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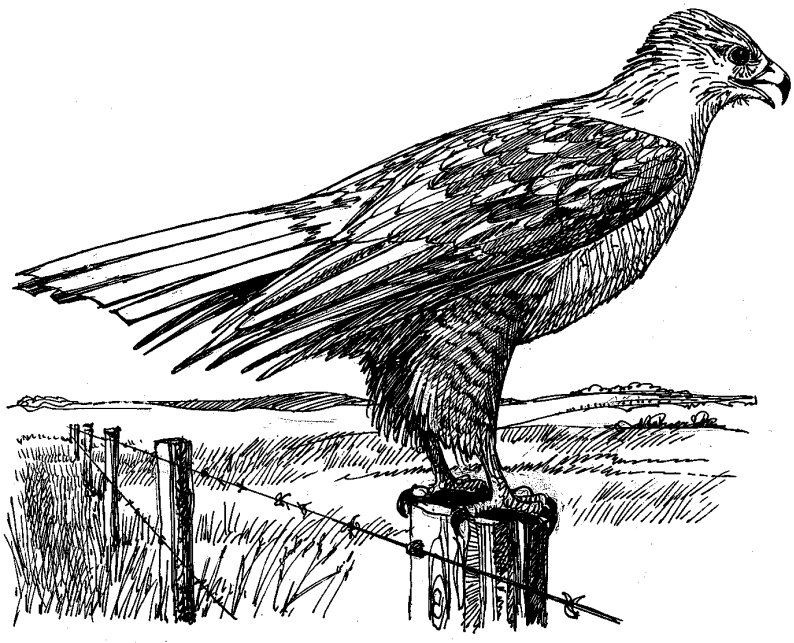
Population Estimates and a Survey Protocol for Ferruginous Hawks in Alberta



Alberta Species at Risk Report No. 70

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

Population Estimates and a Survey Protocol for Ferruginous Hawks in Alberta

Brad N. Taylor

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EXECUTIVE SUMMARY

The ferruginous hawk (*Buteo regalis*) is one of Alberta's "At Risk" species and is considered "Threatened" under Alberta's *Wildlife Act*. Recent declines in the ferruginous hawk population in Alberta prompted an evaluation of the current technique for surveying ferruginous hawks.

Recent population estimates have had relatively low precision with confidence intervals ranging from 30% to 50% of the estimated population. This is due to the clumped distribution of the species. Since native prairie is a critical component of ferruginous hawk habitat, five combinations of native prairie cover were evaluated in order to stratify the Grassland Natural Region. Using two strata, greater than and less than 50% native prairie, increases the precision of the population estimate.

The past survey protocol has not been significantly altered. It provides four years of data spanning a 20 year period and the potential to map habitat changes and monitor other grassland species such as the burrowing owl (*Athene cunicularia*), loggerhead shrike (*Lanius ludovicianus*), Swainson's hawk (*Buteo swainsoni*), upland sandpiper (*Bartramia longicauda*), and Richardson's ground squirrel (*Spermophilus richardsonii*). Additional quadrats have been added in the greater than 50% strata in order to increase precision. Modifications have also been made to the data sheet to provide for annual trend analysis and to collect more precise breeding habitat data.

This design is intended to span another 20 years with full surveys (150 quadrats) being conducted at five year intervals. A minimum of 30 monitoring quadrats will be surveyed annually and evaluations of the protocol and population estimate will be generated every five years.

1.0 INTRODUCTION

Many species at risk are experiencing declining population trends and exhibit clumped distributions. This makes monitoring population trends and determining population estimates for these species a difficult task. It is important that standardised protocols be utilised for monitoring programs to increase the effectiveness of management practices.

The Alberta ferruginous hawk (*Buteo regalis*) population has fluctuated since surveys began in 1982. After it initially increased and stabilised, the population exhibited decline over the past 10 years (Stepnisky et al. 2001). Concerns over the apparent decline of the ferruginous hawk population in the province prompted an evaluation of the current survey methodology.

The primary objectives of this paper are to:
1. Re-evaluate the ferruginous hawk population estimate by stratifying the sample units using the native prairie vegetation baseline inventory data.
2. Develop the standardised protocol for monitoring population trends of ferruginous hawk in Alberta.

