Protecting rare grassland birds from extreme weather events

Ryan Fisher & Erin Bayne

Department of Biological Sciences, University of Alberta

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Corresponding author:
Dr. Erin Bayne
Department of Biological Sciences
University of Alberta
Edmonton, Alberta, Canada T6G 2E9
E-mail: bayne@ualberta.ca

Alberta Biodiversity Monitoring Institute
CW-405 Biological Sciences
University of Alberta
Edmonton, Alberta, Canada T6G 2E9
Phone: (780) 492-6322
E-mail: abmiinfo@ualberta.ca

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REPORT SUMMARY

The Biodiversity Management and Climate Change Adaptation project is intended to provide knowledge and tools necessary to manage biodiversity in a changing climate. This report provides a summary of work completed in 2013 on assessing the vulnerability of the Ferruginous Hawk to extreme weather. This research is creating essential knowledge that will ultimately be incorporated into species at risk recovery plans at both the provincial and federal levels.

STATUS REPORT ON FIELD ACTIVITIES RELATED TO EXTREME WEATHER AND PRAIRIE BIRDS - 2013:

FERRUGINOUS HAWK BREEDING ECOLOGY UNDER ADVERSE WEATHER CONDITIONS

Background

The Ferruginous Hawk (*Buteo regalis*) is a large grassland raptor that breeds in the mixed and moist-mixed grassland ecosystems of Alberta. Ferruginous hawks (~2500 g) are the largest Buteo hawk in North America and build large, open, stick nests in trees and human-made structures. The Ferruginous Hawk is listed as a G4 (Apparently Secure) species by NatureServe and a species of Least Concern by the IUCN. However, population declines in Alberta and Saskatchewan have resulted in the Ferruginous Hawk being listed as an Endangered Species in Alberta and a Threatened species in Canada. Reasons for population declines are not understood; however, habitat loss, fragmentation, and climate change could all be important drivers of population change in this species at the northern extent of their range. Our research focuses on how behaviour, reproductive output, and nest reoccupancy patterns of Ferruginous Hawks are influenced by extreme weather events (see 2012 Field Activities report for further background information on this species' vulnerability to climate change).

The 2013 field season allowed us to collect further long-term data needed to:

1) Examine reoccupancy rates and longevity of artificial nest platforms and compare those rates to natural tree nests.
2) Examine foraging behaviour and adult movements under inclement weather.
3) Examine reproductive success in relation to inclement weather

The research done by our group will contribute valuable information and potential conservation strategies for Alberta Environment and Sustainable Resource Development and to provide information for the drafting of the Canadian Ferruginous Hawk recovery strategy. It should be noted that Drs. Troy Wellicome (Environment Canada wildlife biologist and biologist in charge of the Ferruginous Hawk recovery strategy) and now Ryan Fisher (Recovery Biologist with Environment Canada) are co-investigators on this project. Therefore, our results and management suggestions will have immediate impact on the conservation of this species through incorporation and consideration in the federal recovery strategy.

Summary of Field Activities - 2013

During the summer of 2013, 10 portable, automated weather stations were placed near Ferruginous Hawk nests in Alberta and Saskatchewan from June-August. We had proposed installing cameras and weather stations early in the breeding season (i.e, before egg-laying). However, limitations due to landowner availability and the possibility that Ferruginous Hawks would abandon nests if too much disturbance took place during this critical time period, limited the timing of weather station placement until June. To maximize the usefulness of the weather-station data, we placed the stations in central locations near nests that had multiple research activities occurring (video monitoring, satellite transmitters on adults, and regular nest monitoring; Figure 1). We used two types of weather stations (4 HOBO [Onset Computer Corp] and 6 Davis Vantage Vue [Davis Instruments Corp.]) that recorded a suite of weather data in 15-min intervals for 1-3 months (the approximate length of the Ferruginous Hawk nesting period), specifically: temperature (°C), precipitation (mm), wind speed (kph) and direction, relative humidity (%), and barometric pressure (kPa). Because of issues with livestock in much of our

study area and their potential to severely damage the weather stations, we placed weather stations in fenced areas that were usually associated with landowner homes or acreages. Weather stations were placed ≥ 200m from any tall structures (buildings, trees) and checked periodically during the summer to verify that they were still functioning. Data were downloaded from each weather station after juvenile hawks in nearby locations had departed the study area (typically late August). We are also in the process of supplementing the information gathered from the automated weather stations with information from nearby Environment Canada automated weather stations.

