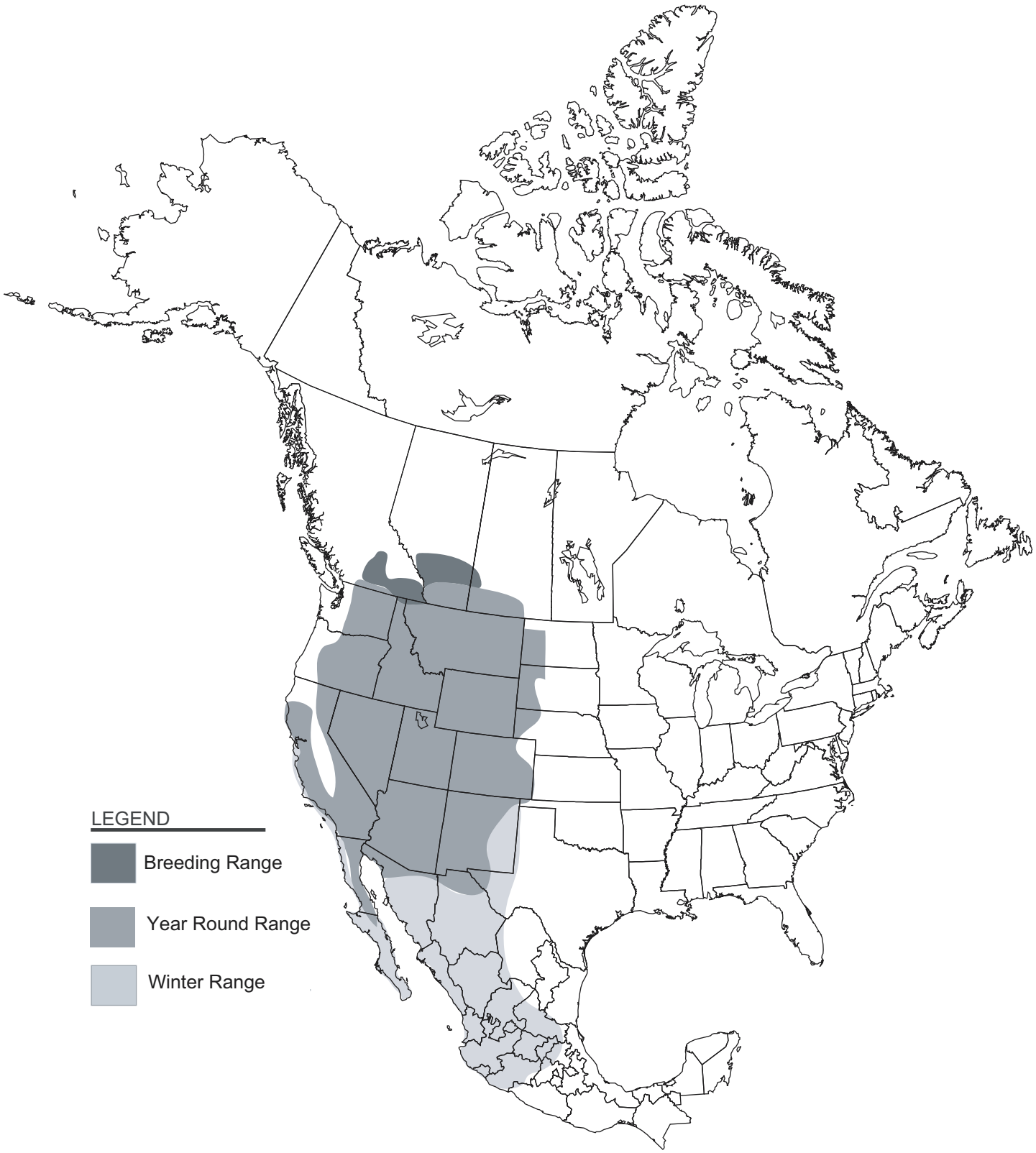

Figure 2. Distribution of prairie falcon in North America.

manner and over the same stretch of river or survey area (Table 1). In the same study area along the Oldman River Reservoir, surveys by Fyfe (1989 – 1997) and Paton (1999 - 2000) were conducted. Bow River surveys (Bow River 1) by Campbell have occurred along the same stretch of river for 15 years, checking traditional sites and documenting new nest sites. Surveys by Hunt (1993) (Bow River 2) occurred from Bassano Dam downstream to an unknown location before or at the confluence of the Bow River with the South Saskatchewan River. Surveys of the Milk River Natural Area were also conducted consistently over the same area.

Between 1974 and 1989-1990 there was a reduction from 18 to 13 occupied nest sites along a section of the Bow River (Canadian Wildlife Service, unpubl. data). It was found that unoccupied nest sites in the study area were located along the river, therefore, the availability of nest sites may not explain the reduction in population numbers (Holroyd 1995). This stretch of river became Hunt's (1993) study area in 1989.

Data regarding the number of successful breeding pairs have been gathered over 11 years of banding along stretches of the Bow River near Calgary and at the Bassano Dam (J. Campbell, pers. comm.). Recent surveys (1997-2000) along these stretches of the Bow River noted a reduction in the number of successful pairs, even with the excavation of new cliff nest ledges each year (n>3, per year). The Bow River 1 and Bassano Dam surveys are adjacent to each other, so it is likely that falcons could use nest sites in both areas. The maximum number of falcons on occupied nest sites on both surveys was 19 in 1990. There were seven occupied nest sites found in the same two survey areas in 2000.

