UNIVERSITY OF MANITOBA

Environmental Conservation Lab

ELK - AGRICULTURE INTERACTIONS IN THE GREATER RIDING MOUNTAIN ECOSYSTEM

Annual Report

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Material presented herein is for information only and is not to be cited or considered as publication without the written consent of R. Brook. The authors retain sole ownership of data presented in this progress report. We are near the mid-point of this five-year study and hence the results presented here are tentative and subject to change as more information is collected. All findings should be interpreted with caution.

KEY STUDY ACCOMPLISHMENTS TO DATE

Ecological Component

1. Total of 196 elk have been captured and collared for the study in 2002-2004.
2. Collar deployment for this study is now completed.
3. There are currently 16 active GPS collars and 44 active VHF collars.
4. Over 7000 locations have been collected on 171 VHF collared cow and bull elk.
5. More than 25,000 locations have been collected from 25 GPS collared cow elk.
6. A total of 2196 visuals of elk group size, behaviour and habitat use have been collected from the air and ground.

Social Component

1. Mail out survey sent to all 4220 farm operators within 50 km of RMNP.
2. Summary report of survey responses completed.
3. Participated in 10 town hall meetings to document local issues and concerns.
4. In-person interviews with farm operators initiated.

Communications Component

1. Presentations and discussions held regularly with TB Stakeholders Action Committee, the Riding Mountain Biosphere Reserve, Riding Mountain Regional Liaison Committee, Riding Mountain National Park Ecological Integrity Study Group, local Rural Municipality offices, local and regional hunting clubs, Riding Mountain National Park Visitor Centre, the regional meeting of the Manitoba Agriculture and Food staff, and the Manitoba Wildlife Federation Annual Convention.
2. Update reports produced three times per year.
3. Website under development.

EXECUTIVE SUMMARY

Management of elk and their interactions with cattle has been a high profile issue in the Riding Mountain region. Intense public concern regarding Bovine Tuberculosis (TB) occurs at local, provincial, national and international levels. In response to concerns over the incidence of TB in the Riding Mountain Region, a study of elk-agriculture interactions was initiated by the University of Manitoba in conjunction with the TB Task Group. This study was initiated in order to better understand the spatial and temporal aspects of elk interactions with agriculture and to examine environmental and farm management factors that influence these interactions. This report is intended as a brief update of an on-going research program. The past six months has focused on collecting aerial and ground telemetry relocations of radio-collared elk, capturing and collaring additional elk, analysis of the mail survey results, development of community participation methods and on-going interaction with stakeholders and community members.

In order to document elk movements and habitat use, 196 animals were captured using a net gun fired from a helicopter. The first phase of elk capture was completed in early February, 2002 with 40 elk receiving VHF ear transmitters or collars. The second elk capture phase was conducted in February and March, 2003 with 117 animals fitted with transmitters. The third and final phase of collar deployment occurred in January and March, 2004 with 19 elk fitted with GPS collars and 30 elk fitted with VHF collars. Ground and aerial tracking has been conducted every week since capture using standard methods. There have been 124 elk mortalities during this study so far, plus 7 dropped collars, and 4 failed VHF transmitters. From the original 40 elk collared in 2002 (22 cows and 18 bulls), 24 are still active (10 bulls, 14 cows).

Over 7000 telemetry locations have been collected on the collared elk to date. The collared elk can be broadly classified into one of two groups based on the relative amount of locations that are inside RMNP. TYPE I elk have been primarily located inside RMNP (<5% of locations outside of RMNP), while TYPE II elk have been located both outside and inside of RMNP (>5% of locations outside the park). Based on the first two years of telemetry data using elk with 40 or more locations, 61% of the collared elk were located outside of RMNP at least once. Cow elk make greater use of areas outside of RMNP than bulls. However, it should be noted that elk may be making excursions out of RMNP that are not detected by the tracking program. Elk have been documented using areas outside of RMNP more during the spring and summer than in the winter months. Three collared elk have moved up to Duck Mountain Provincial Forest (DMPF) during the study, two during the summer of 2002 and one during the summer of 2003.

In April 2003, one of the GPS collared elk was euthanized when its TB blood test was suspicious and the location data were retrieved. The remaining 5 GPS collared elk were recaptured in December 2003 and their collars removed. Data were uploaded and the collars refurbished for reuse. GPS data are now being analyzed to examine movement patterns and habitat use. All 6 collars operated successfully, producing 13,540 locations from March to November 2003. The 5 collars active from March to November averaged 2600 locations each. A total of 755 locations were collected by the GPS collar placed in 5 different habitat types. Overall accuracy of the GPS collars was estimated at 15m, though there were a small number of locations (<1%) with error exceeding 100m.

Interim Conclusions for the Study Include:

1. Elk in Riding Mountain National Park make substantial and often long-term use of surrounding agriculture dominated lands. More than half of all radio-collared elk (61%) have moved out of RMNP at some point during the last two years. Elk move out of the park in all months of the year, often spending weeks and months out of the park. Use of areas outside of the park is greatest in the spring and summer months (April –August). Cow elk make greater use of areas outside of RMNP than bulls, particularly during calving and post-calving.

2. Elk moving out of RMNP normally stay within 10 km of the park boundary and 93% of all collared elk locations were within 6 km of RMNP. However, movements of >100 km from the park have been documented. Elk use of lands outside of RMNP is significantly higher in the first kilometre around the park. These observations are supported with data from hunter harvest data, winter aerial surveys and crop insurance damage claims, suggesting that disease transmission risk between elk and cattle may be highest in areas closest to RMNP. Indeed, all TB positives in regional wildlife and cattle since 1991 have been within 5 km of RMNP.

3. Movements of elk from RMNP north to the Duck Mountains occur infrequently, but can be more than 100 km from the park. These long distance movements of elk from areas of recently diagnosed TB positive elk, deer, and cattle out of the Riding Mountain TB Eradication Area to others areas of high elk-agriculture interactions and high elk-elk interactions represent an important potential risk of disease transmission.

4. Observations of collared and non-collared elk outside of RMNP that were visiting hay bales and grain piles during the winter months (includes apparently illegal hunting bait sites, wildlife feeding areas, and bales left in the field) were very frequent during the winter of 2001-2002, but were dramatically lower during the winter of 2002-2003. For the purposes of this study, hay or grain on top of the snow during the winter appears to be a baiting site when it is directly associated with a hunting operation such as a hunting tower or hunting cabin (within 400 m). During the winter of 2003-2004 there appeared to be a resurgence in hay and grain use by elk in November and December, particularly at apparently illegal hunter bait sites, but the number of observations of elk at these hay and grain sites decreased following action by Manitoba Conservation to have the baits removed. Collared elk in the Duck Mountains were regularly seen at apparently illegal hunter bait sites during the winters of 2002-2003 and 2003-2004 along the north and south boundary of Duck Mountain Provincial Forest.

5. Home ranges of cows are typically smaller than for bulls for both the 100% Minimum Convex Polygon and 50% Adaptive Kernel estimators. Elk that use areas outside of RMNP typically have larger home ranges than elk that remain inside the park. For cows, home ranges are largest in spring and winter and smallest during the calving and post-calving period. There is considerable overlap among elk home ranges, with up to 18 collared elk having overlapping core use areas.

6. Group size of elk is most commonly 2 to 5 animals. Large groups (>50 animals) have been observed, but only inside RMNP. Mean group size varies throughout the year, reaching a peak in early winter at 16 animals.

7. Elk select areas that are >1 km from roads and avoid areas <1 km from roads, particularly avoiding areas with 500m of roads.

8. A preliminary list of causes of natural mortality (n= 15 cows, 14 bulls) include wolf (6), legal hunter harvest (2), black bear (1), and unknown (20). Of all of the mortalities, 10% occurred outside of RMNP (2 hunter mortalities and 1 unknown). From the original 40 elk collared in 2002 (22 cows and 18 bulls), 24 are still active (10 bulls, 14 cows).

ACKNOWLEDGEMENTS

Special thanks to Patty and Bob Simpson of Dauphin Air Service for their tremendous dedication to flying the telemetry flights, as well as Tom Gibbs. Thanks to Rob Watson, Gord Pylipuik, and Astrid Vik Stronen for collecting aerial telemetry data and for their devotion to this project. Roger Baird, Greg Boughen, Nicole Lavalee, Tim Sallows, Doug Bergeson, Glen Schmidt, Pat Rousseau, Ian Kitch, Sean Frey, Paul Friesen and Murray Lungal all helped collect ground telemetry data. Pat Rousseau, Tim Sallows, Gord Pylipuik, Sean Frey, Blair Fyten, Paul Friesen and Greg Boughen all participated in retrieving mortalities. Thanks also to Marc Cattet and to Bighorn Helicopters for efficient and safe handling of the elk. Photographs used in the project were provided by Parks Canada, Manitoba Conservation, Bob Inouye, and Murray Gillespie.

Support for this project was provided by Riding Mountain National Park, Manitoba Conservation, Manitoba Agriculture, Food and Rural Initiatives, University of Manitoba, Riding Mountain Biosphere Reserve, Louisiana Pacific, Nature Conservancy of Canada, Rocky Mountain Elk Foundation, Manitoba Wildlife Federation, Prendiville Industries Ltd., Shur-Gro Farm Services Ltd., Eastlands Wildlife Association, Westlake Wildlife Association, Earth Rhythms Inc., Seven Oaks Game and Fish, Friends of Riding Mountain National Park, Natural Science and Engineering Council, and the Social Science and Humanities Research Council.

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INTRODUCTION

Riding Mountain National Park (RMNP) is a well-known protected area surrounded by agriculture. Satellite imagery of the region has been used to foster the notion that the area around the Park is void of natural habitat and that the Park has been reduced to "an ecological island in a sea of agriculture" (Bailey 1968, Dearden and Rollings 1993, Noss 1995). Indeed, from 1957 to 1991, forested habitat north of the Park has decreased from 51% to 16% cover (Walker 2001). Similarly, between 1976 and 1986, tilled land areas near RMNP increased by more than 20%, while woodland areas declined by more than 45% (Trant 1992). Land use has also intensified in recent decades, with pesticide and fertilizer use increasing by 30% from 1976-1986. In 1995, a major pulp and oriented strand board plant was licensed by the Province of Manitoba to begin harvesting hardwood species in the northern part of the region, with an annual harvest of approximately 1,000 cubic metres. Despite the conversion of much of the natural habitat surrounding RMNP into grazing and cropland and increasing human disturbance to forested areas, much wildlife habitat remains in the region. Together, RMNP and the surrounding Riding Mountain Biosphere Reserve (RMBR) form a complex natural ecosystem that supports a large population of elk (*Cervus elaphus manitobensis*).

The presence of elk populations in the agriculture-dominated landscape of the Greater Riding Mountain Ecosystem creates a potential for conflict with existing land use practices. Landowners may suffer (or perceive) economic losses and inconveniences from elk on their land (Long 1989, Adkins and Irby 1992, Irby et al. 1997, Torstenson et al. 2002). Most farmers suffer some loss of productivity due to wildlife damage (Conover 1998, 2001). Agricultural products such as standing hay crops, grain, and stored hay bales are regularly consumed and destroyed and fences are damaged by elk within the Riding Mountain region (Schroeder 1981, Manitoba Crop Insurance Corporation unpublished data 2001). For example, in 1994/95, $30,463 was paid for damage to stored hay in the RMBR (Ecosystem Conservation Plan Team 1997). Since it can be difficult to confirm, and not all damage is reported, far more damage may be occurring than is actually verified. Elk may also be competitive with cattle by consuming standing biomass in pastures and reducing the amount of forage available to cattle.

Disease transmission between wildlife and livestock has also emerged as a significant issue in recent years. The occurrence of positive test results for Bovine Tuberculosis (TB) in elk, deer (*Odocoileus virginianus*) and cattle (*Bos taurus*) in the vicinity of each other has intensified concerns that TB is spreading between wildlife and domestic animals. TB is a serious disease that is caused by a bacterium (*Mycobacterium bovis*) (Palmer et al. 2000). The disease is spread primarily by close contact with infected animals through direct contact or airborne exposure from coughing and sneezing. Interactions between elk and livestock directly, or indirectly through shared foods, may result in disease transmission (Clifton-Hadley and Wilesmith 1991). TB is slow and debilitating, with a long incubation period and animals that are infected may live and potentially spread the disease for many years. Though there have been many reports of TB in domestic livestock and captive cervid herds in North America, it has been assumed, until recently, that it was not self-sustaining in free-ranging cervids (Essey and Vantiem 1995). However, supplemental feeding on agricultural crops and forage may facilitate disease spread within wild cervid populations (Hadwen 1942, Schmitt et al. 1997).

Management of elk and their interactions with cattle farms has been a high profile issue in the Riding Mountain region. Intense public concern regarding Bovine Tuberculosis (TB) occurs at local, provincial, national and international levels. In response to concerns over the incidence of TB in the Riding Mountain Region, a *Wildlife Health Action Plan* was developed by the Inter-agency TB Task Group, comprised of representatives from Parks Canada, Manitoba Agriculture, Manitoba Conservation, and the Canadian Food Inspection Agency. As part of this plan, a study of elk-agriculture interactions was initiated by the University of Manitoba in conjunction with the TB Task Group. This report is intended as a brief update of an on-going research program.

This project is being conducted under the authorization of University of Manitoba Animal Care Utilization Protocol No. F01-037, Manitoba Conservation Wildlife Scientific Permit No. WSP 02001, Riding Mountain National Park Research/Collecting Permit No. RMNP-000321, and Riding Mountain National Park Environmental Assessment Screening Report No. #RMNP 000321. The aspects of community participation through a mail survey, interviews and focus groups has been approved under the authorization of the Joint-Faculty Human Subject Research Ethics Board Protocol #J2002:043 at the University of Manitoba.

OBJECTIVES

The overall purpose of this study is to better understand the overall relationship between elk and agriculture around Riding Mountain National Park in order to support federal and provincial interagency management of TB within the regional ecosystem.