2.0 POPULATION ESTIMATE

2.1. Background

Ferruginous hawk surveys in Alberta were initiated in 1982 and repeated in 1987, 1992, and 2000. Quadrats[1] 4 miles by 4 miles (6.4 x 6.4 km) in size were randomly selected across the known ferruginous hawk range in Alberta (Schmutz 1982). All ferruginous hawks and active nests were counted and an estimate of breeding pairs was extrapolated from the number of active nests (Schmutz 1982, 1987, 1993; Stepnisky et al. 2001). Ferruginous hawk populations (Table 1) increased from 1982 to 1987 (Schmutz 1987), were similar between 1987 and 1992, and decreased from 1992 to 2000 (Stepnisky et al. 2001).

Table 1. Historic Ferruginous Hawk Population Estimates

Year	Population Estimate (Breeding Pairs)	Confidence Interval (%)
1982	1059	40.5%
1987	1770	28.5%
1992	1702	30.6%
2000	731	50.1%

All four estimates have been based on one stratum. However, Schmutz (1987, 1993) indicated a significant negative correlation between percent cultivation and the number of active ferruginous hawk nests. Ferruginous hawk also exhibit clumped dispersion using only one strata; however, in years with large numbers of hawks (i.e. 1992), dispersion

[1] Quadrat is meant to be synonymous with the terms block and plot which have been used in previous reports

within native prairie quadrats that have greater than 50% native prairie are not significantly different from a Poisson distribution indicating random distribution. It is expected that by using the native prairie cover data available, accurate strata can be developed to reduce confidence intervals for ferruginous hawk population estimates.

2.2. Methods

This analysis was applied to the entire Grassland Natural Region (Figure 1) as opposed to the ferruginous hawk range boundaries (74,000 km^2 and 77,000 km^2) originally defined by Schmutz (1982, 1987). In past surveys, the majority of the fescue subregions have been excluded. These subregions will be included in the survey because ferruginous hawks are known to nest there.

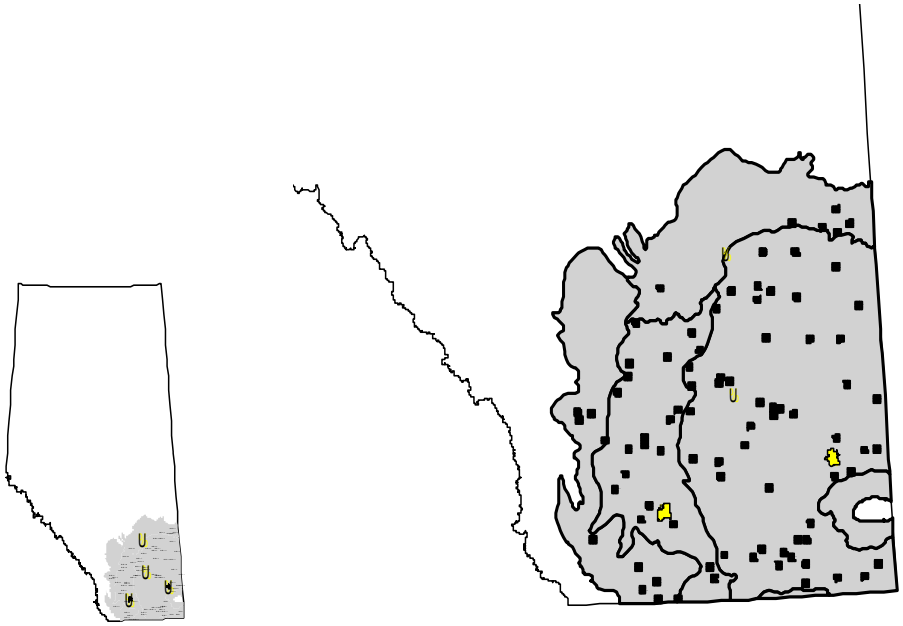

Figure 1. Grassland Natural Region* with ferruginous hawk quadrats from 2000

* See Achuff 1994

Quadrats were stratified according to native prairie class. Native prairie class is the total percent of all grassland components as determined by the Native Prairie Vegetation Baseline Inventory (Prairie Conservation Forum 2000). All ferruginous hawk quadrats were plotted in Arcview 3.2 and combined with the native prairie vegetation cover data. Total percent native prairie data for the 64 quarter sections in each quadrat were averaged to determine the average percent native prairie for each quadrat. Each quadrat was then placed in one of four strata (Table 2).