The Milk River Natural Area has also experienced a reduction in the number of breeding pairs (Table 1). Wershler and Smith (1992) observed three occupied nests, one probable occupied nest, and two possible occupied nests in the Milk River Natural Area during a survey in 1991. Probable and possible nests were estimated based on behaviour of the birds, such as alarm calls, but the actual nest site was not observed. An additional survey of the same area (Shukster 1997) found one prairie falcon nest with a single chick.

The number of successful prairie falcon pairs on the Oldman River Reservoir varied from 13 to 5 between 1990 and 1997 (Fyfe 1997). Fyfe (pers. comm.) noted a large population of ground squirrels in 1989 and 1990, which appears to correspond with the high number of successful prairie falcon pairs. In subsequent years, the number of ground squirrels was lower (visual assessment), with fewer successful pairs of falcons (Table 1). It is possible the reduction of prairie falcon occupied sites is a response to the lower ground squirrel populations. Similar numbers of nesting pairs (mean = 5, range 4-6) were observed in 1974-1978 in the same general area of the Oldman River Reservoir study site (Fyfe 1992). This suggests prairie falcon populations in this area are not unusually low and could possibly increase as ground squirrel numbers increase.

Surveyors undertaking an aerial survey for peregrine falcons (*Falco pereginus*) also collected occupied prairie falcon nest site data (Table 1) (Corrigan 2000, Erickson 2000). The timing of these aerial surveys was based on the later nesting dates of peregrine falcons, therefore, prairie falcon pairs that failed earlier in the nesting cycle may have been missed (G. Court, pers. comm.). The total number of observed prairie falcon nest sites observed on these surveys represents a minimum number of birds since the focus was to locate nesting peregrine falcons. Surveys were conducted along the Red Deer River from Red Deer to Drumheller, Bow River, Oldman River, Milk River, St. Mary River and the South Saskatchewan River (Table 2) (Corrigan 2000). From Drumheller to the Saskatchewan border, the Red Deer river provides more suitable prairie falcon habitat than the areas upstream of Drumheller that were

Table 1. Number of occupied nest sites for prairie falcons in various geographic areas of Alberta.

Alberta location	Number of occupied nests	Year	Source
Oldman River Reservoir	10	1989	Fyfe 1992
Oldman River Reservoir	13	1990	Fyfe 1992
Oldman River Reservoir	8	1991	Fyfe 1992
Oldman River Reservoir	7	1992	Fyfe 1992
Oldman River Reservoir	5	1997	Fyfe 1997
Oldman River Reservoir	6	1999	Paton 1999a
Oldman River Reservoir	7	2000	Erickson 2000, Paton 2000
Bow River 1	11	1990	Campbell pers. comm.
Bow River 1	5	1991	Campbell pers. comm.
Bow River 1	7	1992	Campbell pers. comm.
Bow River 1	4	1997	Campbell pers. comm.
Bow River 1	5	1998	Campbell pers. comm.
Bow River 1	4	1999	Campbell pers. comm.
Bow River 1	3	2000	Campbell pers. comm.
Bassano Dam	8	1990	Campbell pers. comm.
Bassano Dam	6	1991	Campbell pers. comm.
Bassano Dam	5	1992	Campbell pers. comm.
Bassano Dam	3	1997	Campbell pers. comm.
Bassano Dam	2	1998	Campbell pers. comm.
Bassano Dam	5	1999	Campbell pers. comm.
Bassano Dam	4	2000	Campbell pers. comm.
Bow River 2	18	1974	Hunt 1993
Bow River 2	13	1989	Hunt 1993
Milk R. Nat. Area	3	1991	Wershler and Smith 1992
Milk R. Nat. Area	1	1997	Shukster 1997
Suffield NWA	4	1994	Banasch and Barry 1998
Suffield NWA	7	1995	Banasch and Barry 1998
S. Saskatchewan*	13	1999	Corrigan 1999 unpublished
Red Deer River from Red Deer to Drumheller	8	1999	Corrigan 1999 unpublished
Oldman River *	17	2000	Erickson 2000
Bow River *	25	2000	Erickson 2000
Milk River *	19	2000	Erickson 2000
St. Marys *	3	2000	Erickson 2000
Red Deer Complex *	17	2000	Corrigan 2000

* - Helicopter survey

examined during prairie falcon surveys. Therefore, the total number of prairie falcon nest sites may be higher along the Red Deer River downstream from Drumheller, but it has not been surveyed for many years and thus no estimates are available. Surveyors detected 101 occupied prairie falcon nest sites (Corrigan 2000, Erickson 2000). Erickson suggested the majority of the suitable nest sites for prairie falcons on the Oldman, St. Mary and the Milk Rivers were occupied (Erickson 2000).

Data from Corrigan (2000) and Erickson (2000) are considered to be the minimum number of occupied nest sites along each river. These data were used to provide a base number to compile a provincial estimate of prairie falcons (Table 2). Aerial survey numbers were used to estimate the minimum number of nesting pairs. Potential nesting habitat along tributaries and adjacent coulees was also considered, which would represent a minimum number of prairie falcon pairs for the complete river system. This is not the most rigorous method of determining a population, but considering the lack of current data, it is the best means available. The individuals making these estimates are those most familiar with the river system and the prairie falcon populations in the areas.