Specific objectives of the study are to:

I. Characterize the biophysical aspects of the risks associated with elk-agriculture interactions

II. Characterize the social aspects of the risks associated with elk-agriculture interactions

III. Characterize and explain the differences that underlie objective descriptions and subjective perceptions of the risks associated with elk-agriculture interactions

STUDY AREA

The study area includes Riding Mountain Biosphere Reserve (RMBR), which is composed of Riding Mountain National Park (RMNP) as the core area and surrounding rural municipalities (RM's) as the zone of co-operation (http://www.unesco.org, 2002) (Figure 1). It represents a broad transition zone between the Canadian prairie ecosystem and the Boreal Plains (Roots 1988). RMNP is 2,974 km^2 (297,746 ha) in size, extending approximately 115 km from east to west and 60 km from north to south. It is elevated up to 475 metres above the surrounding lands due to the Manitoba Escarpment. The park represents a core area of relatively undisturbed wilderness surrounded by lowland agriculture. Much of the region is dominated by glacial topography and is poorly drained.

Approximately 25,000 people currently live within the RMBR (Statistics Canada 1991), across 1,272,000 ha (http://www.unesco.org). The major agricultural products of the region are cereal and oil crops, hay, and livestock. Farms are managed on an individual basis and so typically are highly variable in their size, structure, number of livestock raised and crops produced. Over half of the land in production is seeded in wheat and barley and canola are also important crops (Carlyle 1996).

The termination of grain freight subsidies previously provided under the Western Grain Transportation Act (WGTA) has resulted in changes in the nature and distribution of grain and forage production. Beef cattle production occurs throughout the study on agricultural lands, particularly on marginal land types. Cattle production in the Grandview area is well above the provincial average, with up to 80% of farmed land in the region under pasture. Cattle grazing was permitted within RMNP until 1970, with between 1,375 head (1950's) and 4,500 head (1919) of cattle present. Grazing by cattle opened up the vegetation in many areas of the park by removing understory, and caused of deterioration of many native fescue prairie sites in RMNP (Blood 1966). Road density inside RMNP and Duck Mountain Provincial Park and Forest is relatively low and the trails that are present in the backcountry typically have low use, particularly in the winter months. In contrast, most of the privately owned land in the study area has a high number of roads, many receiving a high level of use.

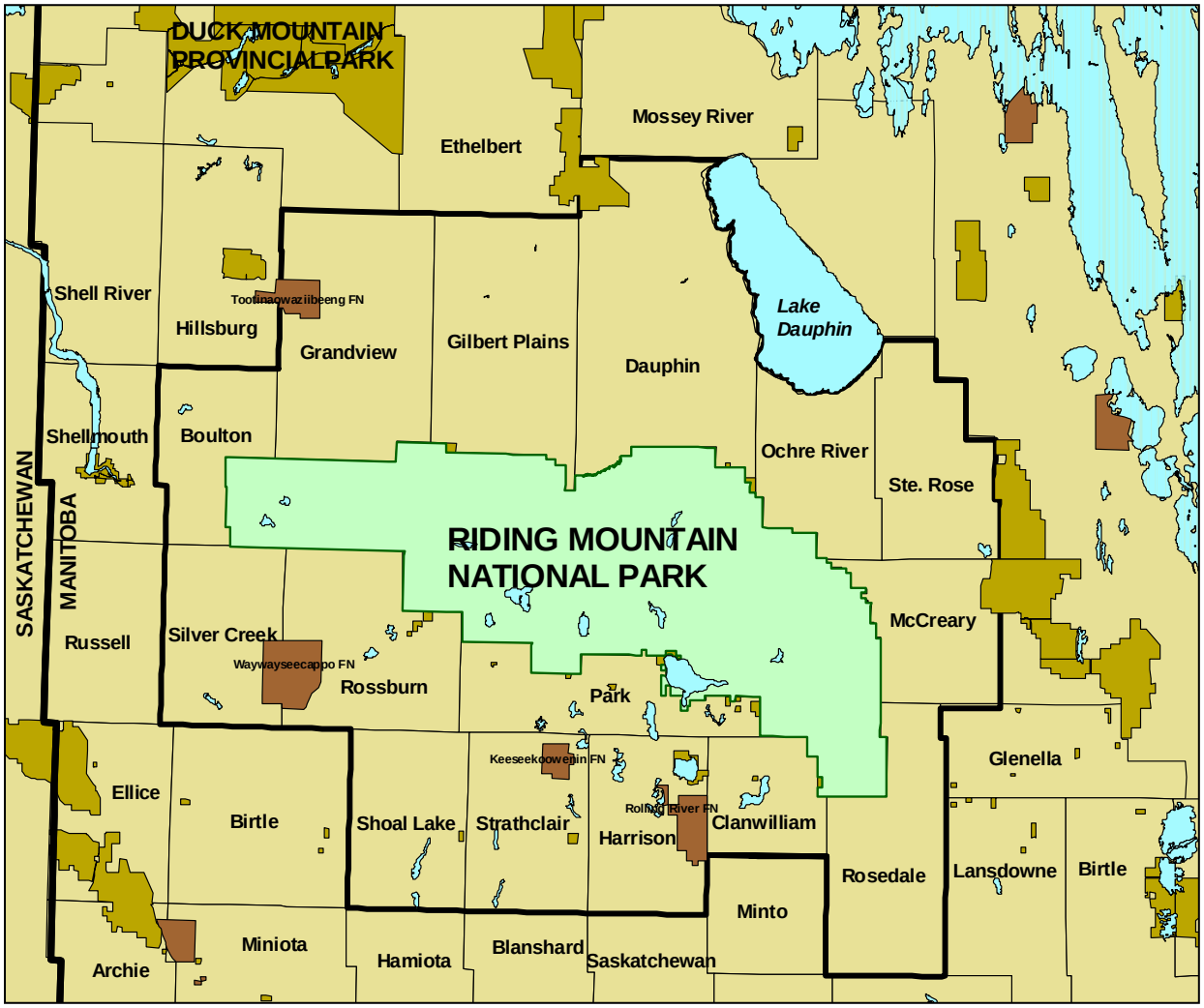

Figure 1. The Riding Mountain Biosphere Reserve (dark line) within the Greater Riding Mountain Ecosystem**.**

METHODS

Elk Capture and Handling

Elk were captured in and around RMNP using a net-gun fired from a Hughes 500D helicopter (Cattet et al. 2004). Animals that were to be captured were first located by a Cessna 172 bird-dog spotter plane. A maximum of two animals were captured from each group of elk. Capture and handling work was conducted by Bighorn Helicopters and Dr. Marc Cattet from the Canadian Co-operative Wildlife Health Centre, with support from Riding Mountain Park staff, Dauphin Air Service, and the University of Manitoba.

The chase procedure involved two separate procedures; positioning and pursuit. Positioning involved using the helicopter to direct an individual animal or group toward an area where capture can occur. At this stage, an animal may become aware that it has become a target. This phase occurred for a maximum of 3 minutes, but was halted if the animal is running hard for more than 2 minutes or appeared to becoming overheated. The pursuit began when an animal was approached closely by the helicopter to capture it. During this phase, the animals were normally running and aware of the intent to capture it. This phase lasted for a maximum of 30 seconds. When the helicopter was in position, a net was fired toward the elk to capture it.

Immediately upon capture, a crewmember exited the helicopter and positioned himself behind the topside rear leg to prevent it from kicking or thrashing. The net was removed, the legs hobbled together, and a cover was placed over the eyes. Animals requiring sedative were given xylazine (Rompun® - 100 mg/ml, Bayer Inc., Agriculture Division – Animal Health, Etobicoke, Ontario, Canada) at 1.5-2.0 mg/kg estimated body weight using a syringe and 15 cm feeding tube inserted into a nostril of captured animals as soon as possible following capture, and often before hobbles were applied (Cattet et al. 2004). Following the collection of blood, but before removing the hypodermic needle from the jugular vein, 10 ml of yohimbine (Antagonil®, Wildlife Pharmaceuticals, Inc., Fort Collins, Colorado, USA) was administered by intravenous route at 0.15-0.20 mg/kg to elk receiving xylazine (Cattet et al. 2004). In 2003 and 2004 yohimbine was replaced with Tolazoline.

Once sedated, a blood sample was taken for assessing animal health and testing for disease. Blood was collected from the jugular or cephalic veins into serum separator tubes for biochemical analysis and measurement of serum cortisol concentration, and into an EDTA tube for a complete blood count. Blood samples were sent to the Canadian Co-operative Wildlife Health Centre for general health assessment. Samples were also sent to the Canadian Food Inspection Agency in Nepean to be screened through a series of three preliminary Bovine TB tests. Each animal received a collar or ear transmitter as well as an ear tag. Ear tags are plastic discs, approximately 4 cm in diameter that fit through the ear and contain a unique identification number.

VHF Telemetry Monitoring

Immediately following capture and collaring, all elk fitted with VHF transmitters were relocated regularly through weekly fixed wing flights and ground triangulation 1-6 times per week using standard methods (White and Garrot 1990). All aerial telemetry locations were

collected during daylight hours. At each animal location, a GPS location was collected, as well as date, time, habitat type, behaviour, and group size. Observations of elk interactions with cattle herds, hay bales, and other agricultural products were also documented. Ground relocations during the day and night were collected, with an emphasis on those animals that are outside of RMNP or were inside the park and were within 5km of the park boundary, in order to document interactions with agricultural operations. Collection of VHF elk locations is on-going and will continue until approximately February 2005.

Home Range

Elk locations were used to map annual and seasonal home ranges using the Animal Movement extension (Hooge and Eichenlaub 1997) for Arcview GIS (ESRI INC.). 100% Minimum Convex Polygons were calculated for elk with >20 locations and 50% Adaptive Kernels were calculated for elk with >50 locations. Annual home ranges were calculated for elk with locations in each of the four seasons (>9 months of data). T-tests and Mann-Whitney U tests were used to test for differences between sex and season. Results were considered significant at p=0.05.

Global Positioning System (GPS) Collars

In March 2003, six store-on-board GPS collars were deployed on cow elk in close proximity to the RMNP boundary near the RM of Grandview. These collars were programmed to obtain one location every 2.5 hours. In April 2003, one of the collared elk was euthanized when its TB blood test was suspicious and the location data were retrieved. During weekly aerial flights, the VHF beacon on each active GPS collar is monitored to listen for mortality signals and ensure the collared elk have not moved out of the study area. The remaining 5 elk were recaptured in December 2003 and their collars removed. Data were uploaded and the collars refurbished for reuse. GPS data collection will continue for at least 18 more months.

There are currently three different types of GPS collars deployed – Telonics store-on-board collars that keep the data on the collar; Telonics ARGOS uplink collars that send the locations to satellite each day, and Global Precision collars that store the locations on the collar and allow uplink of the data to aircraft or ground receiver.

In order to test the spatial accuracy of the locations collected by the Telonics store-on-board GPS collars, a collar was placed in the field within different habitat types. The collar was left in marsh, open deciduous, closed deciduous, mixed deciduous-coniferous, and conifer habitats in an upright position. A location of the collar was then obtained using a Magellan hand held GPS unit, averaging over 1,000 locations over a period of at least 30 minutes. Any deviations from this collar location in the data collected from the GPS collar while at that location was considered to be error. Though this approach does not provide a true measure of accuracy, it provides a useful quantitative assessment of spatial variability in the GPS collar data and is considered to be a reasonably good surrogate for accuracy.

Elk Use of RMNP

All collared elk can be broadly classified into one of two groups based on the relative amount of locations that are inside RMNP. TYPE I elk have been primarily located inside RMNP (<5% of locations outside of RMNP), while TYPE II elk have been located both outside

and inside of RMNP (>5% of locations outside the park). The proportion of locations that are outside of RMNP is calculated for each collared elk for the entire year, for each season, and for each month.

Seasonal Variability

Seasons were delineated based on local and regional literature values for similar elk populations to identify meaningful periods that reflect unique periods for elk such as the rut and calving periods.

Distance to RMNP

In the agricultural dominated landscape around RMNP, it appears that elk are more common close to the Park and decrease in numbers with increasing distance from the boundary. In order to examine the relationship between elk distribution and elk-agriculture interactions relative to the RMNP boundary, distance to park was measured for all Manitoba Crop Insurance Claims made from 1996-2000, as well as aerial survey data (1997, 2000, 2001, and 2002), hunter kill locations from turned in elk heads (1997-2001), and telemetry locations (2002-2004).

Site Level Habitat Selection

Habitats selected by elk at the site level were documented during aerial relocations. When each location was collected, the habitat that the elk was in was recorded by the observer. These observations are summarized by the proportions of the total observations of each habitat type of the total number

Landscape Level Habitat Selection

Habitat selection was determined using resource selection ratios (Manly et al. 1993) which are calculated using the ratio of the proportion used to the proportion available. These analyses were performed at the population level with all animals pooled. Habitat selection for all animals combined (w_i) was characterized by the following term:

$$W_{(x)} = (Ui/U+)/(Ai/A+)$$

Where (Ui/U+) refers to the proportion used at elk telemetry locations, and (Ai/A+) represents the proportion available of that same covariate at randomly generated locations. If use is proportional to availability (i.e. no selection) then the number is resulting ratio is approximately 1. If use is greater than availability (i.e. ratio greater than 1) then selection is occurring for the covariate. If use is less than availability (i.e. ratio less than 1) then the habitat may be avoided. Elk locations (n=7344) were used along with randomly generated locations (n=7344).

Movement Rates

Data collected from the 6 GPS collars on cow elk were sorted sequentially by date and time and then a straight-line distance between point locations was calculated. Daily movement rate was determined by summing the distances between all of the points collected during 24 hours. Hourly movement rate was calculated by dividing the distance between consecutive locations by the time frequency between locations (normally 2.5 hours). Locations were labelled as dawn, day, dusk, night, based on the local sunrise/sunset schedule for the area. Locations ½ hour before and after sunrise were designated as dawn and locations ½ hour before and after sun down were designated as dusk. Both hourly and daily movement rates were analyzed by individual elk, sex, season, and period of day. T-tests were used to test for differences between season and sex.

Mortalities

Mortality signals are emitted from collars remaining motionless for 6 hours or more indicating the collar has been dropped or the animal has died. Each mortality signal is investigated as quickly as possible once it is identified (normally within 48 hours). The collar is located on the ground using triangulation and homing techniques. Evidence at the site is used to determine cause of death, including tracks, scat, and pattern of carcass consumption. The collar is retrieved and date, sex, age, location are recorded and if possible, field necropsies are performed to determine cause of death and to obtain tissue samples for TB testing.

