An Historic Perspective of Mountain Caribou Distribution and Abundance

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Introduction

The density and distribution of a species fluctuates over time. Likewise, factors influencing animal numbers are not static. A major limiting factor identified during on research project may be less important over a longer time period or in a different area. Similarly, the timing of a study may miss a rare but significant event that may cause a rapid change or even local extinction. Results from research over a relatively small area and period of time may suggest some causal relationships but these may be inconsistent over larger scales of space and time. To understand ecological relationships that effect a species' abundance and persistence, it is sometimes helpful to try, as well as possible, to look at broad scales of space and time, in addition to more focussed projects.

Within the limitations of available data, broad spatial-scale factors affecting the current distribution and abundance of a species can be investigated by comparing landscape features where a species remains to where it has been extirpated as done by Apps and McLellan (2006) for mountain caribou using a Geographic Information System (GIS). GIS basemaps are usually a combination of static variables, such as elevation and slope, and dynamic variables such as the age and composition of the forests. Relationships among landscape variables and caribou distribution and abundance can suggest causal relationships. Similarly, it may be useful to investigate the distribution and abundance of a species across broad temporal scales. Long-term trends, when linked with temporal changes in landscapes as well as human abundance and behaviour, may also suggest causal relationships.

Our understanding of the historical distribution and general abundance of mountain caribou relies on written and verbal accounts by early travellers and settlers as well as verbal accounts from native North Americans. The presence or absence of faunal remains at archaeological sites provides evidence of even earlier distribution. Several people have pieced together the early history and pre-history of mountain caribou. In particular, Harrington (2003) collated archaeological data of vertebrates across Canada and Anderson and White (1975) summarised the archaeological data of caribou in Idaho. Flinn (1956) and Evans (1960) interviewed many "old timers" in the US who reported what they had seen or at least what they had been told either directly from the observer or before the story of the observation had passed through many people. These early historians, as well as Freddy (1975), Layser (1974), Manley (1986), McDonald (1996), and Spalding (2000) reported on early writings of explorers, trappers, prospectors, and other early settlers.

Ecological historians usually report locations and use qualitative words to describe the number of animals seen but in some cases actual numbers or estimates of numbers were recorded. Based on early writings, Spalding (2000) estimated trends in caribou population sizes over the past century. There has not been an attempt to estimate historic population sizes.

The objective of this chapter is to describe the prehistoric and historic distribution of mountain caribou and descriptively correlate changes in distribution to changes in landscapes and human activity based largely on the work of Edwards (1954), McDonald (1996) and Spalding (2000). I also compare historic group sizes seen in various portions of the animal's range to group sizes recently seen in subpopulations that vary in size from < 10 to > 700 animals. If group sizes observed are a reflection of subpopulation size or density, then the likely size or density of some subpopulations may be estimated or at least discussed based on groups sizes recently seen.

Methods

The prehistoric and historic distribution of mountain caribou is summarised from the literature, and in particular from Spalding (2000) and McDonald (1996) for British Columbia and Flinn (1956), Evans (1960), Freddy (1975), Layser (1974), and Manley (1986) for the Untied States. These historians report the location and usually qualitative descriptions of the number of animals or the amount of caribou sign seen by other people but sometimes include counts of animals observed. Spalding (2000) and McDonald (1996) discuss changes in caribou numbers in the context of changes in possible causal factors.

In an effort to make an estimate of population size or density of caribou in the past, I correlate recent observations of caribou group sizes with subpopulation size and density and then compare historic observations of group sizes to this relationship. Although most caribou groups seen historically as well as recently are likely small due to the behaviour of these animals, there may be a positive and quantifiable relationship between the total number or density of animals in a subpopulation and the size of the largest aggregations observed at various times of the year. If such a relationship exists, then an estimate or, due to the need for extrapolation, perhaps improved guess of historic populations is possible.

Resent group size information was obtained from census and telemetry databases and subpopulation size and density is reported in Chapter X. Current and historical group sizes were categorized by season.

Results

Early Distribution

The southernmost evidence of caribou in western North America consisted of two fragments of caribou antler in Wisconsin deposits at Shoshone Falls, near Twin Falls, southern Idaho (Anderson and White 1975; Fig. 1). Archaeological excavations in and south of the Snake River Plain of southern Idaho reflected abundant elk, mountain sheep, antelope and in particular mule deer but did not have caribou remains (McDonald 1996). The next furthest south remains of caribou were found in the Birch Creek region about 70 kms northwest of Idaho Falls (Kurten and Anderson 1972, Anderson and White 1975; Figure 1).

Verbal history suggests that caribou may have occurred even further south than the archaeological evidence (Evans 1960, Stevenson and Hatter 1985). A second hand report of a sighting of seven caribou in 1877 in west-central Wyoming was told to Evans (1960), but he was sceptical of this report. Not only was the apparent sighting far beyond temporary (or archaeological) records, but also near the Caribou Mountains and Caribou County which may have confused the account. This area derived its name not from the animals but from a man who had been nicknamed “Caribou” when he worked in a mining camp with that name in British Columbia (Evans 1960).