Based on survey results, personal communication and the amount of unsurveyed suitable habitat still remaining in the province, a rough estimate for Alberta is 200 – 250 prairie falcon pairs.

The number of breeding pairs and their breeding success are important in determining the population trends and status of prairie falcon populations. Ian Newton (1997) suggests the most representative results of breeding success are detected when the population is surveyed twice, once during the setting up of falcon territories to record the number of territorial pairs, and a second survey to document the number of successful territorial pairs and their productivity. This is a very good method by which to assess production, for it takes into account all kinds of failure, including non-breeding by territorial pairs (Steenhof and Kochert 1982, Newton 1998). Data that demonstrate breeding success, such as the number of young per territorial pair, are rare for Alberta prairie falcons. Fyfe (1992, 1997) indicated the number of young produced per successful territorial pair for the years 1989 to 1997 varied from a low of 2.58 (1989) to a high of 3.33 (1990). While clutch sizes in prairie falcons appear to be similar across their

Table 2. Minimum population estimates (# of pairs) and aerial survey observations by river basin for prairie falcons in Alberta.

River Basin	Aerial survey numbers	Estimate
Bow River	25	52 (G. Erickson and J. Campbell, pers. comm.)
Milk River	19	30 (G. Erickson pers. comm.)
Oldman River	24	38 (G. Erickson and D. Paton, pers. comm.)
S. Saskatchewan	13	27 (U. Banasch and H. Armbruster, pers. comm.)
St. Mary River	3	14 (G. Erickson and D. Paton, pers. comm.)
Red Deer River (Red Deer to Drumheller)	17	20-25 (R. Corrigan, pers. comm.)
Total	101	181

distribution, the number of fledglings per nesting attempt is highly variable, ranging from 1.2 young per territorial pair to 3.9 young per territorial pair (Table 3). Runde (1987) calculated that a median replacement standard of 2.0 young/territorial pair/year would be required to maintain a prairie falcon population through time. Maintaining a population through time requires a minimum number of breeding pairs. However, data on the number of individuals necessary for a minimum viable population of prairie falcons were not found in a review of relevant literature.

Although there has been considerable effort put forth to maintain and determine the status of prairie falcon populations in Alberta, it has not been structured in a way that would provide a provincial representation of population trends. Surveys of several core populations of prairie falcons have not occurred for 5-20 years (dependent on the area), thus it is impossible to suggest trends or population estimates with any level of confidence. Survey and monitoring methodologies are needed for the province. Logistically, it does not make sense to attempt to survey the whole province for prairie falcons. It is more worthwhile to return to previously surveyed areas in order to provide an index of population and productivity trends (G. Court, pers. comm.). These would be conducted over circumscribed river reaches of Alberta. Consistent data collected in this way already exist (e.g., Campbell, Bow River).

There are a number of data sources available that are used to provide insights into bird species trends. These include Christmas Bird Counts (CBC), Breeding Bird Surveys (BBS), Breeding Bird Atlases and migration monitoring. Prairie falcon data from CBC and BBS are available for Canadian falcons, but the limited number of detections for this species reduces the sensitivity of the analyses (Lehman and Bates 1997, Steenhof 1998). In August 1996, a group of 40 raptor biologists and statisticians at the Raptor Research and Technical Assistance Center in Boise, Idaho discussed the possibilities of developing current raptor monitoring programs into a continent-wide, statistically sound set of population tracking systems for raptors. At the workshop, it was suggested that BBS data are inadequate for monitoring prairie falcon trends, and CBC data may provide only limited trend information in some areas of the prairie falcon continental range (Lehman and Bates 1997). Breeding bird atlases are important methods of determining distribution data for birds and have provided a more precise assessment of bird distribution than was previously available (Cadman 1997, Downes et al. 2000). For the Alberta Breeding Bird Atlas, abundance data

Table 3. Prairie falcon productivity data.

Location	Young/territorial pair		Young/successful pair		Source
	Mean	n	Mean	n	
Bow River	*	*	2.5	9	Edwards 1973
Oldman River	2.7	60	3.8	41	Fyfe 1992
Alta./Sask.	2.5	62	3.6	44	Fyfe et al. 1969
Bow River	*	*	4.2	109	Campbell & Paton unpublished
Saskatchewan	2.8	31	4.3	21	Oliphant et al. 1976
Wyoming	2.7	201	3.6	138	Runde 1987
Colorado	3.9	27	4.4	24	Olendorff 1973
Colorado	1.2	67	1.9	55	Enderson 1964
Idaho	3.1	110	3.5	87	Ogden & Hornocker 1977

*No data collected

were collected only during the first year. Data analysis indicated the data were not collected consistently and the information was not collected in subsequent years (Cadman 1997). Alberta Breeding Bird Atlas confirmed that falcons bred in 74 squares, probable in eight and possible in 21 of a total 1303, 10 km x 10 km squares, which were surveyed in the Grassland, Parkland and Foothills Natural Regions (Semenchuk 1992). Determining population trends of raptors is also limited with raptor migration monitoring (Kjellen and Roos 2000, Lewis and Gould 2000). Effectiveness of raptor monitoring counts could be useful to monitor abundance over long time periods if monitoring methods are standardized and results are incorporated with other demographic survey techniques (Downes et al. 2000, Lewis and Gould 2000).