Community Participation

Presentations regarding the research have been made regularly throughout the year at the TB Stakeholders Action Committee, Riding Mountain Biosphere Reserve, Riding Mountain Regional Liaison Committee, Riding Mountain National Park Ecological Integrity Study Group, local Rural Municipality offices, local and regional hunting clubs, Riding Mountain National Park Visitor Centre, the regional meeting of the Manitoba Agriculture and Food staff, and the Manitoba Wildlife Federation Annual Convention. Over 30 presentations were made this year to local stakeholder groups.

PRELIMINARY RESULTS

Elk Capture and Handling

A total of 196 elk were captured between 2002-2004. In 2002, a total of 40 elk were captured inside RMNP, with the majority (n=29, 73%) in the west end of the park and the other 27% in the Whitewater-Audy Lakes area (n=5, 15%) and Whirlpool-Ministic Lakes area (n=6, 13%). In 2003, a total of 128 elk were captured in the study area, all in the west end of the park. Three of these captures were re-captures of collared elk for TB blood testing and two of these animals had their ear transmitters replaced with a collar. In 2004, 49 elk were captured and collared, including four animals that were recaptured to remove their VHF collar and replace it with a GPS collar. The 2004 captures were conducted in the west end (n= 29) and in the east end (n=10) of the park. Each captured elk was given either a VHF radio collar (n=136), GPS satellite collar (n=25), or a VHF ear transmitter (n=35).

Telemetry Monitoring

Telemetry monitoring of elk movement has been done regularly since elk capture (beginning February, 2002). Over 7000 telemetry locations have been collected on the VHF collared elk to date, including >1200 ground locations. For elk surviving more than 20 weeks, an average of 67 locations per animal has been collected so far. In total, approximately 1385 hours were flown in fixed wing aircraft to collect elk locations between February 2002 and March 2004.

The collared elk can be broadly classified into one of two groups based on the relative amount of locations that are inside RMNP. TYPE I elk have been primarily located inside RMNP (<5% of locations outside of RMNP), while TYPE II elk have been located both outside and inside of RMNP (>5% of locations outside the park). Based on the first two years of telemetry data using elk with 40 or more locations, 61% of the collared elk were located outside of RMNP at least once. Cow elk make greater use of areas outside of RMNP than bulls. However, it should be noted that elk may be making excursions out of RMNP that are not detected by the tracking program. Elk have been documented using areas outside of RMNP more during the spring and summer than in the winter months.

Three collared elk have moved up to Duck Mountain Provincial Forest (DMPF) during the study, two during the summer of 2002 and one during the summer of 2003. One of the bulls travelling to the Duck Mountains in 2002 returned back to RMNP within 7 days of going up. The round trip distance travelled was a minimum of 60 km. This bull was euthanized in February 2003 when its blood test was suspicious on the TB test. The other two bulls in the Duck Mountains are currently alive, one at the north end of DMPF and one at the south end.

There have been 107 elk mortalities during this study so far, plus 6 dropped collars, and 4 failed VHF transmitters. From the original 40 elk collared in 2002 (22 cows and 18 bulls), 24 are still active (10 bulls, 14 cows).

Table 1. Mortalities, dropped collars and failed transmitters on 157 radio-collared elk (February 2002-January 2004).

	COWS	BULLS	TOTAL
Euthanized	56	39	95
Dropped	4	3	7
Wolf Kill	3	3	6
Bear Kill	0	1	1
Hunter Kill	0	2	2
UNKNOWN	12	8	20
Failed	0	4	4
TOTAL	**75**	**60**	**135**

Distance to RMNP

The probability of observing elk (telemetry locations, aerial surveys), harvesting an elk (hunter harvest locations) or having damage to agricultural crops by elk (MCIC elk damage claims) is relatively very high within the first kilometre of RMNP and that probability decreases substantially with increasing distance from the boundary. As a result, distance to RMNP is a useful coarse predictor of the probability of elk-agriculture interactions. However, there is considerable spatial and temporal variability in this relationship.

Global Positioning System (GPS) Collars

In April 2003, one of the Telonics store-on-board collared elk was euthanized when its TB blood test was suspicious and the location data were retrieved. The remaining 5 GPS collared elk were recaptured in December 2003 and their collars removed. Data were uploaded and the collars refurbished for reuse. GPS data are now being analyzed to examine movement patterns and habitat use. All 6 collars operated successfully, producing 13,540 locations from March to November 2003. The 5 collars active from March to November averaged 2600 locations each.

A total of 755 locations were collected by the GPS collar placed in 5 different habitat types. Overall accuracy of the GPS collars was estimated at 15m, though there were a small number of locations (<1%) with error exceeding 100m. Differential correction may increase the accuracy of these data.

PROBLEMS ENCOUNTERED

In the last year there have been three complaints made from two farm operations in the RM of Grandview regarding the aerial telemetry flights. The perception of these individuals is that the flying can interfere with elk hunting opportunities. Discussion have been held with these individuals and we have examined options to avoid influencing hunting by attempting to fly only between 9:30 a.m. and 4:30 pm during the hunting season. Further discussions will be held to discuss this and examine other ways of working co-operatively.

2003/2004 RESEARCH BUDGET (ECOLOGICAL COMPONENT)

ITEM	VALUE
Student Stipend	$19,500
Assistant Stipend	$8,000
Mileage Aerial Telemetry	$250
Mileage Communications	$2,500
Mileage Ground Telemetry	$6,000
Equipment, Media, Software, Hardware, Photocopying	$3,000
TOTAL	**$39,250**

Note that this budget is subject to change depending on changes in research funding and changes in project activities.

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APPENDIX 1. TIME LINE FOR PROGRESS (2002/2003).

	OUTCOMES	PROSPECTIVES
Progress Reports		
January 2004 Report	Report produced January 2004	Next interim report forthcoming
March 2004 Annual	Report produced March 2004	Next annual report March 2005
Telemetry		
Animal Care	Approved Dec. 2002, Jan. 2003	Collar deployment completed for this project
Elk Capture	Capture 2002, 2003, 2004	Collar deployment completed for this project
Aerial Telemetry	Telemetry flights every week	Telemetry flights on-going
Ground Telemetry	Weekly locations, day and night	Ground relocations on-going
Local Knowledge		
Ethics Review	Approved March, 2002, 2003,2004	
Report to Survey	Report completed	Additional analysis of survey data
Hay Yard Fencing Video	Data Collection Dec.03-May 04	First draft of video in spring
Hay Yard Fencing	Data Collection Dec.03-May 05	Interviews this winter and spring
Communication		
Presentations	Presentations made to stakeholders	Ongoing communications.

APPENDIX II. PLANNED PROJECT ACTIVITIES[1]

1. Telemetry (65.0 hours/week)

- flying telemetry relocations (8.5 hours/week)
- flight preparation, co-ordination and standby time (4.0 hours/week)
- ground tracking data collection (24.0 hours/week)
- data entry and verification (8.5 hours/week)
- data analysis and mapping (20.0 hours/week)

2. Local Knowledge (22.5 hours/week)

- interviews/focus groups/informal meetings (6.5 hours/week)
- questionnaire administration (1.5 hours/week)
- data entry and verification (3.5 hours/week)
- data analysis and mapping (11.0 hours/week)

3. Communications (9.0 hours/week)

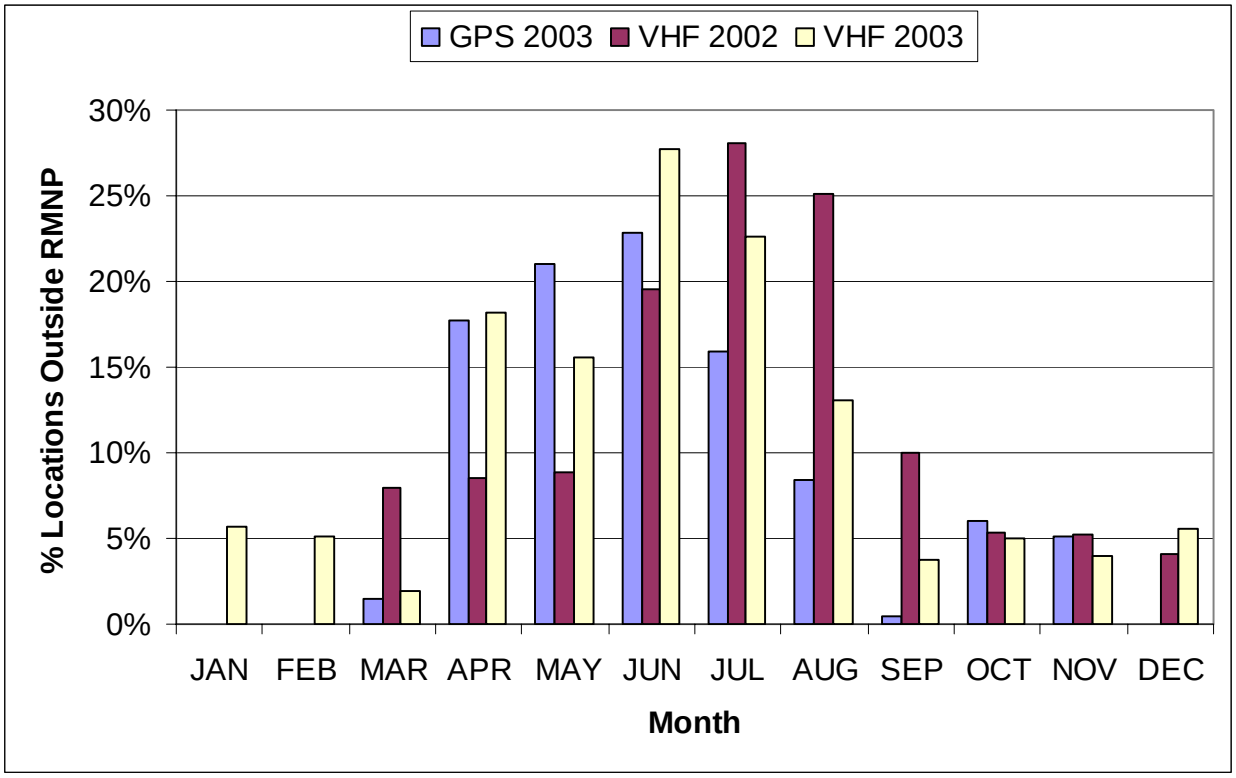
- meetings with TB Stakeholder Action Committee, RM councils, fish and game clubs, Biosphere Reserve, Liaison Committee, TB Task Group etc. (7.5 hours/week)
- Report Writing (1.5 hours/week)

[1] Planned project activities for the upcoming year includes anticipated support from Parks Canada warden service.

APPENDIX III. GPS COLLARED ELK USE OF AREAS OUTSIDE OF RMNP (MARCH-DECEMBER 2003).

ID	Sex/Age Class at time of capture	Status	# of Locations	% Locations Outside RMNP
RE167	Adult Cow	Euthanized	535	17
RE166	Adult Cow	Euthanized	2497	23
RE157	Adult Cow	Euthanized	2621	17
RE155	Adult Cow	Euthanized	2673	53
RE158	Adult Cow	Euthanized	2589	8
RE156	Adult Cow	Euthanized	2624	15

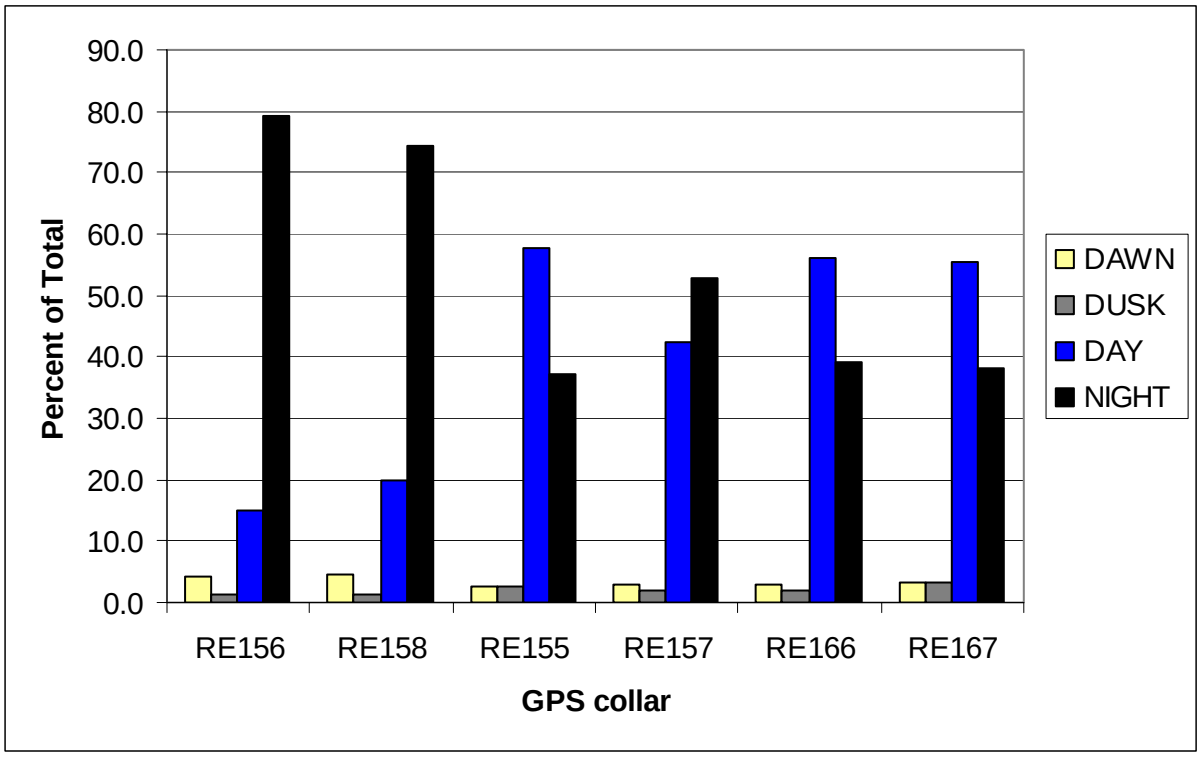
APPENDIX IV. GPS AND VHF COLLARED ELK USE OF AREAS OUTSIDE OF RMNP (2002- 2003)



APPENDIX V. RADIO-COLLARED ELK USE OF AREAS OUTSIDE OF RMNP (INCLUDES ONLY ANIMALS WITH 20 OR MORE LOCATIONS)

Cohort	Type I Elk (<5% locations outside of RMNP	Type II Elk (>5% locations outside of RMNP
All Elk	74%	21%
Cow Elk	75%	25%
Bull Elk	82%	18%

APPENDIX VI. GPS COLLARED ELK USE OF AREAS OUTSIDE OF RMNP (MARCH-DECEMBER 2003).