In 2013, 106 monitored Ferruginous Hawk nests were within 10 km of University of Alberta weather stations and an additional 59 nests were within 10 km of Environment Canada weather stations. Using information from nest visits (nest still active or failed, numbers of nestlings) and data from the weather stations, we will examine how nest survival and the number of offspring produced at each nest vary with local, fine-scale weather. Ten nests were also monitored 24 hrs per day with the use of video equipment and were within 10 km of a University of Alberta weather station (Figure 1). We are using the 10 km distance as a reasonable threshold of where weather may begin to be different at the nest compared to what the weather station is recording. The relatively high temporal resolution data from the portable weather stations (every 15 mins) and their proximity to the video-monitored nests will allow us to test the influences of acute weather phenomena on prey delivery rates to the nest and subsequent nestling survival (See: *Summary of Preliminary Analyses to Date* , below). Twenty satellite transmitters were attached to adult male hawks to record the adult's position every hour; 6 of these birds were within 10 km of a University of Alberta weather station and an additional 1 was within 10 km of

an Environment Canada weather station (Figure 1). There were no field activities this year to attach radio-transmitters to post-fledgling Ferruginous Hawks.

355 Ferruginous Hawk nests that were used historically were rechecked in 2013 to monitor reoccupancy rates and to monitor nest structure damage and/or destruction. Using these long-term data, we will compare the vulnerability of nests in trees to those in artificial nesting platforms to extreme wind blow-outs.

Use of the automated weather stations provided unique opportunities to foster better relationships with local landowners. Where possible, datalogging equipment was placed inside the houses of local landowners so that they could monitor local weather, while we acquired the needed data. Several landowners were willing to have the equipment placed in their houses.

The Ferruginous Hawk project will be the subject of an upcoming promotional video done by the Alberta Biodiversity Monitoring Institute. This is the first project in the Biodiversity Management and Adaptation group to be featured in such a video. The video can be found here: http://blog.abmi.ca/2013/12/19/httpwww-biodiversityandclimate-abmi-ca/ .