Flinn (1956) and Evans (1960) report the southern-most recorded sighting of caribou by quoting Merriam (1890): “Captain Charles E. Bendire (who had been in the Clearwater River, Idaho, in 1872) informs me that caribou are common in Northern Idaho and that they occur as far south as the neighbourhood of Elk City, in Idaho County”. This sighting is about 130 km southwest of the Lolo area, southwest of Missoula, Montana where caribou have been infrequently reported from the 1800’s to the 1960’s (Manley 1986). In Idaho, reports of early sightings become increasingly common in the St. Joe drainage of northern Idaho, and much more common further north (Evans 1960).

Oral history and writings suggests that caribou were present in the Cabinet and Bitterroot Mountains between northern Idaho and Montana and the Galton/Whitefish Mountains and North Fork of the Flathead River drainage that drains southeastern British Columbia into Montana. Apparently the old Kutenai Indian name for Logan Pass, Glacier National Park, Montana, is “bigfeet was killed”, and is thought to be from an incident involving caribou (Manley 1986). There does not appear to be reports of caribou in Washington except the northeastern corner in the Selkirk Mountains, near to where they remain today.

In the Rocky Mountains between the North Fork of the Flathead in southeastern B.C. and the Blaeberry River where Moberly (1866 – cited from Spalding 2000) found them to be numerous in the mid-1800s, there have been very few sightings of caribou. Sighting in this area include 2 caribou killed in 1914 perhaps in Lizard Creek, just north of Fernie, B.C., a recent sighting of a male caribou on Mount Seven, near Golden, and 8 animals seen near Blackwater Lake in 1973 (Russell et al. 1982). Caribou seen in the Blaeberry area likely mixed with the shallow snow ecotype in the northern portion of Banff National Park where a few animals

still remain. Although fossils were found Southeastern Alberta near Medicine Hat (Anderson and White 1975) it is unlikely that they occurred outside of the mountains of southern Alberta as no remains were not reported in archaeological mammal remains in the Waterton or Kananaskis areas (McDonald 1996).

The southwestern distribution of mountain caribou includes scattered references to a herd seen in the plateau area west of Peachland in the late 1800's and a report of 2 animals near Missezula Lake, between Princeton and Aspen Grove, in 1914. These locations are about 170 km west of where caribou are found today in the Monashee Mountains. There are many reports of caribou east of Okanagan Lake in the late 1800's and early 1900's including a caribou hunting trip by Theodore Roosevelt into Grayback Mountain (he also hunted caribou in the Selkirk Mountains near Creston in 1888). Reports were common of caribou in the highlands from Mabel and Sugar Lakes through the Kettle and Granby River area to near the U.S. border (Wahl, 1988, Spalding 2000).

There are reports of caribou just north of Kamloops in the late 1800's, about 130 km from where they occur today. North of there, it is uncertain where caribou were more or less continuously distributed from the interior wet-belt mountains to the Coast Mountains near Tweedsmuir Park and Chilcotin area. They were once found west of Highway 97 near Prince George (Stevenson and Hatler 1985) and were reported to be abundant in the Vanderhoof, Fraser Lake, and Francois Lake area in the late 1800's (Spalding 2000).

Early Abundance

Although caribou were present in the south-eastern corner of British Columbia and adjacent portions of Washington, Idaho, and Montana, faunal reports from archaeological investigations suggest that they were a relatively minor component of the ancient cultures in that area. Near the southern edge of caribou distribution in Montana and Idaho, deer were the primary prey of native North Americans. In the 1840's, Father de Smit reported that along the Clark River, thousands of deer came down from the mountains in early winter and if conditions were right, 40 Kalispel Indians would kill 300 in a day (McDonald 1996). References of use of caribou by the Kutenai Indians are rare, but they do mention that the Tobacco Plains, Libby, Bonner's Ferry and Creston people joined to hunt caribou somewhere in the Yaak (Yaak is the Kutenai word for caribou) area, but often enough caribou were found near their home to avoid travel (McDonald 1996). Russell et al. (1975) mention that the Kootenai Indians of Creston claim that many years prior to 1900, caribou migrated across the Creston Valley in large numbers, a phenomenon that ceased prior to European settlement. At the upper end of lower Arrow Lake in 1827, David Douglas reported "not fewer than a hundred skins were in this lodge. They are killed readily during the deep snow with the bow". Baillie-Grohman (1900) reported that "fifteen years ago (1885) they were plentiful on the steep slopes around Kootenay Lake; at least to judge by the well-beaten trails they had made".

However, reports from this period suggested that the Lower Kutenais lived primarily on deer, fish, and berries while the Upper Kutenais lived primarily on buffalo obtained from the prairies (McDonald 1996).