Five combinations of the four strata (Table 3) were analysed using ferruginous hawk data from 1992 and 2000 to determine the stratification that offered the most precision.

Table 2. Characteristics of native prairie strata

% Native Prairie Strata	Area (km^2)	Equivalent Quadrats	Quadrats Surveyed in 2000
76 – 100	35,100	847	20
51 – 75	4,500	109	18
26 – 50	6,900	166	19
0 – 25	50,300	1215	29
Total	96,800	2,337	86

Table 3. Percent native prairie in each stratification combination

Combination	Strata 1 (%)	Strata 2 (%)	Strata 3 (%)	Strata 4 (%)
1	0 – 100	n/a	n/a	n/a
2	51 – 100	0 - 50	n/a	n/a
3a	76 – 100	26 – 75	0 - 25	n/a
3b	51 – 100	26 – 50	0 - 25	n/a
4	76 – 100	51 - 75	26 - 50	0 – 25

Population estimates (in terms of breeding pairs) were based on the number of nests observed per quadrat and extrapolated for each stratum (Krebs 1989). After the best stratification scheme was selected, strata were compared using a t-test to ensure the mean number of nests per quadrat in each strata were significantly different. This was done in order to validate the stratification selection.

Ferruginous hawk data from 1992 and 2000 were used in the analysis since the native prairie cover was developed from 1991 - 1993 air photos (Prairie Conservation Forum 2000). Also, in relative terms 1992 had a high number of ferruginous hawks and 2000 had a low number.

2.3. Results

Use of two strata, greater than 50% and less than 50% native prairie, appears to yield the tightest confidence intervals for ferruginous hawk breeding pairs (Table 4). This is consistent in both high and low years.

Table 4. Population estimates and associated confidence intervals (%) using a stratified approach for ferruginous hawk breeding pairs from 1992 and 2000 survey data

Number of Strata	Population Estimate		Confidence Interval (%)	
	1992	2000	1992	2000
4	2177	947	35.4	66.4
3a	2197	950	35.2	66.1
3b	1992	807	29.8	51.4
2	2072	888	27.1	47.9
1	2140	924	30.8	50.8

By stratifying the survey area, the mean number of nests per strata was established. In 1992 and 2000, the mean number of nests per quadrat in Strata 1 was at least 3.5 times that of Strata 2 (Table 5). The number of nests per quadrat was significantly different in each strata in both 1992 ($p < 0.0001$) and 2000 ($p < 0.05$). However, given the limitations of the t-test with respect to normal distribution, this can only serve as an approximate guide.

Table 5. Comparison of the mean number of nests per quadrat between strata and between years

Year	Strata		P – value
	> 50%	< 50%	
1992	1.58	0.40	< 0.0001
2000	0.65	0.18	0.037

2.4. Discussion

Utilising two strata (> 50% and < 50% native prairie) appears to be the most consistent in producing the lowest confidence intervals. Although precision is still relatively low, it is improved. By increasing the number of quadrats surveyed in the greater than 50% strata, the confidence intervals should drop further.

The number of adult ferruginous hawks per quadrat was also examined as a possible method for projecting population estimates; however, this method can not identify breeding pairs and there is also the potential error of double counting. Active nests should be used as the population estimator. In order to maintain consistency from year to year and so that nesting birds are not intruded upon, a simple definition of active nest should be used. A stick nest either on the ground or on an elevated structure (e.g. tree, nesting platform, windmill) from which a bird (ferruginous hawk) is flushed, perched on or near, or circling above should be considered an active nest.

Several studies have correlated ferruginous hawk populations with a single prey species (Howard 1975; Woffinden 1975; Lokemoen and Duebbert 1976; Schmutz 1982, 1987). Results of a 20 year study indicated that drastic declines in prey cause a decline in ferruginous hawk populations but increases in prey do not necessitate an increase in ferruginous hawks (Woffinden and Murphy 1989). Given the reliance of Alberta's ferruginous hawk on Richardson's ground squirrels (*Spermophilus richardsonii*), it would be important to initiate a Richardson's ground squirrel monitoring protocol in Alberta. The protocol developed by Downey (2003) would complement the ferruginous hawk surveys and should be initiated.