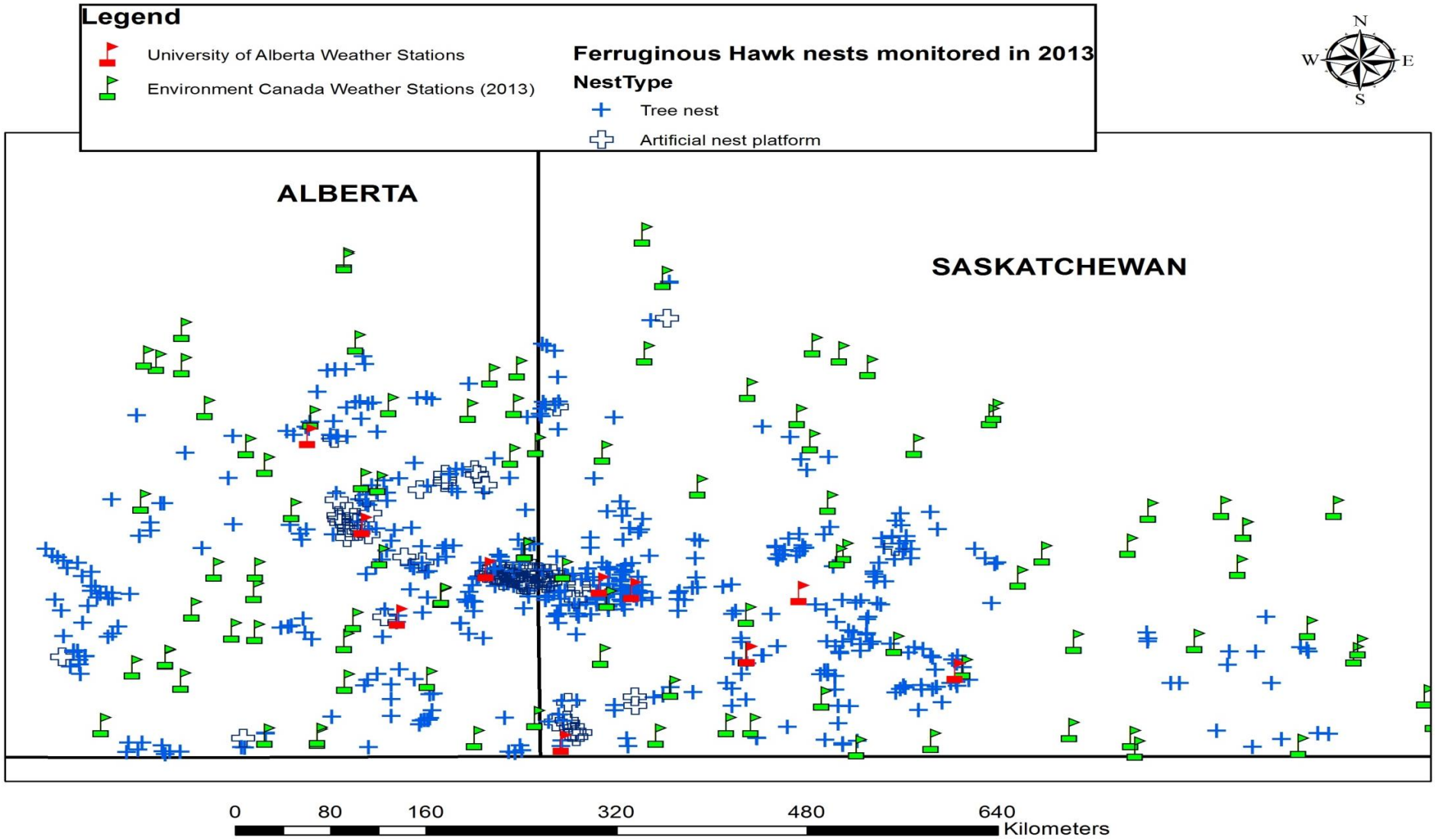

Figure 1: Locations of University of Alberta automated weather stations, Environment Canada weather stations, nests monitored with video cameras, and nests with males that were affixed with a satellite transmitter.