APPENDIX VII. FIELD ESTIMATION OF GPS COLLAR SPATIAL ACCURACY.

Habitat	Mean (m)	Max (m)	Min (m)	STD (m)	Sample Size	Habitat Description
Marsh	11.1	115.5	0.4	14.2	173	Sedges with few willows
Open Deciduous	16.1	227.7	0.8	25.2	118	Open canopy, sparse understory
Closed Deciduous	13.9	78.8	1.6	12.1	96	Very dense canopy
Mixed Woods	21.3	113.8	1.4	17.7	97	On the side of a small hill
Coniferous	12.2	184.1	0.9	16.3	271	Dense conifer stand

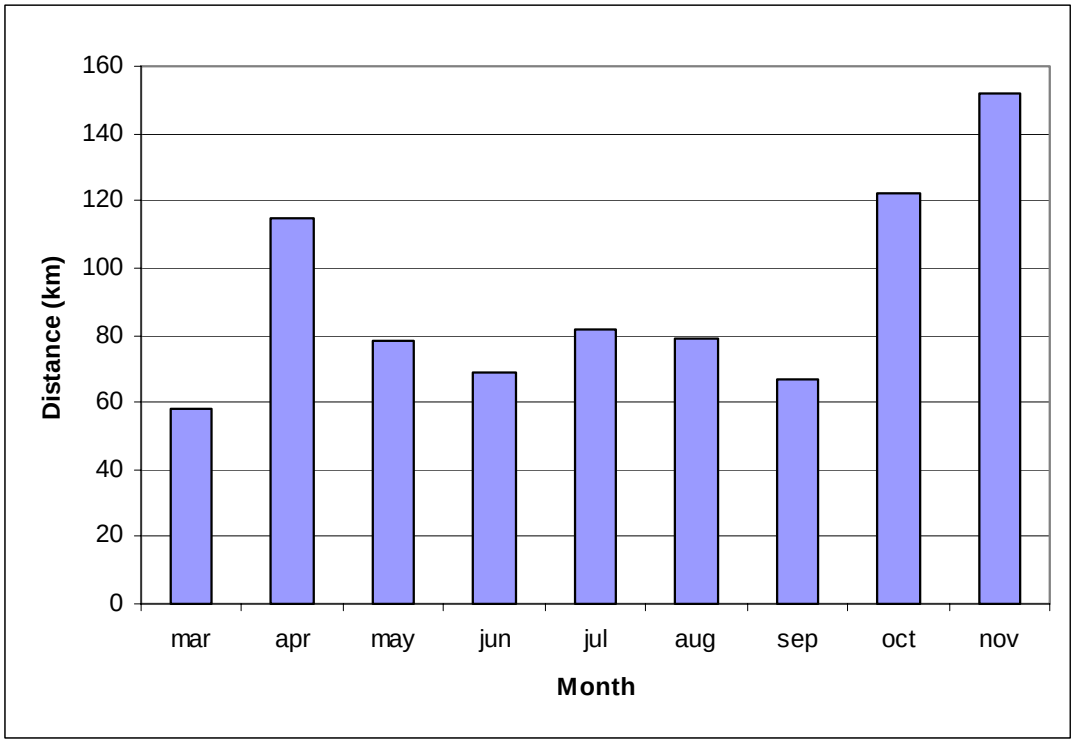
APPENDIX VIII. ANNUAL HOME RANGE SIZES OF VHF RADIO-COLLARED ELK WITH 20 OR MORE LOCATIONS (100% MCP).

Cohort	Sample Size	Min. (km^2)	Max. (km^2)	Mean (km^2)	Median (km^2)	Std Dev.
All Elk	93	12.2	2948.3	133.8	54.2	324.6
Cow Elk	54	12.2	780.0	97.4	48.1	135.8
Bull Elk	39	19.0	2948.3	184.2	62.9	474.2
TYPE I	67	12.2	780.0	88.2	52.8	118.8
TYPE II	28	14.5	2948.3	257.9	68.1	560.8

APPENDIX IX. SIZE OF ANNUAL CORE USE AREAS OF VHF RADIO-COLLARED ELK WITH 50 OR MORE LOCATIONS (50% ADAPTIVE KERNEL).

Cohort	Sample Size	Min. (km^2)	Max. (km^2)	Mean (km^2)	Median (km^2)	Std Dev.
All Elk	37	3.7	40.3	13.7	11.3	8.6
Cow Elk	19	4.0	17.2	10.5	10.1	4.1
Bull Elk	18	3.7	40.3	17.1	13.8	10.7

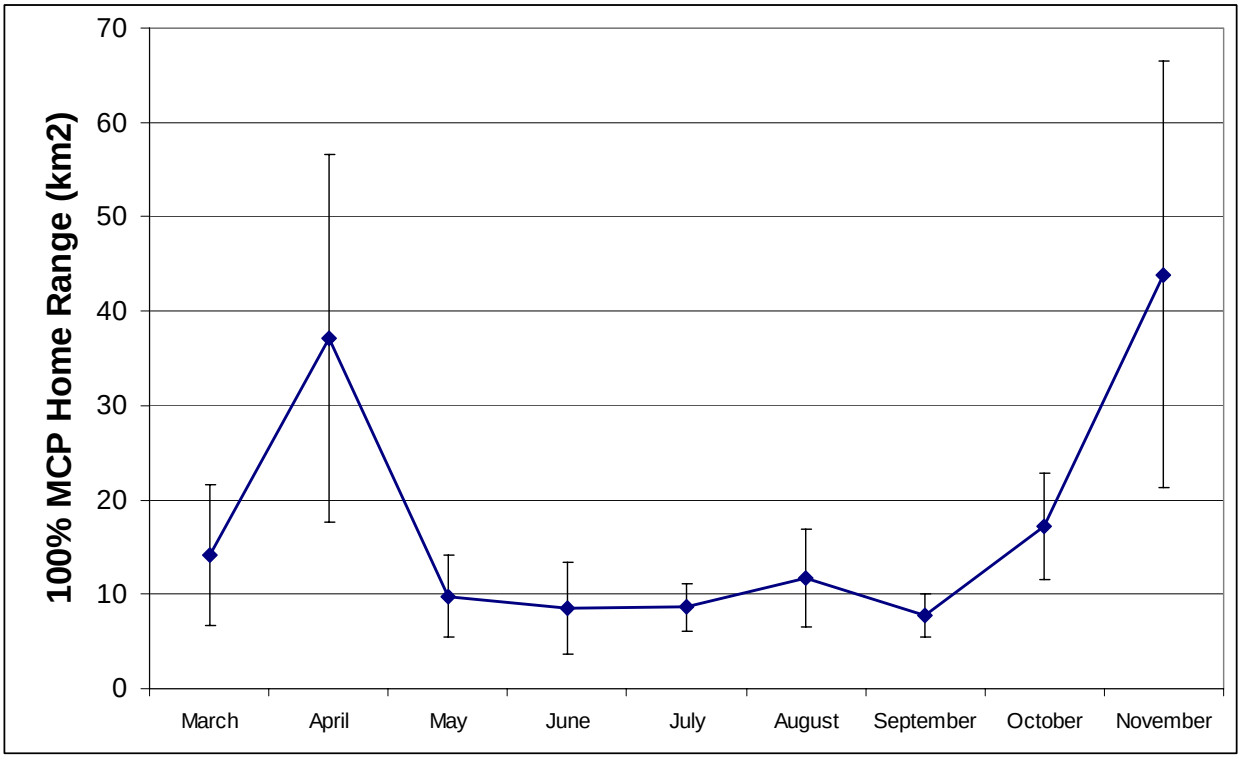
APPENDIX X. MEAN MONTHLY LINEAR DISTANCES TRAVELLED BY GPS COLLARED COW ELK (MARCH-DECEMBER 2003).



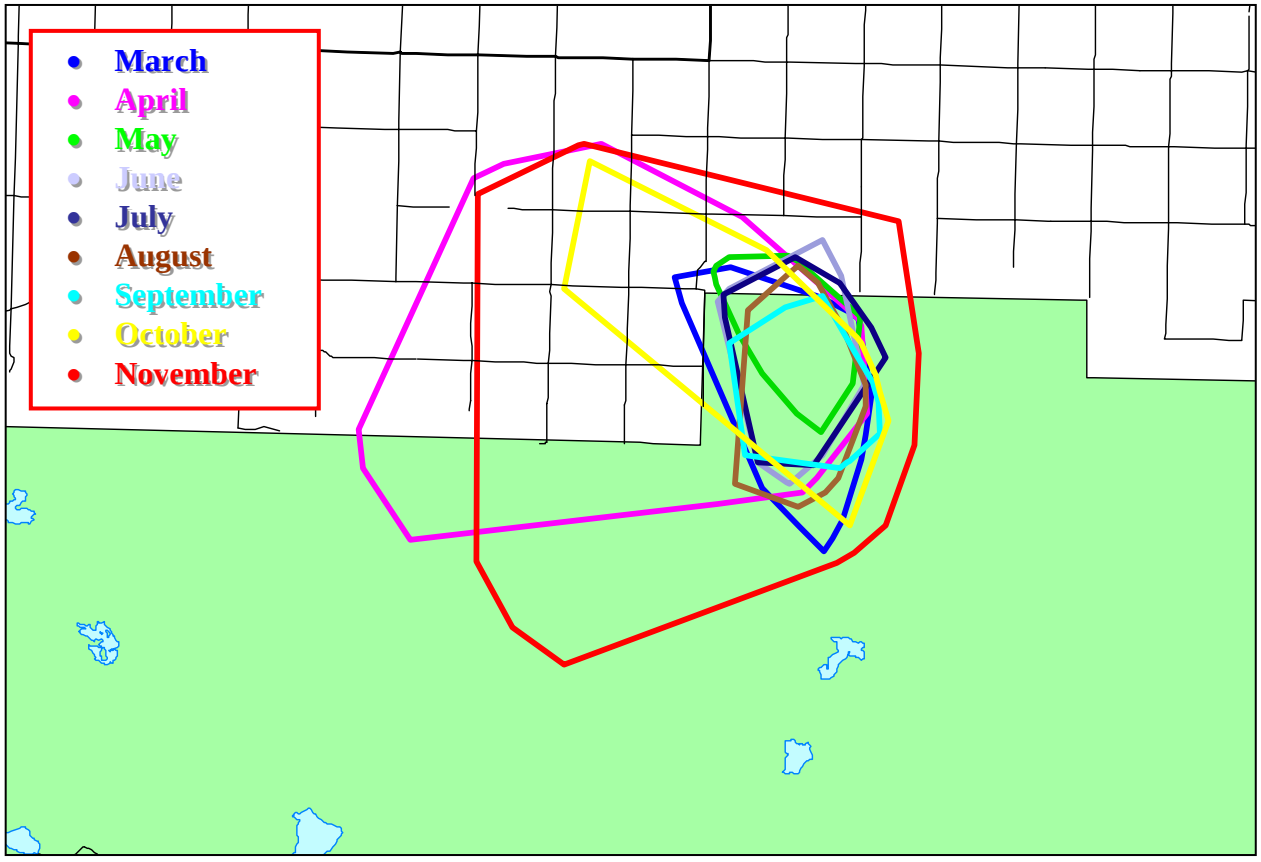
APPENDIX XI. SIZE OF HOME RANGES OF GPS COLLARED COW ELK (MARCH-DECEMBER 2003) USING MINIMUM CONVEX POLYGONS (MCP) AND KERNEL ESTIMATORS. Adaptive and fixed kernels estimated using least squares cross-validation (LSCV) with a cell size of 100m. (Missing values are due to a fault in the home range computer program)

Type	RE167	RE166	RE157	RE155	RE158	RE156	Mean
Number of Locations	535	2497	2621	2673	2589	2624	2256.50
Min. Convex Polygon							
100% MCP ha	1752.99	6263.73	5102.17	7054.67	10292.11	9727.04	6698.79
95% MCP ha	1555.51	3836.32	2613.05	5841.75	3269.93	3636.62	3458.86
Adaptive Kernel							
90% adaptive	331.08	936.81	770.55	1583.12	996.25	1067.38	947.53
80% adaptive	190.06	562.73	548.71	983.17	697.47	747.53	621.61
70% adaptive	116.08	359.51	384.25	657.99	490.29	527.91	422.67
60% adaptive	70.31	236.04	250.88	447.34	330.29	374.61	284.91
50% adaptive	43.79	151.35	166.90	285.75	201.19	247.36	182.72
40% adaptive	26.83	82.53	95.26	153.50	119.18	132.76	101.68
30% adaptive	13.21	42.69	missing	72.60	59.68	74.89	52.61
20% adaptive	6.69	12.48	19.94	29.73	31.97	34.43	22.54
10% adaptive	1.75	3.50	5.10	5.69	5.18	7.64	4.81
Fixed Kernel							
90% fixed	251.57	977.08	875.81	1479.55	1094.82	1148.49	971.22
80% fixed	160.09	missing	620.58	990.35	803.83	827.20	680.41
70% fixed	107.99	421.09	448.75	699.70	missing	624.11	460.33
60% fixed	76.08	292.41	330.38	515.13	427.17	456.74	349.65
50% fixed	51.13	206.67	211.41	337.47	289.43	329.72	237.64
40% fixed	33.68	145.48	138.99	201.96	189.53	208.42	153.01
30% fixed	20.45	77.30	83.58	113.87	95.36	109.82	83.40
20% fixed	12.06	37.29	37.34	53.84	48.33	54.32	40.53
10% fixed	3.08	12.72	10.18	12.40	14.18	21.32	12.31