For prairie falcons in Canada and North America, a summary of data analyses of the CBC, the BBS, as well as migration monitoring is found in Kirk and Banasch (1996).

To determine what proportion of the Canadian and North America population of prairie falcons are found in Alberta, a cited estimate of 250 pairs for Canada was broken down into individual estimates for Alberta, Saskatchewan, and British Columbia (Woodsworth and Freemark 1981, Kirk and Banasch 1996, Steenhof 1998). According to the literature, British Columbia has six known nesting pairs and eight were estimated for the province. Saskatchewan biologists suggest there are 25 to 50 pairs in that province; the author selected 40 pairs as the number in Saskatchewan. The totals from British Columbia and Saskatchewan were subtracted from the 200 or 250, resulting in an estimate of 202 pairs for Alberta. Therefore, the minimum Alberta population of prairie falcons represents approximately 81% of the Canadian population and 6% of the continental population. The short-term population trend in Alberta is difficult to ascertain because there is a limited amount of up-to-date information. Using the most recent small-scale survey data as a basis for predicting, the population may be stable with small scale surveys suggesting local declines (Hunt 1993, Fyfe 1997, Kirk and Banascsh 1996, Paton 1999a, J. Campbell pers. comm.). Long-term trends will strongly depend on the amount of prairie grasslands, cliff nest sites, and prey species conserved in Alberta. A continued loss of prey, nesting, and foraging habitat will result in a steady decline of prairie falcon populations.

***2. Other Areas.* -** Palmer (1988) estimated the total North American population of prairie falcons to be 5000 to 6000 pairs. Steenhof (1998) suggests there is a minimum population of 4273 breeding pairs in North America. In British Columbia, the prairie falcon is considered to be a very rare and localized breeder (Campbell et al. 1990, Hooper 1997). There are only eight breeding prairie falcons estimated in British Columbia (six known pairs), yet the grasslands of British Columbia cover five million hectares in six main regions of the province (B.C. Ministry of Environment, Lands, and Parks 1995, Cooper 1998). Saskatchewan biologists (E. Wiltse, pers. comm., W. Harris, pers. comm.) estimate a population of 25 to 50 pairs in that province, with populations presently stable but at a level lower than historic numbers. There has been low productivity in the southwestern portion of Saskatchewan and a recent increase in productive pairs on the South Saskatchewan River (W. Harris, pers. comm.). A summary of unpublished prairie falcon population data (M. Gollup pers. comm.) indicates there has been a reduction in the number of successful pairs in the Milk River drainages of Saskatchewan. These data record a high of 13 successful pairs in 1976, 10 in 1985, a low of four in 1997, and 5 pairs in each year from 1998–2000.

In a 20-year study at the Snake River Birds of Prey Conservation Area, Steenhof et al. (1999) determined Idaho prairie falcon productivity rates were correlated with ground squirrel abundance. Falcon densities and reproduction in Idaho fluctuated throughout eight years of

surveys (dispersed over the years 1976 to 1994), possibly in response to population changes in prey, drought, and/or habitat fragmentation resulting from fires, agriculture and military activity (Steenhof et al. 1999). The number of breeding pairs in Idaho was at a high of 206 in 1976 and a low of 160 in 1994.

LIMITING FACTORS

There are a variety of important factors that limit populations of prairie falcons. A number of natural limiting factors for raptors are food supply, nest sites, predation, parasites and pathogens, and inclement weather. This section will discuss some of these factors, particularly those associated with human impacts. These factors include habitat alteration/loss, availability of nest sites, availability of food, contaminant levels and human disturbance. These factors can affect falcons in the following ways: (1) mortality of eggs; (2) mortality of offspring and adults; (3) changing habitat of a prey base and nest sites; or (4) disrupting behavior (Howard and Postovit 1987).

1. Habitat Alteration/Loss. - Throughout the prairie falcon's range, humans continue to cause dramatic changes to the habitat that this species depends upon for foraging. Cultivation of native grasslands for cropland, land development for commercial or recreational purposes, and human presence in the vicinity of nest sites may mean the difference between survival of nestlings or complete nest failure (Anderson and Squires 1997). One of the most important factors related to these human activities is the negative effect they have on the prairie falcon's most important food source, the Richardson's ground squirrel (*Spermophilus richardsonii*).

Cropland agriculture practiced on a large scale is detrimental to breeding prairie falcons, which are dependent upon ground squirrels as a food source (Steenhof 1998). In a study along the Bow River, Hunt (1993) determined that prairie falcons had core hunting habitats with lower proportions of irrigated cropland than expected. Only 2.9% of the total area of native grassland contained ground squirrels and 94% of the prairie falcon diet was obtained from the ground squirrel colonies (Holroyd 1995). The cultivation of grasslands could result in a loss of these colonies, which in turn would result in a reduction of falcon foraging habitat. A change of land use practices to cropland agriculture has already caused reductions in prairie falcon habitat in southern Alberta (Kirk and Banasch 1996). Cropland agriculture, if practiced on a small scale, may benefit prairie falcons when interspersed with areas of native grasslands containing colonies of ground squirrels and habitat for other prey species (Hunt 1993, Marzluff et al. 1997).