3.0 SURVEY AND MONITORING PROTOCOLS

3.1. Background

Numerous methods are available for measuring populations; however, three key constraints are important in the consideration of the methods selected. These are effort (number of people required), time (to complete), and resources (funding and equipment). Four methods (aerial, mark-recapture, road transects, and quadrats) were examined throughout the process of this exercise, with only road transects and quadrats being logistically feasible for long term monitoring.

Aerial surveys would probably be the best method for producing a ferruginous hawk population estimate with tight confidence intervals, provided visibility bias is accounted for (Ayers 1999). It would only require one or two observers and could be completed in a relatively short time. The significant drawback of this methodology is the cost. It would require a large budget to conduct this type of survey across the entire Grassland Natural Region and given fiscal constraints, it would not be feasible to expect the survey to be flown on a regular interval. Sightability surveys would have to be conducted prior to aerial surveys and would be costly and require significant effort (Ayers 1999).

Mark-recapture methods are also an effective means of estimating populations; however, due to the ferruginous hawk's sensitivity to disturbance (White and Thurow 1985; Schmutz 1999), mark-recapture could not be conducted until the young were nearly fledged. Furthermore, given the large range in Alberta, this method would require a lot of effort with fairly high costs and require more time than is practical.

Point counts along road transects can produce tight confidence intervals for some grassland species (Saunders 2001). A limited number (2 – 4) of observers would be able to cover a large amount of area in a relatively short period of time (2 months). Costs would be moderate relative to the other methods. The major advantage to using this method is that access to land is not required and many transects could be completed in a single day. Drawbacks to this method include visibility concerns (since this would not be a call survey), as well as the potential for road bias (since there is not an active search protocol).

The quadrat technique is similar to the road transects in terms of constraints and has been the selected method in past surveys. A wide variety of data can be collected on each quadrat (i.e. habitat, other grassland species) as well as the flexibility to search areas that are not visible from roadways. However, this method does require land access, which could inhibit the survey.

3.2. Standardised Protocol

The quadrat technique will be used for continued monitoring of ferruginous hawk in Alberta. Some minor alterations to the data sheets and addition of new quadrats in greater than 50% native prairie will improve the data collected and the precision of the

results. The survey protocol, equipment list, and data sheets are located in Appendices A, B, and C.

3.2.1. Justification

Over the past 20 years, four complete surveys have been conducted to produce population estimates for ferruginous hawk. It is important to maintain this consistency in efficiently tracking the population dynamics of the species. The quadrat technique allows for capture of habitat data and change over time for both birds and habitat. This technique can also capture other grassland species such as those indicated in Appendix D. Roadside surveys would probably not allow for good population estimates given the potential bias against roads and visibility problems. Christmas Bird Count (CBC) area searches are also better at detecting ferruginous hawks than the Breeding Bird Survey roadside point counts (Butcher 1990). Furthermore, the ability of this raptor to ground nest and the fact that roadside surveys do not incorporate a search suggests that nests will be missed, particularly nests located in riparian areas (i.e. rock outcrops and hoodoos) where road access is limiting. Some concern exists over the visibility of ground nests; however, Schmutz (1984) indicates more unoccupied ferruginous hawk nests were found than occupied nests using this technique which suggests that this is an effective method

3.2.2. Modifications

In order to make effective use of existing technology, base maps for each quadrat will be created from digital information (i.e. air photos, ArcView). This will allow for more consistent and spatially accurate habitat maps to be constructed and will enhance the monitoring process over time.

Another addition is the inclusion of observer hours. Christmas Bird Counts are standardised through the use of observer or party hours (National Audobon Society 2002). Although limited in predictive capabilities, they do provide an index that corresponds to breeding information (Butcher 1990). Alberta ferruginous hawks primarily winter in the south central region of the United States (Schmutz and Fyfe 1987; Schmutz et al. 1994) and data from Christmas Bird Counts in that area exhibit a similar trend to the breeding population in Alberta from 1982 - 2000 (Figure 2).