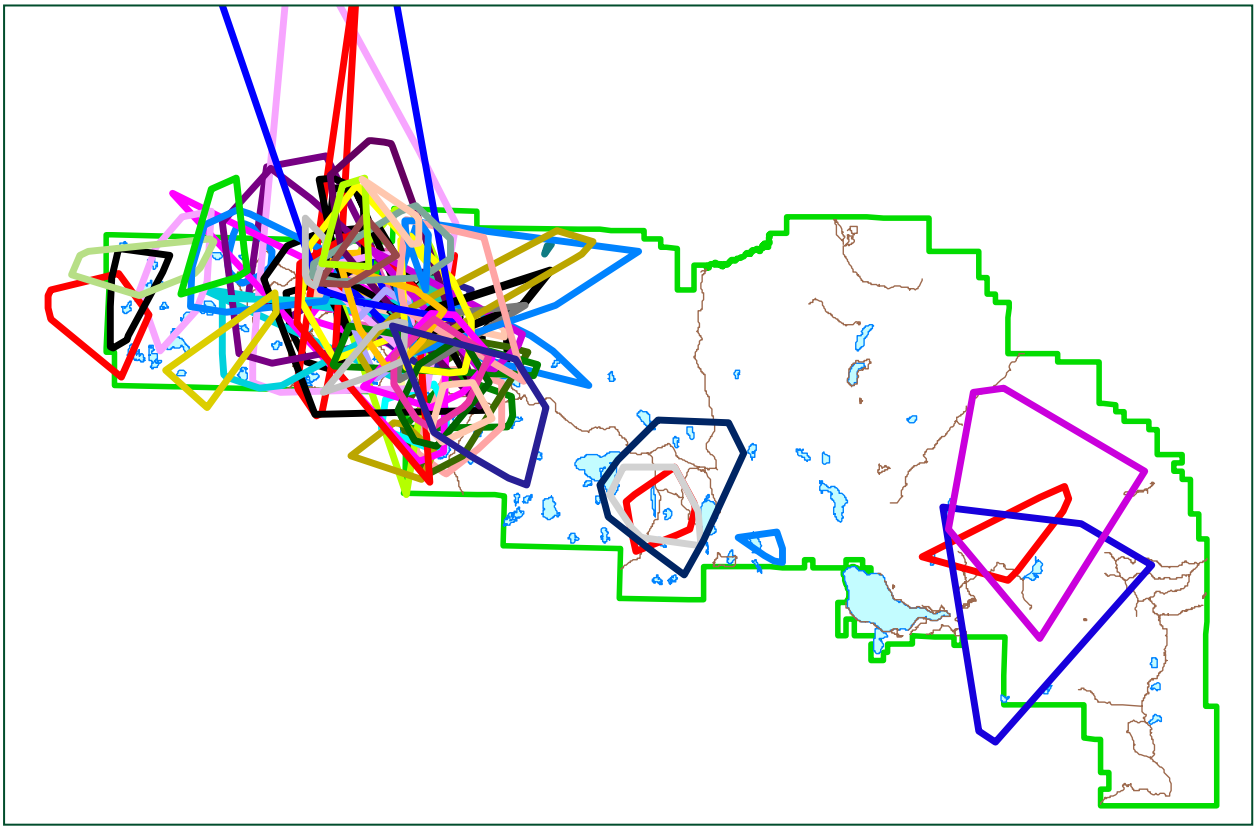
APPENDIX XII. MONTHLY VARIATION IN SIZE OF HOME RANGES OF GPS COLLARED COW ELK (MARCH-NOVEMBER 2003) USING 100% MINIMUM CONVEX POLYGON (MCP) WITH STANDARD DEVIATIONS.



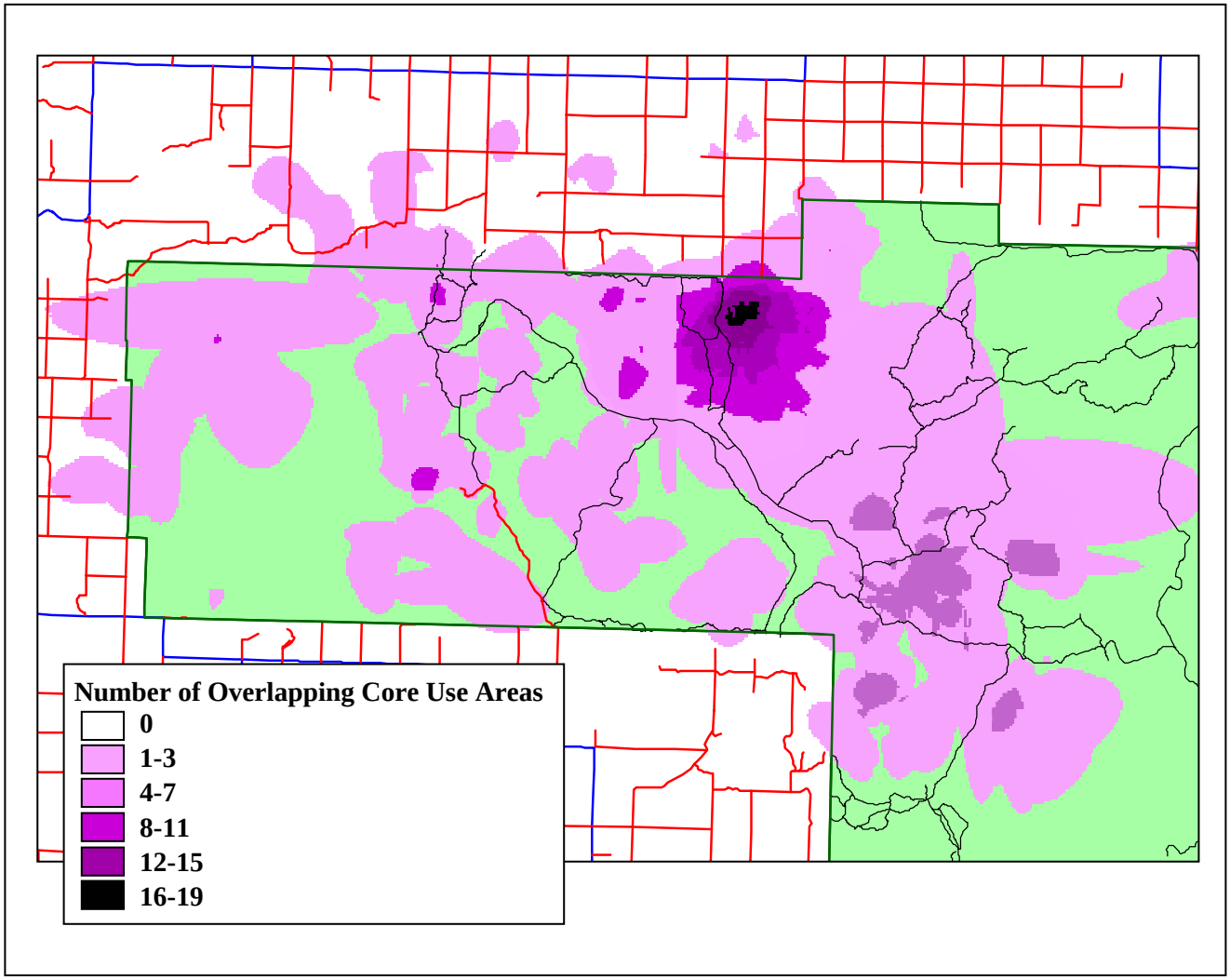
APPENDIX XIII. MONTHLY VARIATION IN SIZE OF HOME RANGE OF GPS COLLARED COW ELK RE156 (MARCH-NOVEMBER 2003) USING 100% MINIMUM CONVEX POLYGON ESTIMATOR (MCP).



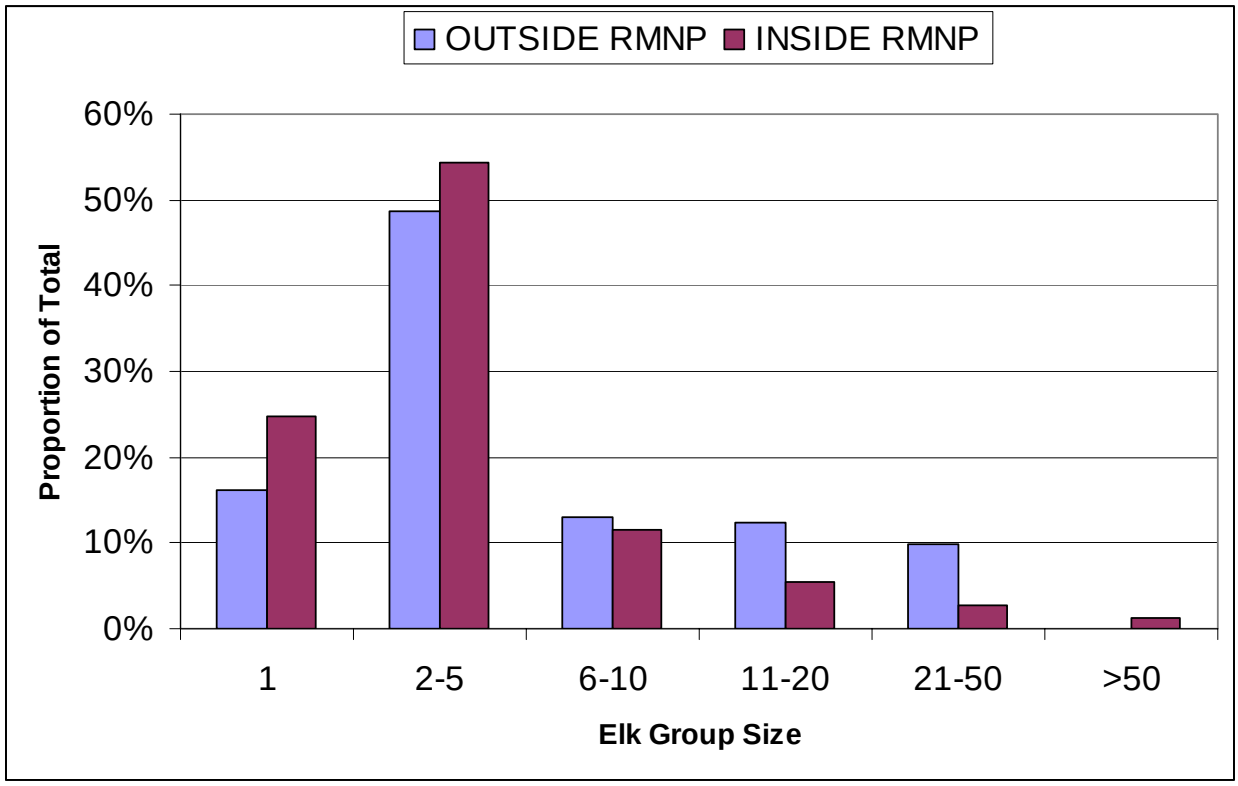
APPENDIX XIV. HOME RANGES OF GPS AND VHF COLLARED ELK (2002-2004) USING 100% MINIMUM CONVEX POLYGONS (MCP).



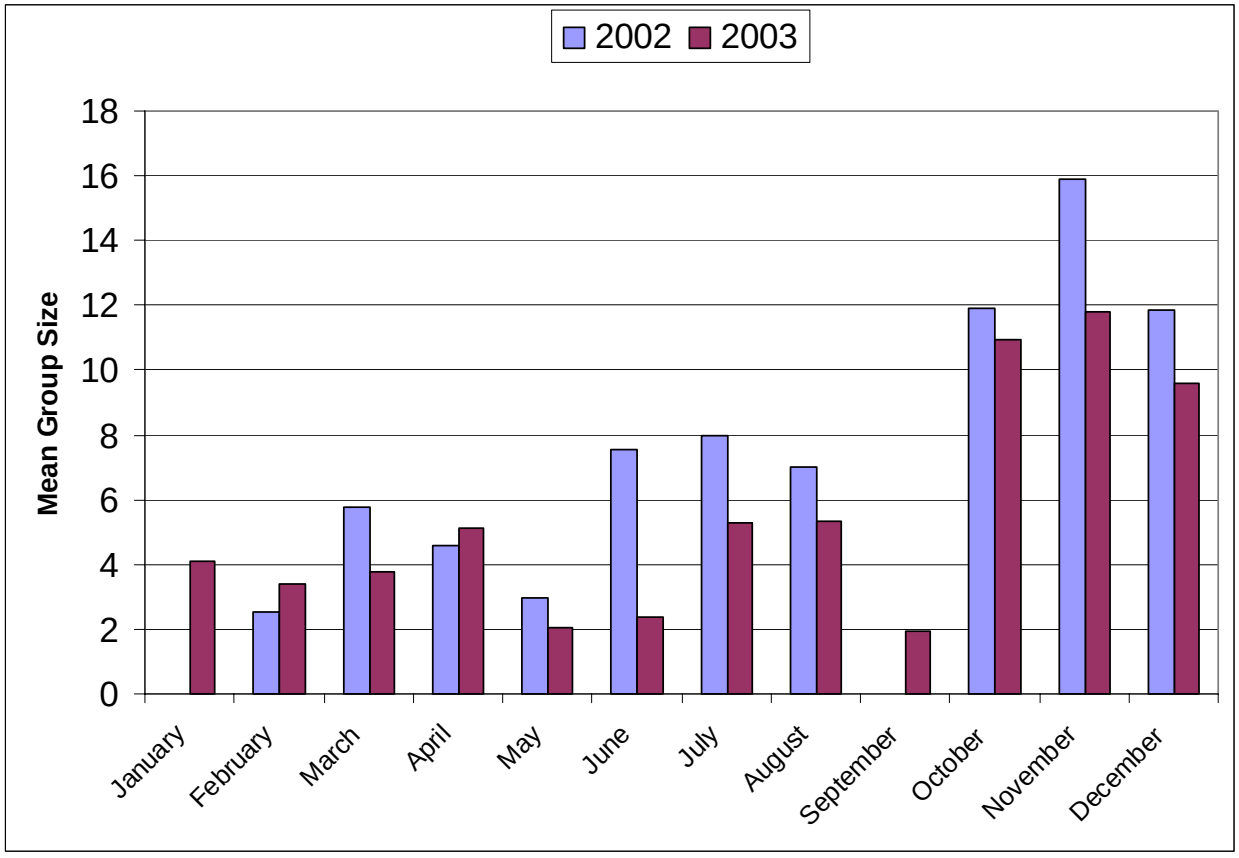
APPENDIX XV. OVERLAP IN CORE USE AREAS (50% ADAPTIVE KERNAL) OF RADIO-COLLARED ELK.