While studies have found native grasslands to be important to ground squirrels, research in Alberta indicates Richardson's ground squirrels are able to maintain a population in an area consisting of non-native grasses (Michener 1996). The long-term study successfully re-established a population of Richardson's ground squirrels in a disturbed area, revegetated by non-native grasses, and may indicate that this species is not totally dependent upon native plant species for reproduction or survival. Michener (1996) suggested the success of the release site was a result of the availability of old burrow systems (from a previous extirpated population), even though the burrows had been abandoned for five years. An attempt to colonize a second pasture was not successful. The recolonization of "tame" pastures or colonization of previously unoccupied habitat by ground squirrels may be very difficult, therefore, it is important to conserve ground squirrel colonies and the grasslands they prefer.

Across the prairie landscape of western Canada, native grasslands are being replaced by agricultural, urban, and industrial land developments (World Wildlife Fund Canada 1988, Prairie Conservation Forum 2000). This development of land has severely fragmented the

Alberta prairie (Prairie Conservation Forum 2000). Major sources of fragmentation are cultivation, increasing road densities, oil and gas development, and dams. The number of acres under irrigation in the 13 irrigation districts of southern Alberta increased from a 1993 total of 0.9 million to 1.2 million acres in 2000 (Alberta Agriculture 2000). A large portion of the irrigated land is adjacent to major river systems, which may be critical prairie falcon breeding and hunting habitat (Hunt 1993, Holroyd 1995). Wildlife biologists (CWS unpublished) documented a prairie falcon population reduction from 18 pairs in 1972 to 13 pairs in 1988 along a stretch of the Bow River. Over a similar time period, agricultural land use increased 25% within 6 km of the same Bow River study (Hunt 1993, Holroyd 1995). Kirk and Banasch (1996) noted that this study only represented a small proportion of the species' Alberta range. They also noted that impacts of other land use changes may have been missed, and/or cliff nest sites may have collapsed.

Extensive areas of cropland can result in a loss of habitat for the ground squirrels (Hunt 1993, Marzluff et al. 1997), while activities such as ranching may help protect the prairie against fragmentation because ranchers prefer large blocks of pasture land to graze cattle. Livestock grazing in Alberta occurs in much of the foraging habitat used by prairie falcons, however, the effects of grazing on the falcon lifecycle are not well studied. In New Mexico, Platt (1974) suggested that overgrazing by cattle is one of the major threats to prairie falcon population stability as it reduces the plant cover and the food resources necessary for prey species' survival. However, although this may be true for New Mexico's arid environment, it may not apply to Alberta with the exception of an extremely severe drought. Michener (1996), during her southern Alberta study of ground squirrel use of short grass prairie areas, notes observations that concur with the author's personal observations that high population densities of ground squirrels can be maintained on over-grazed pastures. Most prairie mammals and birds are adapted to moderate levels of grazing, and yet some species such as the Richardson's ground squirrel have survived well in heavily-grazed grasslands (Bradley and Wallis 1996).

Oil and gas development occurs over a large portion of the prairie falcon range in Alberta, but there is a paucity of information available that documents the effects of such activities. There are 75 000 wellsites and 45 000 km of access roads, and a total of 50 000 km of highways on Alberta's prairie (excluding city roads). When development destroys nest sites and alters prey habitat, the falcons are negatively affected (Steenhof 1998). Studies on the effects of mining and low level recreation, as well as low level oil and gas activities in Wyoming, Montana and Idaho indicate that prairie falcons are fairly accepting of these activities on their foraging areas. (Holthuijzen 1989, Harmata 1991, Squires et al. 1993). The most significant impacts of resource extraction to falcons are likely caused by fragmentation of the prairie region and the loss of ground squirrel colonies.

In a few areas of southern Alberta, dams have been created to collect water for irrigation (Young et al. 1986b, D.A. Westworth and Associates 1992). Flooding from the establishment of reservoirs has resulted in a loss of prairie falcon nest sites (Fyfe 1990) and of their ground squirrel prey base (Alberta Public Works 1998). Over time, dams may create cliffs wherein nest sites may occur or can be dug for falcons (H. Armbruster, pers. comm.). As part of the Oldman River Reservoir mitigation activities, artificial nest sites were constructed to provide alternative nest sites for raptors (Fyfe 1990). Prairie falcons successfully occupied these new sites, maintaining their nesting numbers. Fyfe (1990) documented impacts of disturbance to prairie falcons at nest sites as a result of construction of the Oldman River dam and reservoir. The study documented three desertions, which may be attributed to intense construction disturbance. Observations from

Fyfe's (1990) study parallel a study from Idaho by Holthuijzen (1989), that suggested prairie falcons can have a remarkable tolerance for disturbance if it occurs later in the nesting cycle and is non-direct (i.e. land noises and human activity present but at a distance). Levenson and Koplin (1984) suggested raptors that nest in areas of relative seclusion may respond differently to disturbance than raptors already desensitized by exposure to disturbance.

Berry et al. (1998) conducted a study on the effects of suburban expansion on winter abundance of raptors near Boulder, Colorado. The results show that only 5-7% urbanization was enough to cause some raptors (bald eagles (*Haliaeetus leucocephalus*), ferruginous hawks, rough-legged hawks (*Buteo lagopus*) and prairie falcons to avoid the developed study areas.