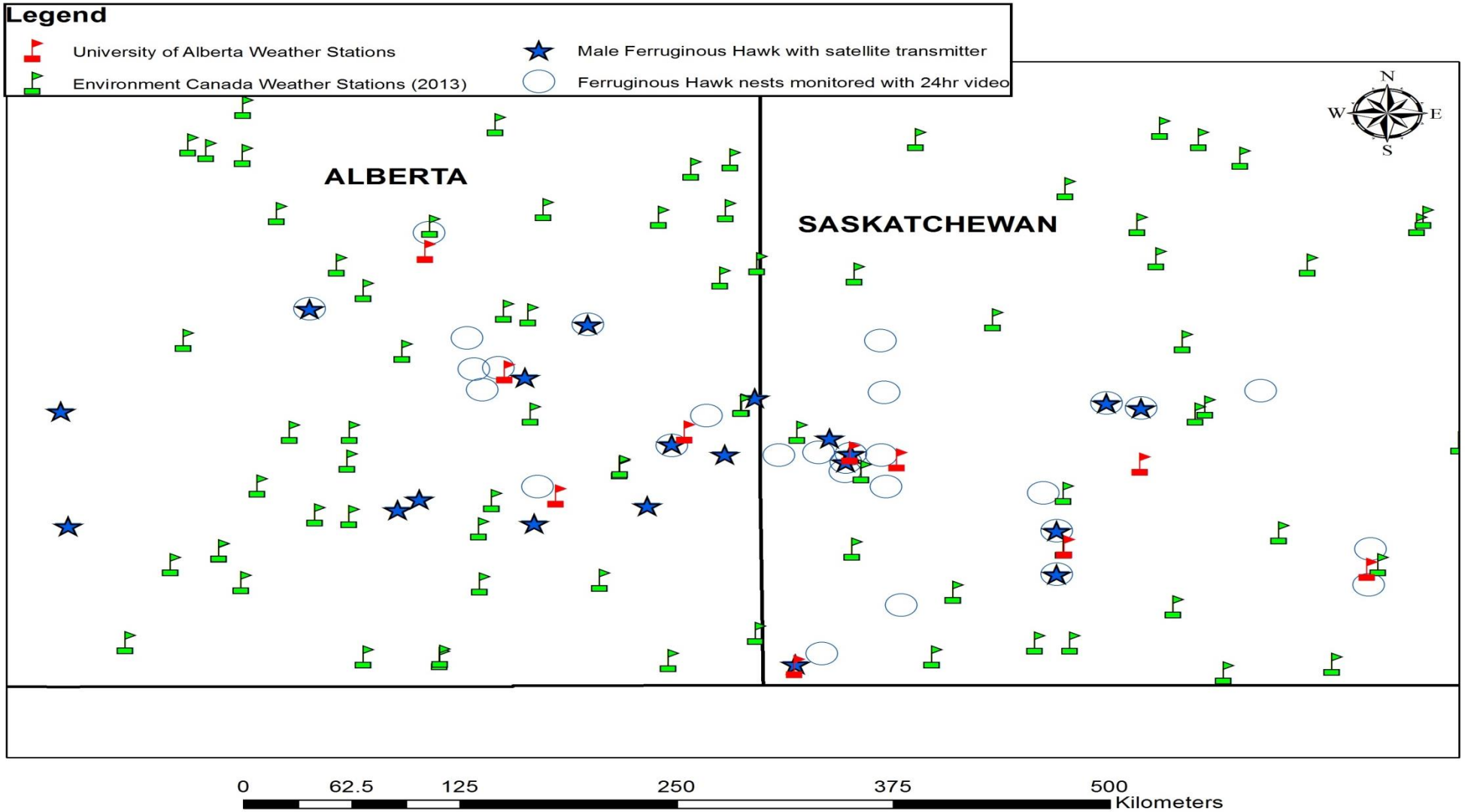

Figure 2: Locations of Ferruginous Hawk nests (tree nests, artificial nest platforms and other nesting structures) that were monitored in 2013, in addition to locations of Environment Canada weather stations and University of Alberta weather stations.

Summary of Preliminary Analyses – 2013

Prey deliveries and extreme weather

In 2013, Holly Stemberger (Biology 499 student under the co-supervision of Erin Bayne and Ryan Fisher) examined prey delivery rates of 7 Ferruginous Hawks in relation to several weather covariates that were collected using the University of Alberta automated weather stations. Ferruginous Hawk behaviours were recorded on the day before a storm event and the day of the storm event. At a relatively large temporal scale (day level), prey delivery rates were not statistically different between days with and without storms (Figure 3).

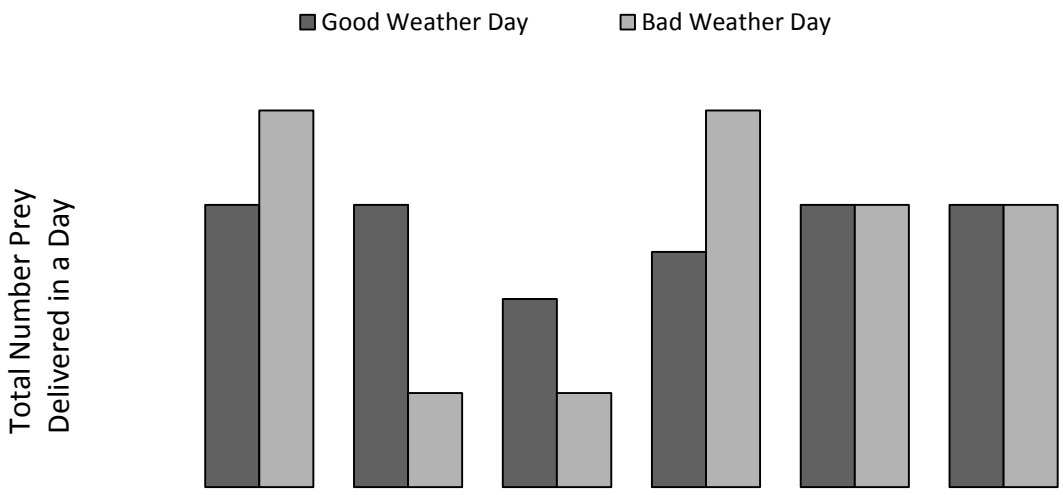

Figure 3: Total number of prey deliveries per day made by adult Ferruginous Hawks to the nest on good weather days (≤ 10 mm precipitation in 24 hrs), versus bad weather days (> 10 mm precipitation in 24 hrs).

More interestingly, the response of Ferruginous Hawks to inclement weather in terms of prey delivery probability (i.e., whether a prey delivery event occurred or not) occurred over a much narrowed time interval (i.e., hourly). Ferruginous Hawk probability of prey delivery increased when barometric pressure began to drop several hours before a storm (Figure 4). Probability of prey delivery is also negatively influenced by wind chill (when temperatures, corrected for wind, are colder, prey delivery rates decrease; Figure 5).