Given the high variability of nests among quadrats in the > 50% strata and the large number of zeros in the data sets, a modification to the survey is needed. The 41.4 km^2 area (6.4 x 6.4 km) is already a large area for the ecological needs of the ferruginous hawk and the standard deviation of nests/km^2 does not decrease significantly by increasing the quadrat size (Taylor unpubl. data). Consequently, more quadrats need to be established in order to survey a larger area. Variability within the > 50% native prairie strata is the largest and more quadrats need to be established in that area. Sample size determination tests (Krebs 1989) indicate a need for approximately 200-500 quadrats to produce a confidence interval of +- 20%, depending on whether it is a high year (1992) or a low year (2000). That simply can not be accomplished in the time frame without a large contingent of observers. Realistically, 150 quadrats could be surveyed in the

allotted time frame. All new quadrats will be randomly selected from the > 50% native prairie strata.

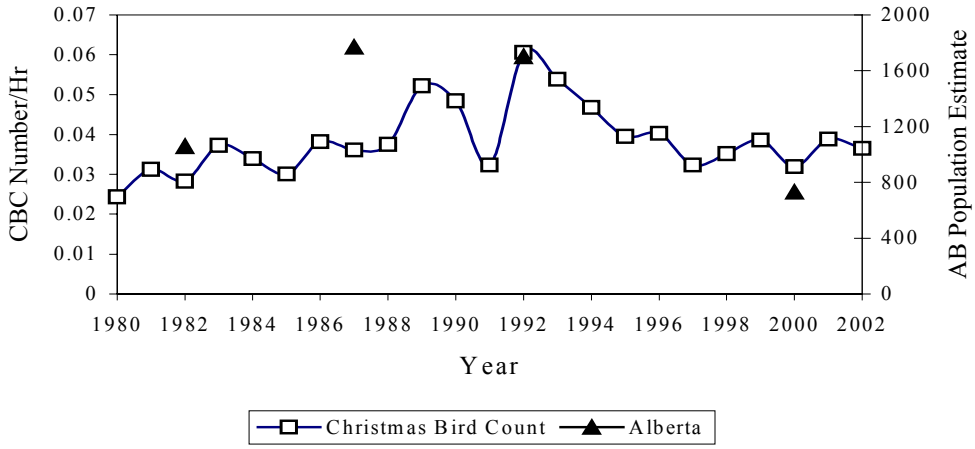

Figure 2. Comparison of Alberta population estimates and CBC data* from Texas, New Mexico, Oklahoma, Colorado, and Kansas

*Adapted from National Audobon Society (2002)

It is also important that a detailed nest site habitat data sheet (Appendix E) for ferruginous hawk and other raptors be included for nest site locations. This will provide more precise habitat measures (i.e. ¼ section resolution) for landscape level management of the species.

3.2.3. Limitations

Ferruginous hawks begin arriving on their breeding territories in late March to early April (Schmutz 1999). Hatching begins in mid May, usually within two days of the emergence of juvenile ground squirrels (Schmutz and Fyfe 1987). Consequently, it is possible to extend the survey start time to early April and incorporate adult ground squirrel surveys (see Downey 2003). However, given the hawk's sensitivity to disturbance, it is important that observers do not disturb ferruginous hawks during the nesting period or early in the incubation period. Furthermore, starting the surveys earlier would also run the risk of missing other species, such as the Swainson's hawk (*Buteo swainsoni*) which has a longer migration path and generally arrive in Alberta later than ferruginous hawks (Schmutz and Fyfe 1987). Also college students as summer staff would not be available until late April. Previous surveys did not start until mid May; however, to accommodate additional quadrats, the survey period will now be from May 1 to July 10.

Time can be an issue in areas that do not have good access. Recording additional data variables can also increase the time required to complete a survey. Even with modifications to the survey, it is still possible for each observer to complete at least two quadrats per day. Table 6 outlines the number of days required to complete 150 quadrats based on an 80-20 split between survey staff and Area Wildlife Biologists as well as utilising different numbers of survey staff.

Table 6. Required days for ferruginous hawk survey

# Observers	# Quadrats to Survey by each observer (80%)	# Quadrats to Survey by Area Biologists (20%)	Total Number Of Quadrats	Number of Days to Complete
1	120	30	150	75
2	60	30	150	45
3	40	30	150	35
4	30	30	150	30

Given that the survey period is approximately 70 days, there are only approximately 52 surveyable days taking into account weekends (18 days). Weather can also adversely affect surveys; consequently, in order to maintain consistency, surveys will not be conducted during rain or during winds that are or exceed 40 km/hr. Assuming 14 days of bad weather leaves 38 total surveyable days. Using three observers would be the best way to complete the survey in time; however, two observers can complete the survey with additional help from Area Wildlife Biologists.