2. Availability of Nest Sites. - The availability of suitable cliffs, banks or escarpments is an important breeding requirement for prairie falcons. Such a specialization in nest site requirements makes this falcon one of the least versatile nesters among Alberta raptors (Banasch and Barry 1998). Many of the nest sites are potholes in dirt cliff banks. Annual high water, extreme high water events or rain eventually erode the cliff face, and the cliff slumps into the river, destroying the nest site (Banasch and Barry 1998). At least 9 of the 29 known sites on the South Saskatchewan River have been lost as a result of slumping (Banasch and Barry 1998).

3. Availability of Food. - Prairie falcons utilize a variety of prey species, including small mammals, small to medium-sized birds, reptiles and insects (Beauvais et al. 1992, Hunt 1993, Banasch and Barry 1998). In southwestern Idaho, researchers found that prairie falcon reproduction appears to be influenced by the abundance of ground squirrels, whose populations are negatively affected by droughts (Steenhof 1998).

Over the last decade, there has been a decrease in ground squirrel numbers on portions of Alberta's prairie (Jones 1993, Schmutz 1999) while there had been an increase in fragmentation of the prairie landscape (Prairie Conservation Forum 2000). There is little historic information available to gauge the impact of the ground squirrel decline on Alberta prairie falcon populations. Little is known about the effects of habitat fragmentation on ground squirrels. Thus far, ground squirrels have been able to persist in human-modified habitats in "island" populations surrounded by expanses of cultivated fields (Michener 1997). In response to low densities of ground squirrels, prairie falcons in Idaho have been shown to demonstrate poor reproductive success despite having expanded their home ranges to access islands of native grassland habitat that contained ground squirrels (Marzluff et al. 1997). Marzluff et al. (1997) suggested that these falcons in Idaho could not range more than 300 km^2 to provide adequate food and care for their young. Prairie falcons have also been shown to increase their consumption of small to medium-sized birds in years when ground squirrel numbers were low. However, in these years, prairie falcon productivity was found to be lower (Steenhof and Kochert 1988, McFadzen and Marzluff 1996, Steenhof 1998).

Prairie falcons require a large number of ground squirrels to raise a brood of nestlings, however, the number of ground squirrels needed to support an entire prairie falcon population is unknown. The ferruginous hawk, feeds extensively on ground squirrels and is estimated to consume 400 to 480 Richardson's ground squirrels per breeding season to maintain the pair and its young (Michener 1997, Environment Canada 2000). Research on a section of the Bow River found the prairie falcon's diet consisted of 68% ground squirrels (n = 169) and 27% (n = 67) small birds such as horned larks, western meadowlarks (*Stunella neglecta*), and European starlings (*Sturnus vulgaris*) as well as 5% (n = 14) small mammals. Ground squirrels

comprised 93.5% of the prey biomass in direct observations and 64.45% in analysis of prey remains and pellets.

4. Contaminant Levels. - Prairie falcons and peregrine falcons nest in similar habitats in western Canada and the United States. During the 1960s and 1970s, prairie falcon populations did not decline as substantially from the effects of pollutants as did peregrine falcons. Since the prairie falcon summer diet consists mainly of ground squirrels, Fyfe et al. (1978) suggested these falcons were not exposed to enough organochlorine pesticides to experience severe population declines. Fyfe et al. (1969) found that prairie falcon eggs contained extreme variability in the levels of pesticides, suggesting that some prey were heavily contaminated with organochlorine pesticides while others were not. In addition to pesticides, mercury levels, which were high in prairie falcon eggs collected in the late 1960s, declined in Alberta prairie falcon populations because of restrictions on the use of mercury compounds as seed dressings (Fimreite et al. 1970, Fyfe et al. 1976). The use of harmful chemicals and poisons continues (Environment Canada 2000), although chemical contamination of raptors has decreased.

5. Human Disturbance. - A survey undertaken by LeFranc and Millsap (1984) identified human-associated disturbance as a major threat to raptor populations. Declines in raptor populations as a result of human disturbances were documented in a number of other studies (Craighead and Mindell 1979, Swenson 1979, Richardson and Miller 1997). The most flagrant human disturbance of falcons is the deliberate shooting of raptors (Howard and Postovit 1987). Historically, persecution of prairie falcons in Alberta was a problem (Van Tighem 1967, Dekker 1985). The situation today is likely much better than 20 or 30 years ago because people realize the beneficial role of raptors in pest control (Environment Canada 2000). Fyfe and Olendorff (1976) discovered that the adult's feet rest underneath the eggs during incubation and if humans startle the adult the eggs or nestlings may be kicked out of the nest. Desertion of eggs or young by parent birds varies amongst raptor species and individual pairs, but is more likely to occur earlier rather than later in the breeding season (Fyfe and Olendorff 1976).

STATUS DESIGNATIONS

1. Alberta. - The prairie falcon is designated as a "nongame species" under Alberta's *Wildlife Act*, meaning it is illegal to kill or capture without the appropriate permits (Province of Alberta 2000).

The species was downlisted from the 1991 "Blue List" (Alberta Fish and Wildlife 1991) (see Appendix 1 for status definitions) to "Yellow A" in 1996 (Alberta Wildlife Management Division 1996) because of new methodology used in the 1996 status exercise, rather than because of a known change in prairie falcon populations (G. Court, pers. comm.). Currently, the prairie falcon is considered "Sensitive" in Alberta because of concerns about adequate ground squirrel prey base and availability of secure nest sites in southern Alberta, as well as a reduction in its northern range (Alberta Sustainable Resource Development 2001). The Alberta Natural Heritage Information Centre (ANHIC) ranks this species as S3 indicating the frequency/distribution of breeders may be rare and local throughout its range, or in a restricted range it may be abundant in some locations (ANHIC 2001).