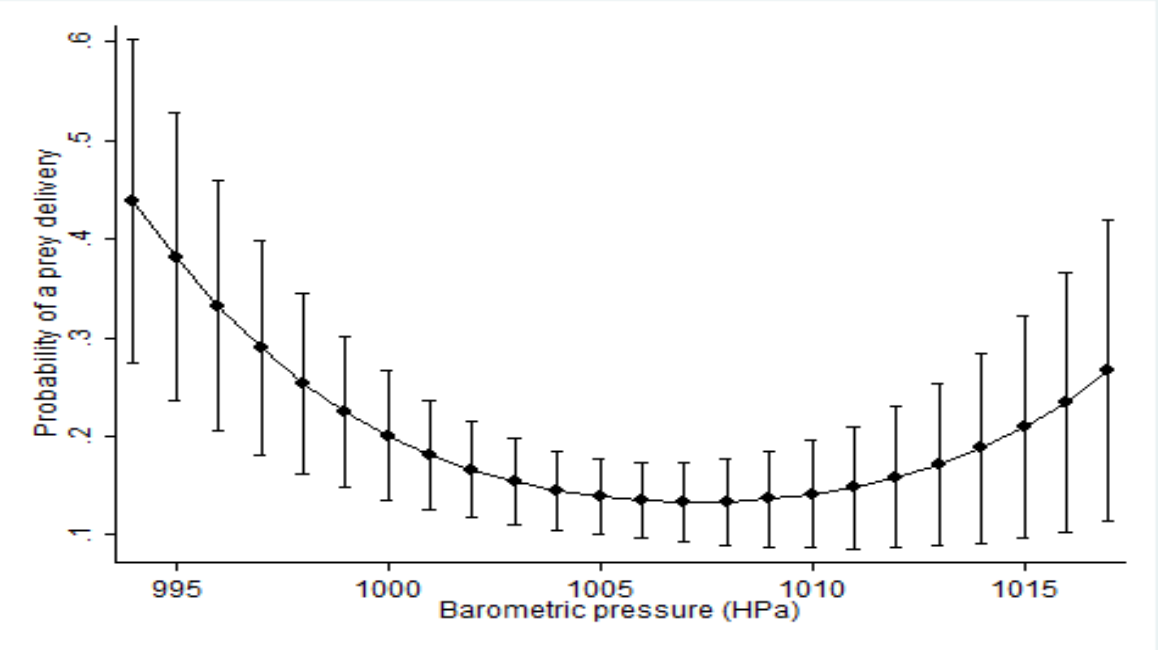

Figure 4: Probability of a prey item being delivered by an adult Ferruginous Hawk in a given hour in relation to barometric pressure, measured in HPa. Probability of prey delivery is highest at lower pressures that occur before a rain storm is about to occur.