3.3. Annual Trend Monitoring

Alberta Fish and Wildlife Division will be responsible for initiating the monitoring protocol. Thirty quadrats were selected (a minimum of 5 quadrats per Fish and Wildlife Division resource management area) from currently existing quadrats within the entire Grassland Natural Region (Figure 3).

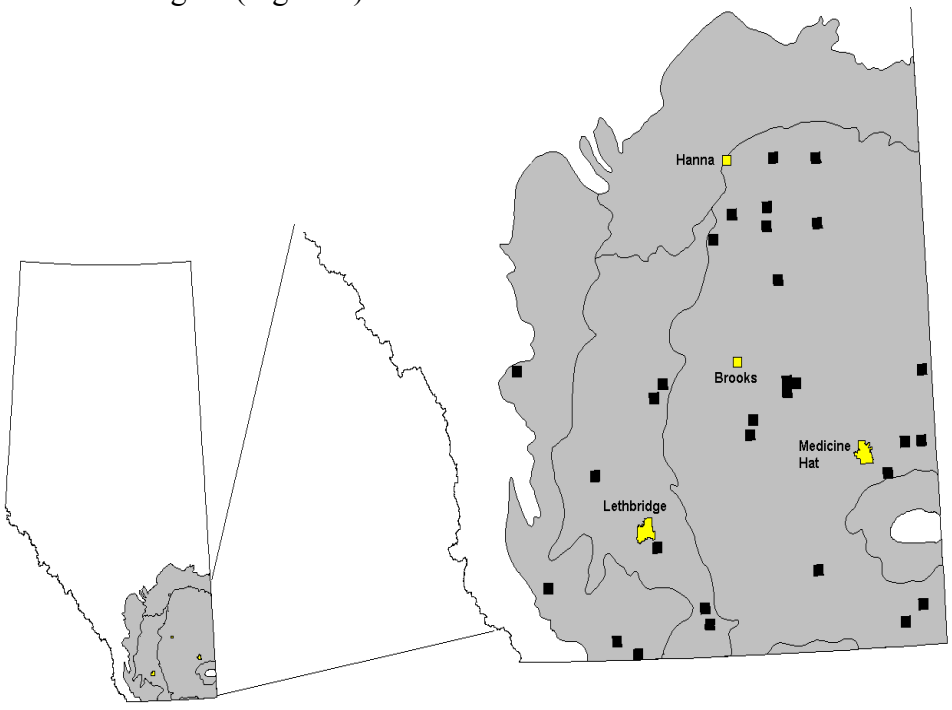

Figure 3. Locations of ferruginous hawk monitoring quadrats in the Grassland Natural Region

These quadrats will be monitored annually using the protocol from the province wide survey. After five years, another full survey must be completed and an evaluation conducted on this monitoring technique. The intention is to monitor six high density quadrats, six low density quadrats, and eighteen medium density quadrats based on previous data. By monitoring the results of the Christmas Bird Counts from south central U.S., a correlation may be made by using nests/observer hours to predict upcoming ferruginous hawk populations in Alberta. Although the CBC data is useful, it does have its limitations and should only be used in conjunction with annual breeding surveys.

3.4. Proposed Timeline

The intention of the entire protocol is to monitor the Alberta breeding ferruginous hawk population over another twenty year period using both full and partial surveys (Table 7). It is evident that a 10 or 15 year period is not long enough to adequately understand the population cycles of this species. By utilising this protocol, information can be gained for better management of this species, other grassland species, and overall native prairie habitat.

Table 7. Timeline for Alberta ferruginous hawk surveys

Year	Survey Type	Number of Quadrats	Outcome
0	FULL	150	Population Estimate
1	Partial	30	Annual Trend
2	Partial	30	Annual Trend
3	Partial	30	Annual Trend
4	Partial	30	Annual Trend
5	FULL	150	Population Estimate and Technique Evaluation
6	Partial	30	Annual Trend
7	Partial	30	Annual Trend
8	Partial	30	Annual Trend
9	Partial	30	Annual Trend
10	FULL	150	Population Estimate and Technique Evaluation
11	Partial	30	Annual Trend
12	Partial	30	Annual Trend
13	Partial	30	Annual Trend
14	Partial	30	Annual Trend
15	FULL	150	Population Estimate and Evaluation
16	Partial	30	Annual Trend
17	Partial	30	Annual Trend
18	Partial	30	Annual Trend
19	Partial	30	Annual Trend
20	FULL	150	Population Estimate and Evaluation

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APPENDIX A – FERRUGINOUS HAWK PROTOCOL

All quadrats are plotted on 1:250,000 maps as well as ArcView shape files.