2. Other Areas. - Historically, prairie falcons have been identified as an endangered species in Canada because of their restricted range (Godfrey 1970). In 1981, Woodsworth and Freemark suggested prairie falcon populations were stable and possibly increasing in Canada. Currently, the prairie falcon is ranked "Not At Risk" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2001). COSEWIC listed the prairie falcon as "not in any category" in 1978 (Woodsworth and

Freemark 1978), "Not At Risk" in 1982 because of increasing populations (Woodsworth and Freemark 1981), and "Not At Risk" in 1996 because of a lack of evidence of overall decline or population change (Kirk and Banasch 1996). As a result of the lack of recent data and the fact that the species is at the northern limits of its range, Kirk and Banasch (1996) suggested the prairie falcon is a species of long-term concern and should be monitored. The prairie falcon's Global Heritage Status Rank is G5, meaning its status is "Secure" (NatureServe 2001). British Columbia designated the prairie falcon as S2, indicating this species is "imperiled" provincially as a result of a low breeding population (British Columbia Conservation Centre 2001). Saskatchewan ranked the prairie falcon as S4, suggesting populations are "apparently secure" but may be of long-term concern (Saskatchewan Conservation Data Centre 2001).

RECENT MANAGEMENT IN ALBERTA

Management actions have included activities such as a prairie falcon re-introduction program at Fish Creek Provincial Park (Depper 1988), the fostering of chicks (Fyfe et al. 1978, Fyfe 1989), the rehabilitation of injured birds at certified centres, the sampling of eggs for pesticides (see limiting factors) and the assessment of foraging habitat using Landsat imagery (Usher 1993). During the early peregrine falcon recovery efforts, there was experimental cross-fostering of prairie falcon chicks using red-tail and Swainson's hawks to determine the potential of this method for rearing young peregrines. Construction of artificial nest holes has been used in Alberta to replace nest sites lost from natural causes and from human disturbance (Paul and Steele 1976, Fyfe 1989). During the 1970s, Canadian Wildlife Service personnel dug new nest holes and ledges in the cliffs adjacent to the Bassano Reservoir that resulted in 12-13 pairs of falcons using the cliff sites to raise young. All of these sites have since slumped into the reservoir, but today three to four pairs of falcons continue to nest on the reservoir (J. Campbell, pers. comm.). These nest sites are used by prairie falcons and canada geese (*Branta canadensis*) and are an effective way to help maintain the number of available nest sites (Smith 1985, Banasch and Barry 1998).

A monitoring program was established to evaluate the effects of dam construction on raptors and the effectiveness of artificial nest sites to mitigate for the loss of nest sites at the Oldman River Dam (Young 1988, Fyfe 1989). For most of the 10 years of monitoring at the Oldman River Reservoir, approximately 50% of the nest sites occupied within the study area were located in artificial or improved nest sites (Paton 1999b). Six Wildlife Control Areas (public exclusion areas) were established along the Oldman River Reservoir to specifically protect birds of prey. Legislation was put forward and the project was monitored (Fyfe 1990). The technique has been effective with three sites being used by prairie falcons and one used by golden eagles.

A Masters of Science thesis studying the diet and habitat use of nesting prairie falcons in an agricultural landscape was completed in 1993 (Hunt 1993). Hunt (1993) determined that ground squirrel colonies near nest sites are very important. The average distance falcons with radio transmitters delivered prey was 6 km for ground squirrels and 4 km for bird prey. As a result of the close relationship of these falcons with their prey, it is likely impossible to effectively manage falcons without managing their prey and habitat.

In 1994, a wildlife inventory of the Canadian Forces Base Suffield National Wildlife Area was undertaken by the Canadian Wildlife Service. A component of the report determined which raptors occurred on the proposed Suffield National Wildlife Area and documented their ecological relationships. Data reviewed by Banasch and Barry (1998) indicated that from 1966-1980, 5 to 11 pairs of prairie falcons occupied 29 different nests in the study area. Conservation and management of prairie habitats are important since they are linked to the ability

of prairie falcons to maintain and increase their population numbers. Numerous organizations are focussed on maintaining grassland habitat in Alberta. The North American Waterfowl Management Plan is working in cooperation with the agriculture sector, to develop an ecological approach to land management as well as to protect and enhance wetland habitat (Baydack 1995). The Permanent Cover Program has removed thousands of hectares from annual cropping. The Alberta Conservation Association has implemented projects which provide habitat for prairie falcons and other non-game animals (McMaster and Davis 2001). Conservation education programs and literature, such as *How Landowners Can Help to Conserve Raptors, A Landowners Guide: Prairie Raptors, Operation Grassland Community and Operation Burrowing Owl* provide landowners with information and techniques to conserve raptors and habitat (Holroyd et al. 1995, Environment Canada 2000). Irrigation districts have developed programs to enhance biodiversity and to assess the impacts of irrigation on the natural environment (Russel and Craig 1993). The Prairie Conservation Forum brought together stakeholders to develop a framework for prairie ecosystem management and has provided opportunities for discussion of the application of ecosystem management on the prairies (Bradley and Wallis 1996). The conservation of native prairie grasslands and will help to maintain and enhance critical habitats of benefit to the prairie falcon populations.