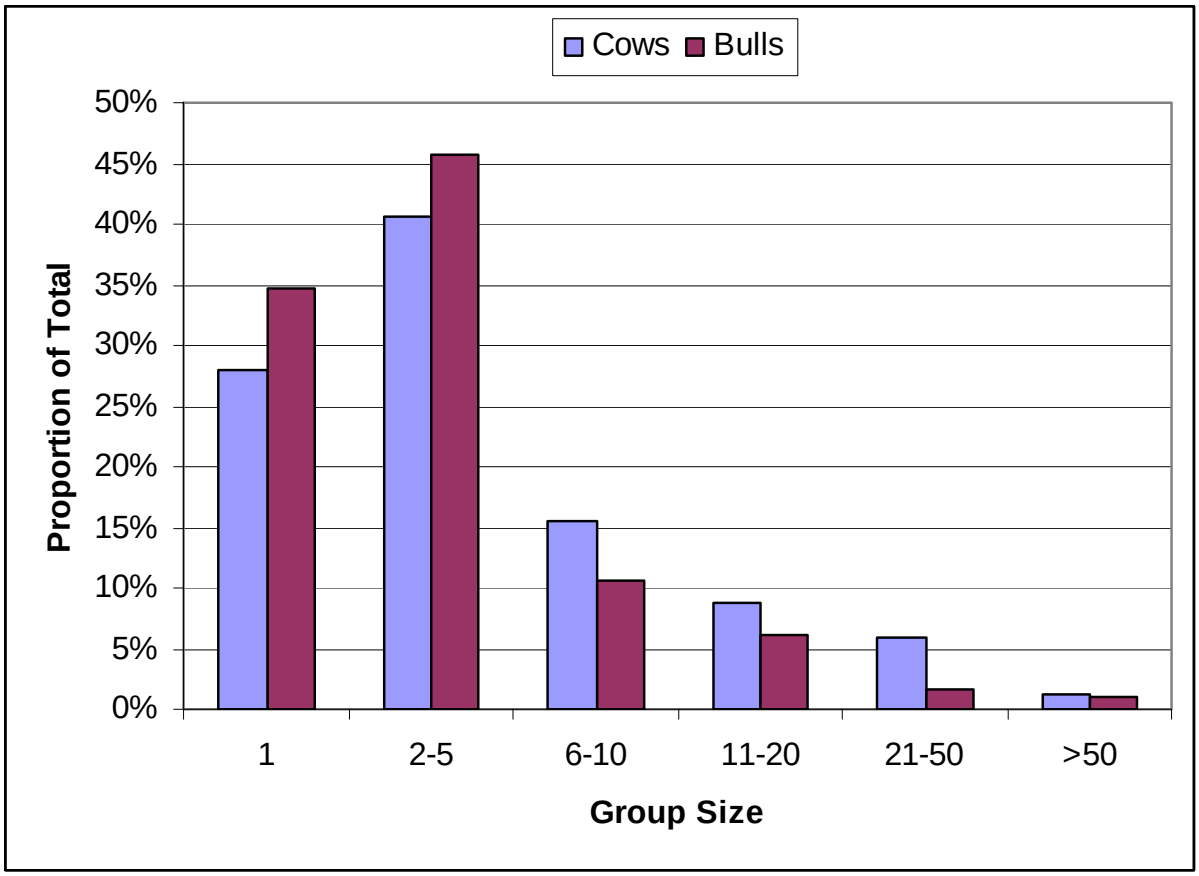
APPENDIX XVI. MEAN GROUP SIZE OF RADIO-COLLARED ELK OBSERVED DURING AERIAL RELOCATIONS OUTSIDE AND INSIDE RMNP DURING 2002 AND 2003 (n=2196).



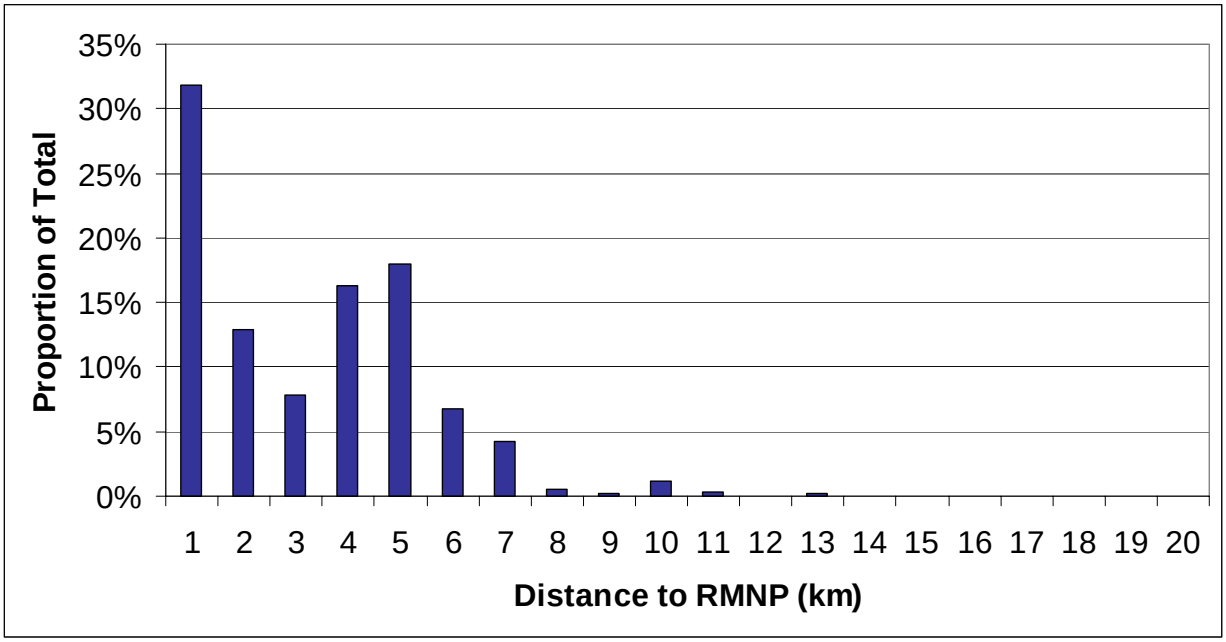
APPENDIX XVII. MEAN GROUP SIZE OF RADIO-COLLARED ELK OBSERVED DURING AERIAL RELOCATIONS DURING EACH MONTH OF 2002 AND 2003 (n=2196).



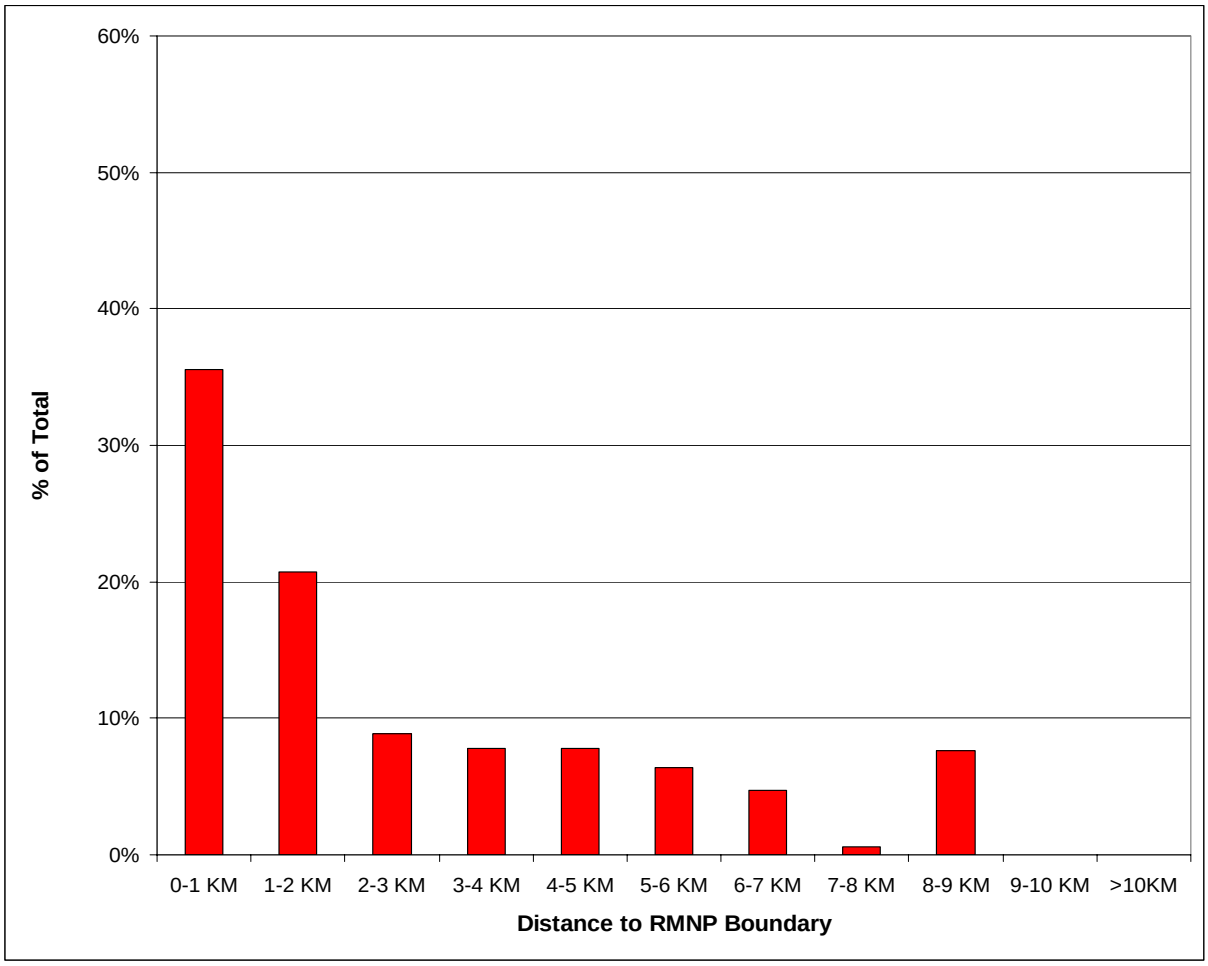
APPENDIX XVIII. MEAN GROUP SIZE OF COW AND BULL RADIO-COLLARED ELK OBSERVED DURING AERIAL RELOCATIONS DURING EACH MONTH OF 2002 AND 2003 (n=2196).



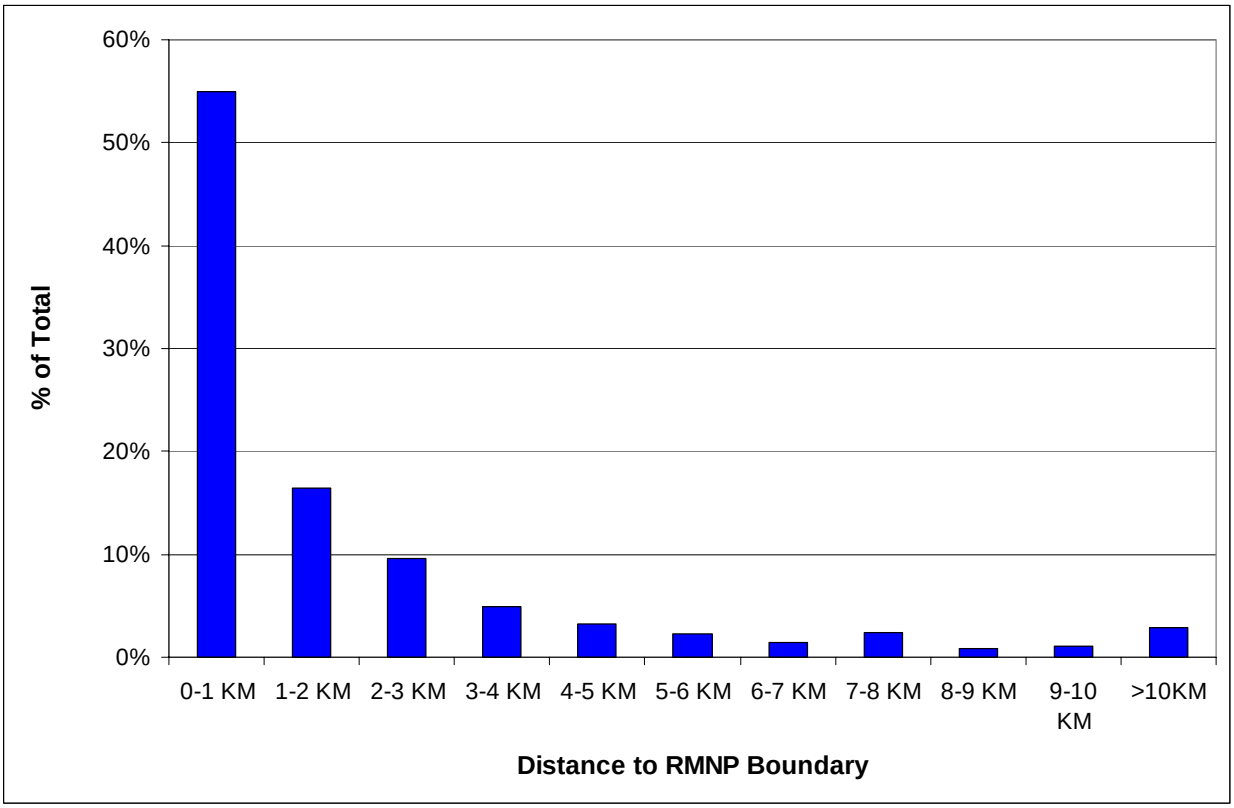
APPENDIX XIX. RADIO-COLLARED ELK DISTANCE TO RMNP BOUNDARY (2002-2004).