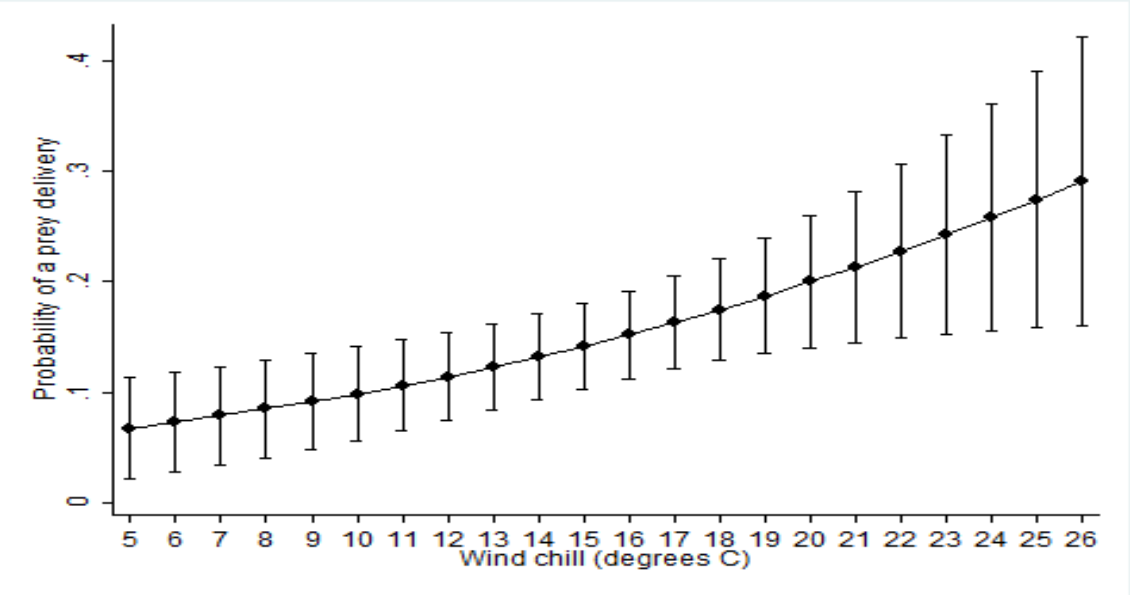

Figure 5: Plot representing the probability of a prey item being delivered by an adult Ferruginous Hawk, in a given hour, as related to wind chill temperatures. The probability of a prey delivery event in a given hour increases as the wind chill temperature increases.

This analysis on seven nests yielded interesting information that we will further augment with increased sample sizes from the 2013 weather station and video monitoring field activities. Without the information recorded by the automated weather stations at very short time intervals (hourly), these patterns would not have been apparent.

Nest damage and reoccupancy

Since 2010 we have monitored 445 individual Ferruginous Hawk nest structures (295 nesting trees and 84 artificial nest platforms) each spring to document Ferruginous Hawk reoccupancy, nesting structures usurped by other species, and collapsed and damaged nesting structures. Our two main objectives were to: (1) examine how susceptible artificial nest platforms are to collapse/damage compared to tree nests, and (2) examine whether artificial platforms are reoccupied at greater rates as compared to tree nests.

The odds of a tree nest being damaged or collapsing overwinter were approximately 2 times higher compared to artificial nest platforms (Figure 6). However, the probability of nest reuse by a Ferruginous Hawk (i.e., a nest used one year was used the following year) was not statistically different between tree and artificial nests if the nest was not damaged or rendered unusable (Figure 7). We are currently refining this analysis to include other covariates (reproductive success the previous year and landscape context); however, these results suggest that it is promising that the artificial nest platforms can withstand extreme weather events better than tree nests and are reoccupied at the same rates as natural nests.

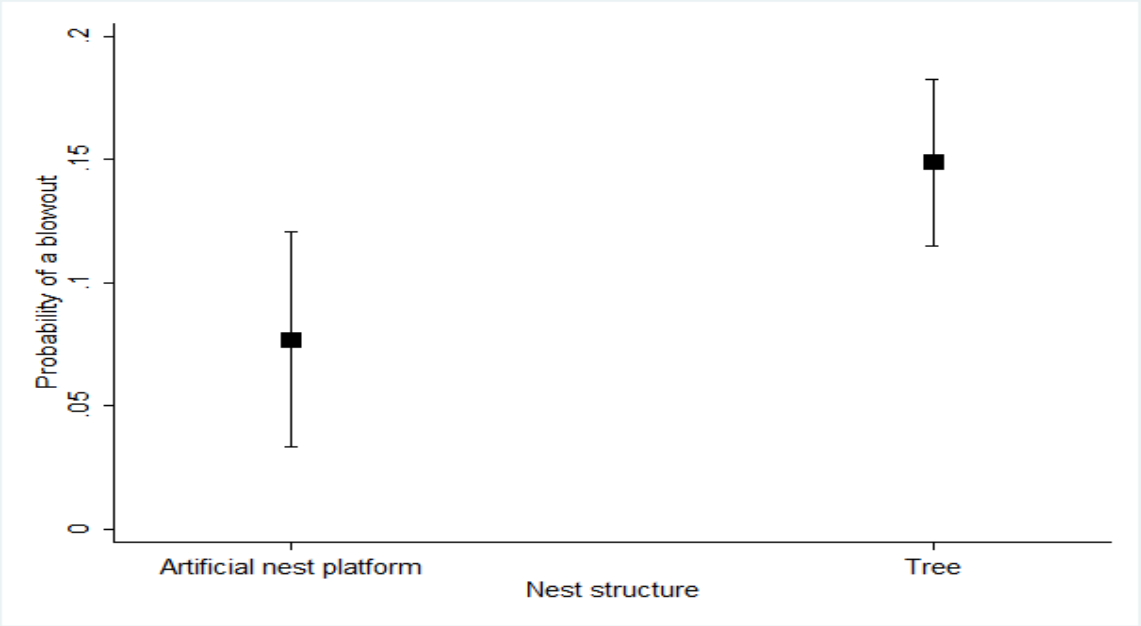

Figure 6. Probability (±95% CI) of a nest being rendered unusable or damaged between breeding seasons is approximately two times higher for tree nests compared to artificial nest platforms.