SYNTHESIS

Significant changes driven by human activities have occurred across the prairie ecosystem. These changes have had an impact on birds of prey (Houston and Schmutz 1995, Schmutz 1999), but little is known about the consequences to prairie falcons. Earlier estimates of prairie falcon population trends suggested that the population might be stable or increasing (Woodsworth and Freemark 1981, Semenchuck 1992, Kirk and Banasch 1996, Fyfe 1997). However, surveys of portions of the provincial population indicate there has been a reduction over 5 to 10 years in the number of successful nesting pairs (Table 1). Factors such as low ground squirrel numbers, loss of nesting and foraging habitat, and disturbance, may be affecting prairie falcon breeding numbers. It is likely a combination of several of these factors. Further investigation is needed to clearly and accurately determine the provincial status of the prairie falcon through standardized surveys of critical portions of its range. A comparison of nesting territories of the last ten years using CWS data from the 1960s and 1970s would be a good starting point, as well as the incorporation of existing survey areas such as the Bow River (Campbell) into a monitoring program. The Alberta population estimate was determined by six raptor specialists to be 200 - 250 pairs (Table 2).

Although it may be impossible to have an annual monitoring program which could provide data for all aspects of population dynamics (abundance, distribution, productivity, and survivorship), it is important to ensure that, at a minimum, species abundance and productivity are tracked (Downes and Welsh 1997, Newton 1997). Monitoring can provide insights into population trends and changes in the distribution of birds, but its main value is to help assess the status of species and set priorities for research and conservation actions. Surveys and periodic monitoring of core populations of prairie falcons will help to ensure that negative trends in populations are detected. Investigations into the habitat requirements and ecology of prairie falcons and their preferred prey species, the Richardson's ground squirrel, will provide insights into maintaining a critical prey base. Alberta prairie falcons exhibit strong nest site fidelity, therefore maintenance and conservation of traditional nesting sites and prey populations adjacent to these nest sites would enhance efforts to conserve them. These efforts are steps in maintaining the biodiversity of the prairie ecosystem and an integral component of this system: the prairie falcon.

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APPENDIX 1. Definitions of selected legal and protective designations.

A. The General Status of Alberta Wild Species 2000 (after Alberta Sustainable Resource Development 2001)

2000 Rank	1996 Rank	Definitions
At Risk	Red	Any species known to be at risk after formal assessment and designation as Endangered or Threatened in Alberta.
May Be At Risk	Blue	Any species believed to be at risk. These species will require a detailed assessment for possible formal designation as Endangered or Vulnerable.
Sensitive	Yellow	Any species known to be, or believed to be, particularly sensitive to human activities or natural events.
Secure	Green	Any species known to be, or believed to be, not at risk.
Undetermined	Status Undetermined	Any species where not enough information exists to adequately use the ranking system (exceptional cases only).
Not Assessed	n/a	Any species known or believed to be present but which have not yet been evaluated.
Exotic/Alien	n/a	Any species that have been introduced as a result of human activity.
Extirpated/Extinct	n/a	Any species no longer thought to be present in the jurisdiction or are believed to be extinct.
Accidental/Vagrant	n/a	Any species occurring infrequently and unpredictably outside their usual range.

B. Alberta's *Wildlife Act*

Species designated as "Endangered" under Alberta's *Wildlife Act* include those defined as "Endangered" or "Threatened" by *A Policy for the Management of Threatened Wildlife in Alberta* (Alberta Fish and Wildlife 1985):

Endangered	A species whose present existence in Alberta is in danger of extinction within the next decade.
Threatened	A species that is likely to become endangered if the factors causing its vulnerability are not reversed.

C. Committee on the Status of Endangered Wildlife in Canada (after COSEWIC 2002)

Extinct	A species that no longer exists.
Extirpated	A species that no longer exists in the wild in Canada, but occurs elsewhere.
Endangered	A species facing imminent extirpation or extinction.
Threatened	A species that is likely to become endangered if limiting factors are not reversed.
Special Concern	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk	A species that has been evaluated and found to be not at risk.
Data Deficient	A species for which there is insufficient scientific information to support status designation.

D. Heritage Status Ranks: Global (G), National (N), Sub-National (S) (after NatureServe 2001)

G1/N1/ S1	**Critically Imperiled**: Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction. Typically 5 or fewer occurrences or very few remaining individuals (<1,000) or acres (<2,000) or linear miles (<10).
G2/N2/ S2	**Imperiled**: Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction or elimination. Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000) or acres (2,000 to 10,000) or linear miles (10 to 50).
G3/N3/ S3	**Vulnerable**: Vulnerable globally either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction or elimination. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals.
G4/N4/ S4	**Apparently Secure**: Uncommon but not rare (although it may be rare in parts of its range, particularly on the periphery), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals.
G5/N5/ S5	**Secure**: Common, widespread, and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals.
GX/NX/ SX	**Presumed Extinct** (species) - Believed to be extinct throughout its range. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered. **Eliminated** (ecological communities) - Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.
GH/NH/ SH	**Possibly Extinct** (species) - Known from only historical occurrences, but may nevertheless still be extant; further searching needed. **Presumed Eliminated** (Historic, ecological communities) - Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration, for example, American Chestnut (Forest).

E. United States Endangered Species Act (after National Research Council 1995)

Endangered	Any species which is in danger of extinction throughout all or a significant portion of its range.
Threatened	Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

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