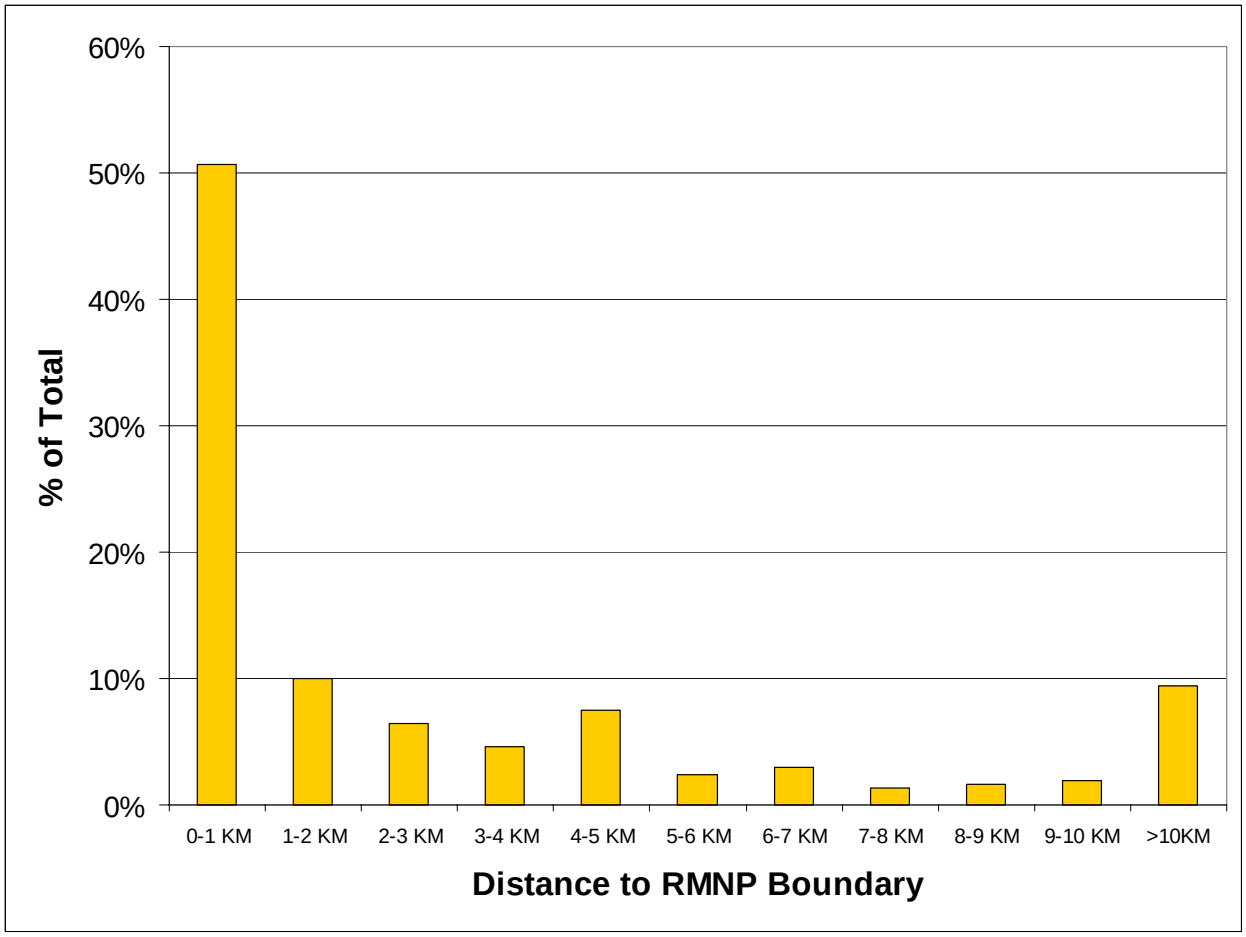
APPENDIX XX. AERIAL SURVEY ELK LOCATIONS OUTSIDE OF RMNP DISTANCE TO PARK BOUNDARY (1997, 2000, 2001, 2002).



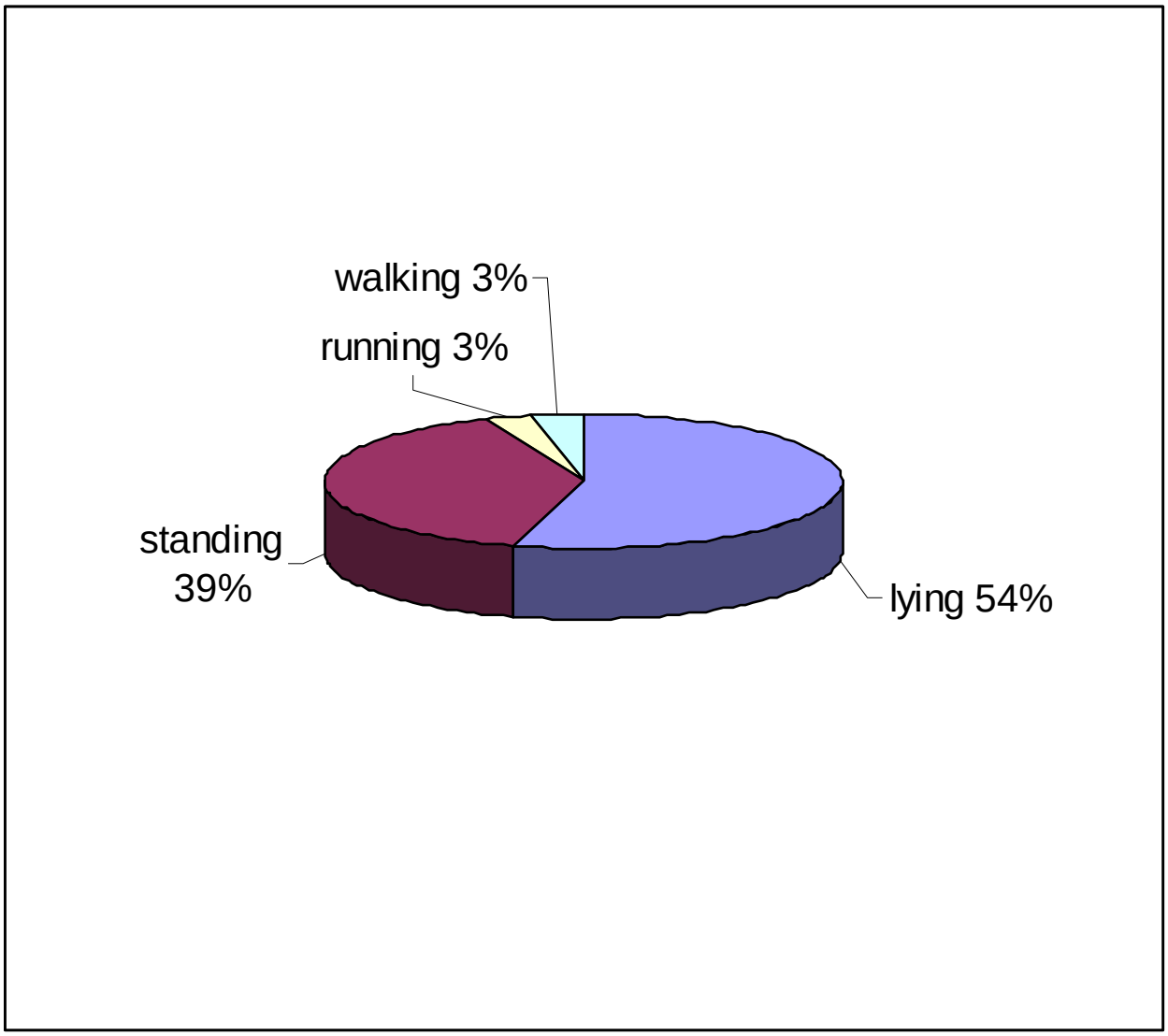
APPENDIX XXI. HUNTER HARVEST LOCATIONS DISTANCE TO PARK BOUNDARY (1997-2001).



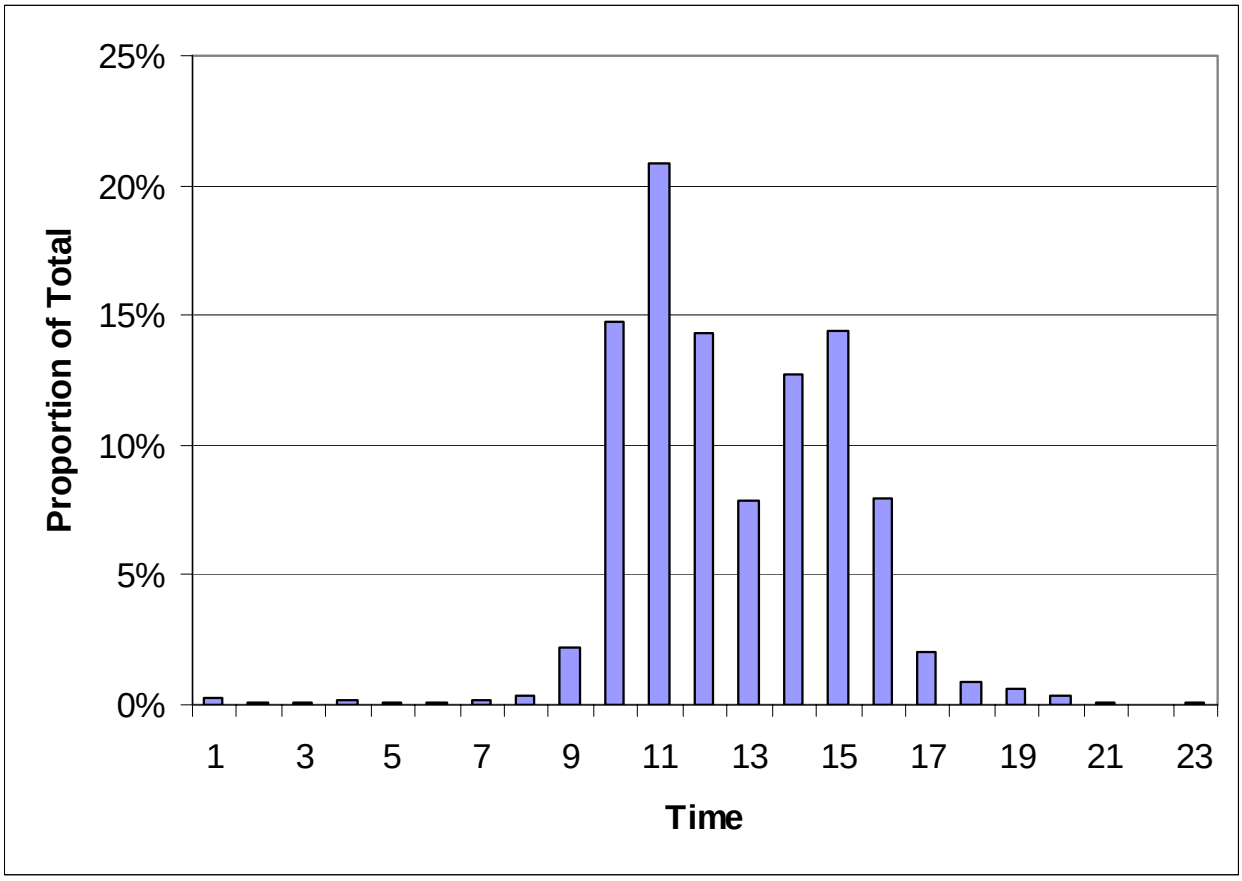
APPENDIX XXII. DISTANCE FROM FARMS MAKING CLAIMS TO MANITOBA CROP INSURANCE CORPORATION DISTANCE TO RMNP BOUNDARY (1997-2001).



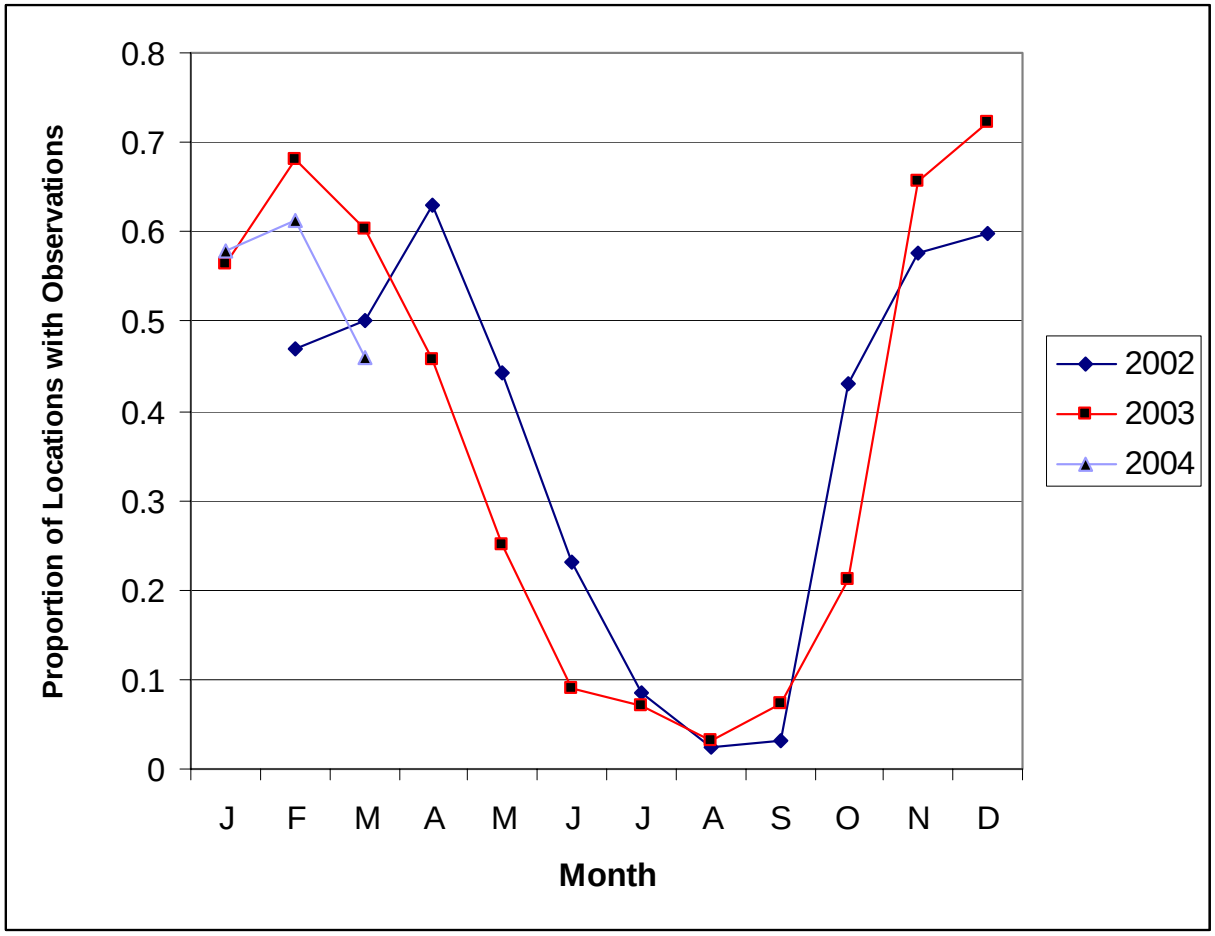
APPENDIX XXIII. BEHAVIOURAL OBSERVATION OF RADIO-COLLARED ELK FROM AERIAL RELOCATIONS (n=2196).