1. Locate quadrat on map and identify if an ATV or mountain bike will be required.

2. Drive to quadrat and fill in start information: date, quadrat number, name of observer(s), start time, and general weather conditions. NOTE: Do not survey during periods of rain or winds ≥ 6 on the Beaufort scale.

3. Survey along roads first to map habitat on map data sheets and identify all areas not visible from the road that require further searching. Use binoculars and spotting scopes to scan area to reduce disturbance to nesting birds.

4. Consult the landowner(s) before investigating areas not visible from the road. Large coulees and eroded banks can be searched with two observers driving/biking simultaneously along the top and bottom of embankments stopping intermittently to scan with binoculars for nests. Gently undulating grasslands can be searched by driving/biking along ridges or across hilltops.

5. All ferruginous hawk observations as well as the additional grassland species of interest will be marked on the Ferruginous Hawk Data Sheet and the ID number will be plotted on the Map Data Sheet. GPS units will be used to record observations using Universal Transverse Mercator (UTM) coordinates in NAD 83. Record the number of nests, adults, and young (if visible) at the site, as well as the activity and color phase of all birds. If an active raptor nest is found, the Raptor Nest Site Habitat Data form will be filled in. If a bird is a juvenile, record under the young category but indicate that it was a juvenile. Also, if possible, take a photograph of breeding sites.

6. After a quadrat has been surveyed, prepare the summary information using the information collected on the Ferruginous Hawk Data Sheet. Attach any photographs taken of breeding sites within the quadrat.

7. All data and map sheets will be returned to Alberta Fish and Wildlife Division in Lethbridge for data analysis and storage.

APPENDIX B – EQUIPMENT LIST

Basic Equipment

- Vehicle (Truck)
- ATV/Mountain Bike
- Binoculars
- Spotting Scope
- GPS Unit
- Cell Phone
- 1:250,000 maps with quadrat locations
- Clipboard
- Ferruginous Hawk Data/Map Sheet
- County maps
- Nest Site Data Sheet
- Bird Identification books, tapes, CDs
- Stationary supplies (i.e. pens, pencils, etc.)
- Camera equipment

Truck/Quad Equipment List

- Fire extinguisher
- First Aid kit
- ATV helmet
- Rope
- Lock and Chain
- Ratchet tie-downs
- Fuel canisters
- Tools
- Air pump

APPENDIX C – FERRUGINOUS HAWK DATA AND MAP SHEET

Date (DDMMYY): Quadrat #: Start Time: End Time:
Observers: Total Hours:
General Weather Conditions:

Habitat Summary % Cultivation: % NP: % Tame:
% Not Surveyed:
Are potential nesting structures present? Description:
Site Photo Taken?
Site Photo Coordinates and Direction:

Species Summary

Species	Nests	Adults	Young

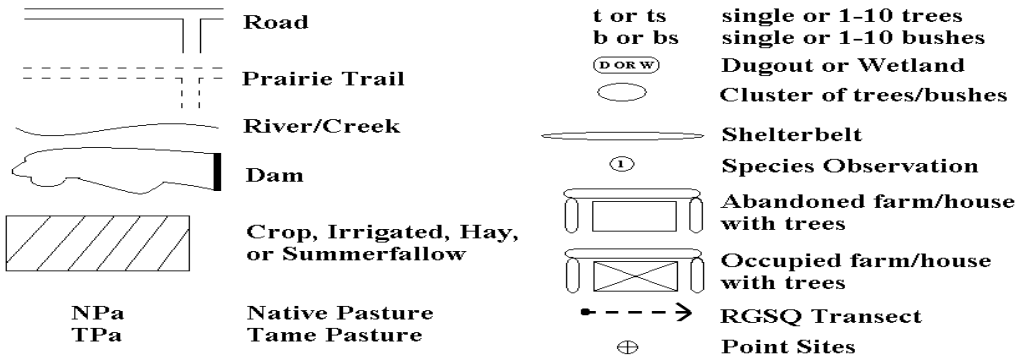
Species Observations

ID	Species	Nests	Adults	Young	Activity	UTM NAD 83 Easting	Northing
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Observer Comments:

RANGE

TWP


Road
Prairie Trail
River/Creek
Dam
Crop, Irrigated, Hay, or Summerfallow
NPa Native Pasture
TPa Tame Pasture
t or ts single or 1-10 trees
b or bs single or 1-10 bushes
D OR W Dugout or Wetland
Cluster of trees/bushes
Shelterbelt
1 Species Observation
Abandoned farm/house with trees
Occupied farm/house with trees
RGSQ Transect
Point Sites

APPENDIX D – ADDITIONAL GRASSLAND SPECIES TO RECORD

Common / Latin names	Data Sheet Code
American Badger / *Taxidea taxus*	BADG
Baird's Sparrow / *Ammodramus bairdii*	BDSP
Bobolink / *Dolichonyx oryzivorus*	BOBO
Bullsnake / *Pituophis catenifer*	BULL
Burrowing Owl / *Athene cunicularia*	BUOW
Golden Eagle / *Aquila chrysaetos*	GOEA
Great Blue Heron / *Ardea herodias*	GBLH
Lark Bunting / *Calamospiza melanocorys*	LKBU
Loggerhead Shrike / *Lanius ludovicianus*	LOSH
Long-Billed Curlew / *Numenius americanus*	LBCU
Long Tailed Weasel / *Mustela frenata*	LTWE
Mountain Plover / *Charadrius montanus*	MTPL
Peregrine Falcon / *Falco peregrinus*	PEFA
Prairie Falcon / *Falco mexicanus*	PRFA
Prairie Rattlesnake / *Crotalus viridis*	PRRA
Pronghorn / *Antilocapra americana*	PRON
Red-tailed Hawk / *Buteo jamaicensis*	RTHA
Sage Grouse / *Centrocercus urophasianus*	SAGR
Sage Thrasher / *Oreoscoptes montanus*	SATH
Sandhill Crane / *Grus canadensis*	SACR
Sharp-tailed Grouse / *Tympanuchus phasianellus*	STGR
Short-eared Owl / *Asio flammeus*	SEOW
Sprague's Pipit / *Anthus spragueii*	SPPI
Swainson's Hawk / *Buteo swainsoni*	SWHA
Swift Fox / *Vulpes velox*	SWFO
Thirteen-lined Ground Squirrel / *Spermophilus tridecemlineatus*	TLGS
Trumpeter Swan / *Cygnus buccinator*	TPSW
Upland Sandpiper / *Bartramia longicauda*	UPSA

APPENDIX E – RAPTOR NEST SITE DATA SHEET

Observer: **Date:** **Time:**

Species:

Datum: **Northing:** **Easting**

Number of Adults?		Number of Young?	
Nesting location (circle) Tree Shrub Nesting Pole Ground Other	Describe (incl. tree species):	Height of Tree/Shrub/Pole in meters: Height of nest in meters:	
Ground squirrels present?	Y / N		

800m x 800m

Circle the percent composition of each habitat class within 400 m of the nest. If not present leave blank.	Cultivation Dryland	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Cultivation Irrigation	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Tame Pasture	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Native Graminoid	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
Topography (circle) Rolling Hills Flat Plains Coulee or Valley Other	Shrubs	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Riparian	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Wetland	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Lake	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Treed	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Other	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%

Additional Features – indicate yes or no and circle closest distance to nest

Barbed Wire Fence	Y N	Distance from nest (m): 0-50, 50-100, 100-150, 150-200, 200-250, 250-300, 300-350, 350-400
Roads (Gravel, Paved, or Trail)	Y N	Distance from nest (m): 0-50, 50-100, 100-150, 150-200, 200-250, 250-300, 300-350, 350-400
Power Lines	Y N	Distance from nest (m): 0-50, 50-100, 100-150, 150-200, 200-250, 250-300, 300-350, 350-400
Buildings (Active or Abandoned)	Y N	Distance from nest (m): 0-50, 50-100, 100-150, 150-200, 200-250, 250-300, 300-350, 350-400
Other:	Distance from nest (m): 0-50, 50-100, 100-150, 150-200, 200-250, 250-300, 300-350, 350-400	

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