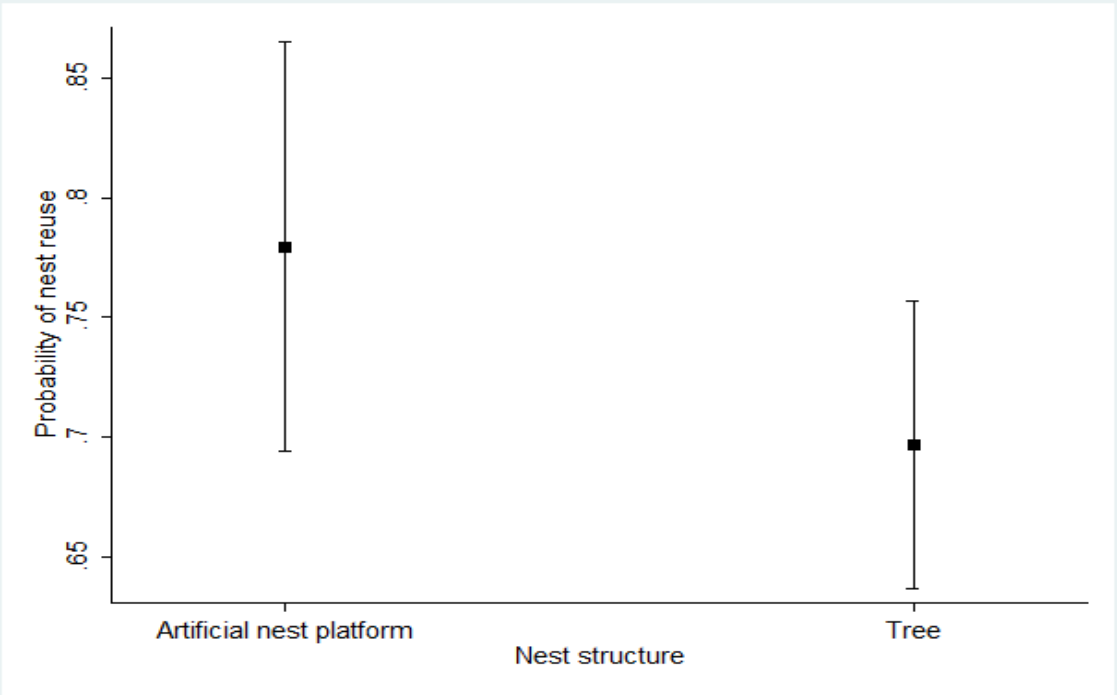

Figure 7: Probability of a nest being reused by a Ferruginous Hawk is not statistically different between artificial nest platforms and trees.

Post-fledgling survival

Melynda Johnson, M.Sc., is currently examining how inclement weather, in addition to several other variables of interest, may influence survival of post-fledgling Ferruginous Hawks using data from the 2011 and 2012 field seasons. Final results are expected by December 2014.

Adult movements

An undergraduate student, along with M.Sc. student Jesse Watson, are currently examining how hourly movements of adults are influenced by inclement weather. They will be using hourly data from the automated weather stations, in conjunction with hourly information on locations of adult males to test several hypotheses regarding foraging effort during inclement weather. Work by Jesse Watson will also help to identify wintering grounds of Ferruginous

Hawks in the United States and Mexico, in addition to documenting sources of mortality during migration and on the wintering grounds.

Plans for 2014 field work

There are only plans to do spring nest monitoring (i.e., nest checks for basic reoccupancy information) across the entire study area in 2014. This will add one final year of data collection for monitoring nest-structure longevity. It is not expected that video monitoring will occur in 2014. Nest success monitoring will take place and a limited number of satellite transmitters will be attached to male Ferruginous Hawks in a smaller study area along the foothills in Alberta in 2014.

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