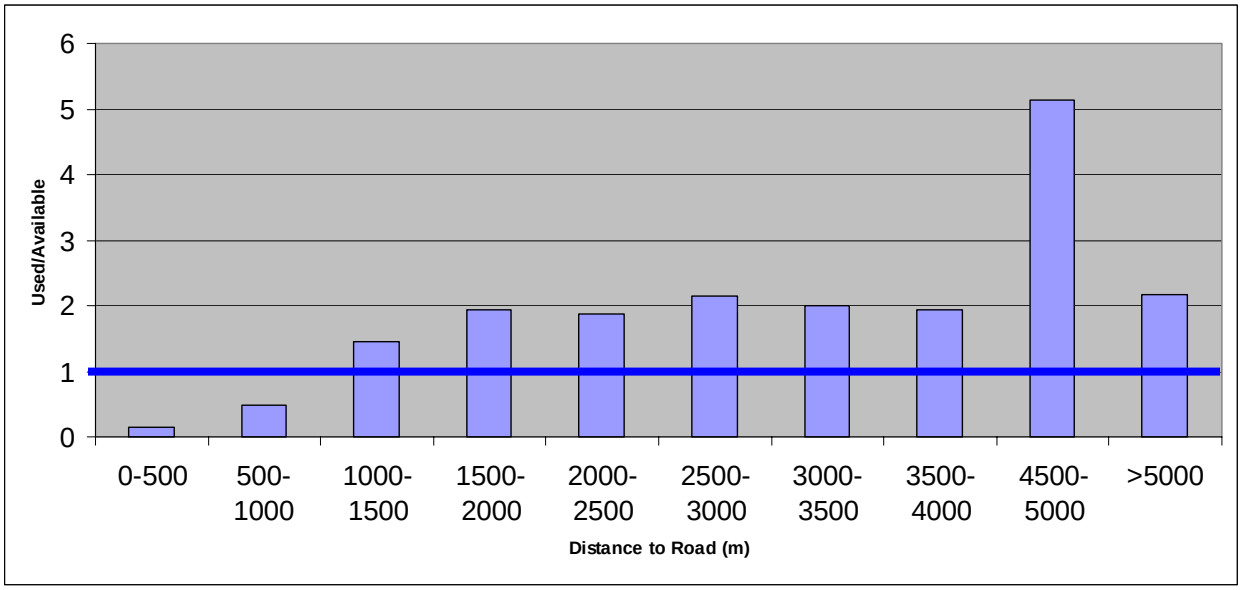
APPENDIX XXIV. TIME OF DAY OF OBSERVATION OF RADIO-COLLARED ELK FROM AERIAL AND GROUND RELOCATIONS (n=2196).



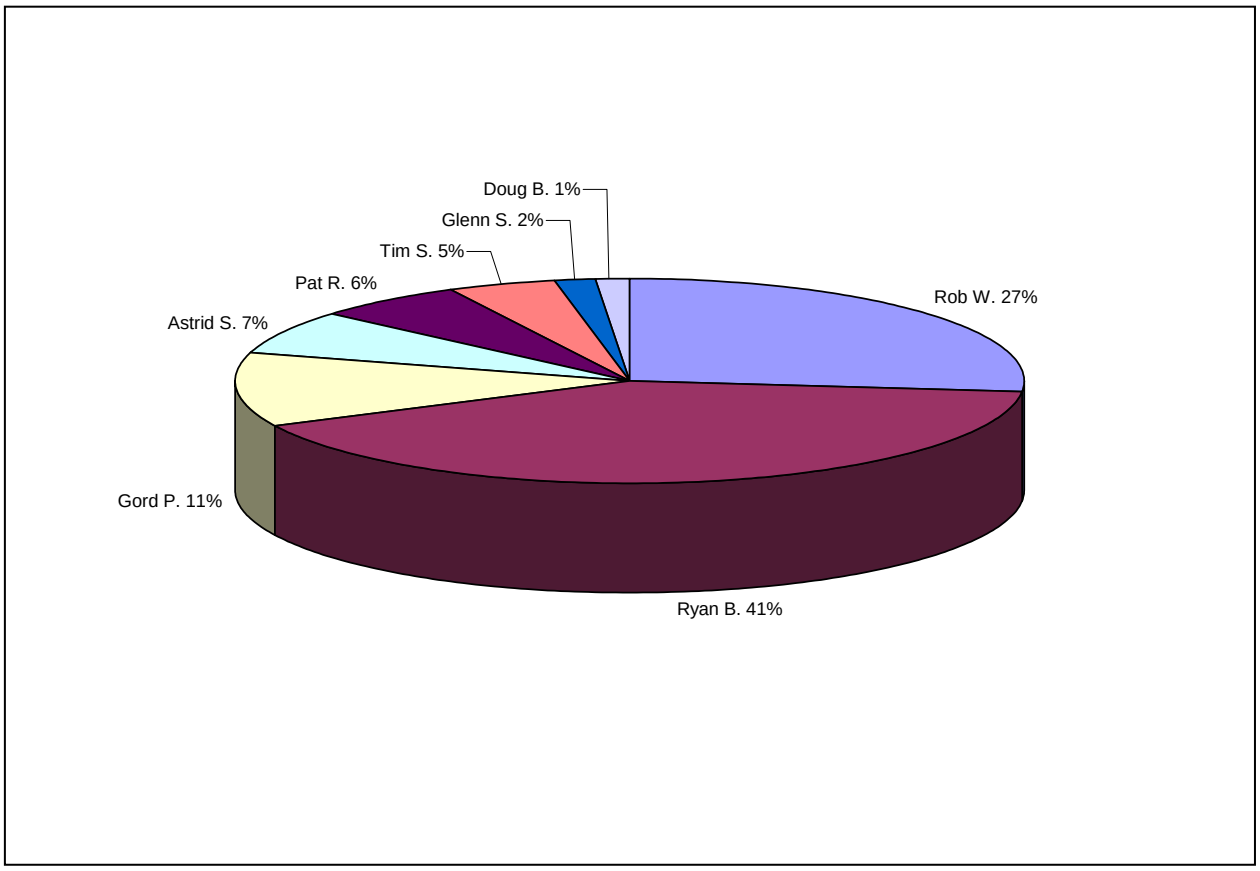
APPENDIX XXV. PROPORTION OF AERIAL ELK TELEMETRY LOCATIONS WHERE THE ANIMAL WAS OBSERVED.



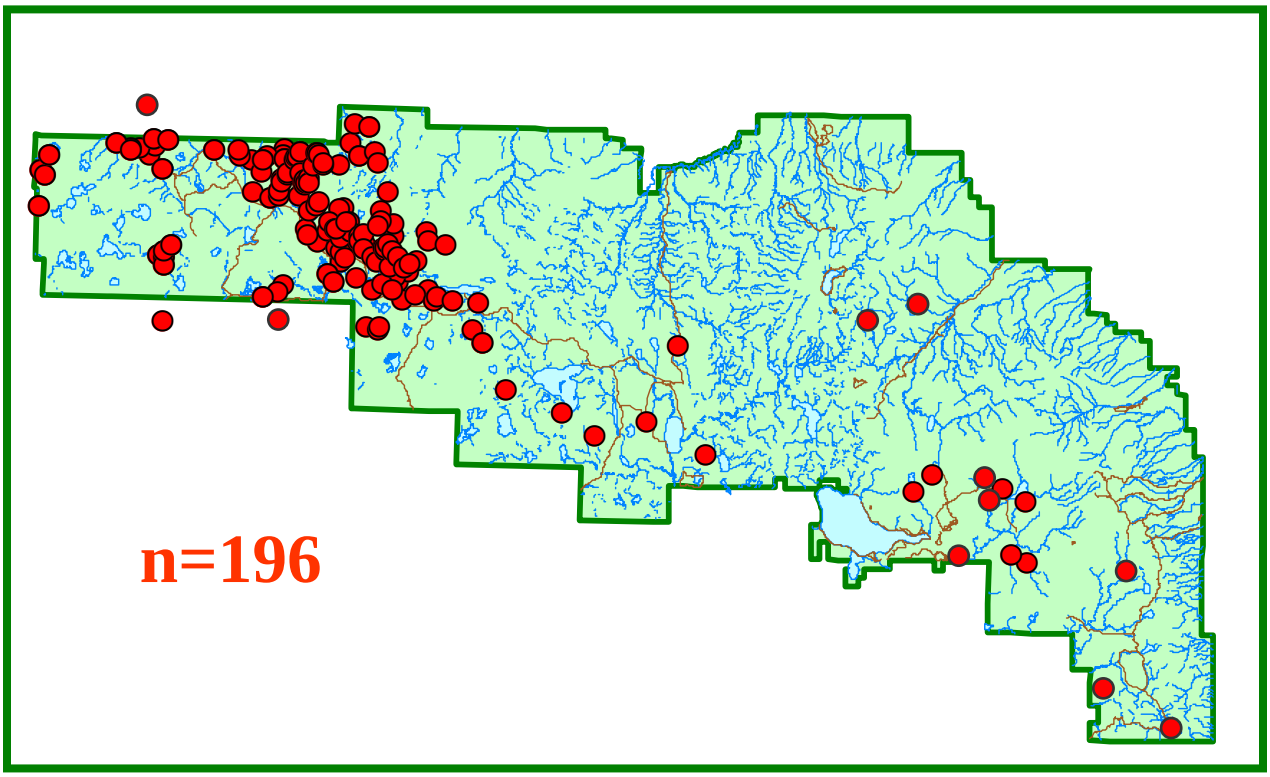
APPENDIX XXVI. ELK TELEMETRY LOCATIONS OUTSIDE OF RMNP MINIMUM DISTANCE TO ROADS.



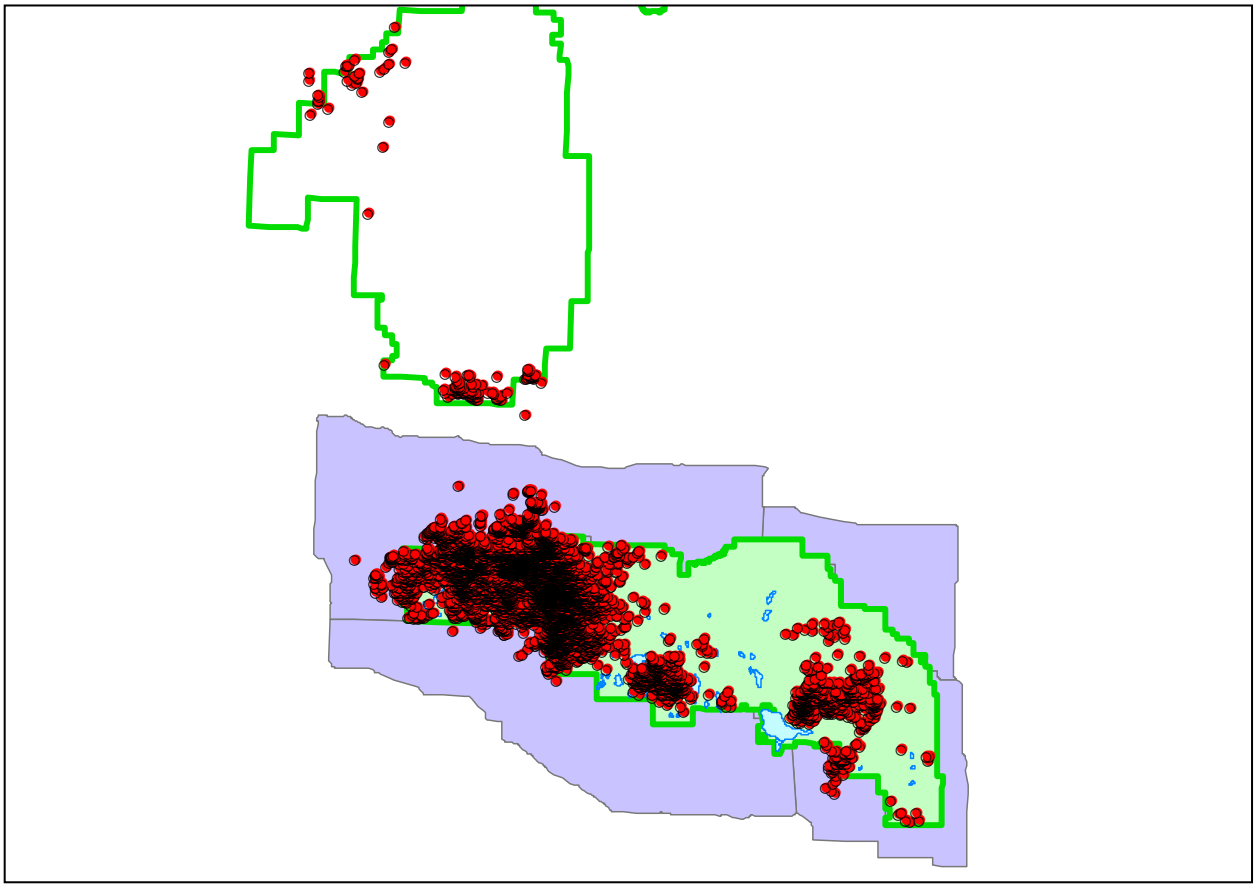
APPENDIX XXVII. RELATIVE PROPORTION OF HOURS OF ELK AERIAL TELEMETRY FLOWN BY TELEMETRY CREW FROM FEBRUARY 2002 TO MARCH 2004 (ESTIMATED TOTAL FLYING HOURS = 1385).



APPENDIX XXVIII. LOCATIONS OF ELK CAPTURE SITES WITHIN THE STUDY AREA (FEBRUARY 2002-MARCH 2004).



APPENDIX XXIX. TELEMETRY RELOCATIONS FOR ALL COLLARED ANIMALS COMBINED (FEBRUARY 2002-MARCH 2004). Blue shaded area is the Riding Mountain TB Eradication Area (RMEA) which corresponds to Provincial Game Hunting Areas (GHA's) 23 &23A.



APPENDIX XXX. MOVEMENTS OF THREE RADIO-COLLARED BULL ELK FROM RMNP TO THE DUCK MOUNTAIN PROVINCIAL FOREST (FEBRUARY 2002 TO MARCH 2004). Movements to the Duck Mountains occurred on July 2002 for RE 111 and RE132, and on July 2003 for RE217.