In the Okanagan Highlands, caribou were an important source of food and clothing for the Indians before European settlement and the area became known as a good place to hunt caribou in the 1880's. North of the big-bend in the Columbia however, was the greatest increase in use of caribou for food and clothing by the indigenous peoples (McDonald 1996, Spalding 2000). The significance of caribou to indigenous peoples is reflected in the legendary caribou wars between the Chilcotin and Shuswap people in the mid 1870s over hunting territory that included the Clearwater Valley in what is now Wells Gray Park. Great herds of caribou migrated across the valley each spring and even in the 1920's Glynn-Ward (1926) stated that during the migration it was "impossible to count them; we could only guess at their hundreds" These caribou wars resulted in geographic names such as Battle Mountain and Fight Lake on the southern, plateau portion of Wells Gray Park.

The Carrier Indians, who relied heavily on caribou for food and clothing, called the mountains near Barkerville "Ho-tsee-kaya" or caribou land and resulted in the region being called the Cariboo. In this area and further north there are many reports of large herds, large migrations across valleys, or caribou being very plentiful (McDonald 1996, Spalding 2000). In 1793, Alexander Mackenzie reported that the Indians in the Parsnip River area wore clothing made of caribou.

Although the amount of caribou in the diet and clothing of native peoples is a good indication of their relative abundance, qualitative descriptions of numbers are relatively common but difficult to interpret. An abundance of caribou to one observer may be only few to another. More quantitative reporting of actual numbers of caribou seen or killed near their southern distribution has been recorded since the late 1890's that may help indicate actual population sizes. There are many early accounts of people killing between 1 and 8 animals in the Selkirk Mountains of Idaho and the Cabinet/Yaak Mountains of Montana and two hunters apparently killed 25 caribou during the winter of 1888-89 on the Pend Oreille River (Merriam 1890). In a letter to Flinn (1956), Colon Smith said that in the 1890's, "there were hundreds of them around Priest Lake and Priest River". Evans (1960) reported that a very reliable and experienced woodsman who spent most of his life trapping in the Priest Lake area of northern Idaho, estimated that, between 1911 and 1920, there were 400 caribou wintering in the Granite Creek and upper Priest River drainage. In the summer of 1955, a pilot who had flown animal censuses for the Idaho State Government reported an intriguing observation in northern Idaho; "numerous brown animals that were neither deer or elk. The whole alpine meadow and hillside came alive and it seemed that there were nearly 400 animals" (Flinn 1956). Although most accounts reported to or seen by Flinn (1956) in the 1950's were of single animals

or small groups, one report was of 50 animals and Flinn himself saw a group of 23. After 2 winters of ground work and interviewing many people, Flinn (1956) estimated 100 plus animals in Idaho in 1956 and that excluded animals in the British Columbia portion of the mountain range. In the early 1970's, Freddy (1974) and Layser (1974) concluded that there were about 25-35 animals in the entire South Selkirk population and an extensive helicopter survey in 1983 found 26 animals.

In the international boundary area, but outside of the Selkirk Mountains of Idaho and Washington, there were observations of caribou between 1900 and the 1970's in the Cabinet/Yaak Mountains between northern Idaho and Montana, the Bitterroot Mountains south of the Clark Fork River, and the Galton/Whitefish Mountains and Glacier National Park in Montana. Groups of 10 to 15 animals were occasionally reported in all three of these areas and there was a second-hand report of 35 caribou seen in the Yaak River area of Montana in the 1940's (Evans 1960). It appears that caribou disappeared from all of these areas in the 1980's with last sightings of 5 animals in the Yahk drainage of B.C. in 1984 (Manley 1986) and a single male in the North Fork of the Flathead in 1981. Aerial surveys in the 1980's found tracks that may have been from caribou but they could not be verified (Manley 1986). No animals have been seen in these mountain ranges for over 20 years.

Similar to reports in the US, there are many reports from the late 1800's and early 1900's of hunters killing 1 to 7 animals and observing groups of up to 30 animals across the mountains of southeastern British Columbia but there are also some quantitative reports of notably larger groups. In the summer of 1913 "150 caribou in one band" was reported in the mountains in the Kettle River drainage (Spalding 2000). Further north, on the Hunter Range southeast of Sicamous, "close on 200 animals in one place" was seen in March of 1906 (Spalding 2000) and a sighting of 98 animals was recorded on a cabin door on Mara Mountain in the 1920s (Stevenson and Hatler 1985). In the spring of 1884, "35-40 head were recorded in one group in the Wap River southwest of Revelstoke and a herd of about 50 was seen in nearby Sawtooth Range in 1920 (Spalding 2000). In the Lardeau area large herds were reported and "over 100 in a single herd" was reported in 1917 but that report was by a person lobbying for the legal sale of game meat and thus may have been prone to exaggeration (McDonald 1996).

Further north, sightings of groups of 30-60 animals are not rare but much larger groups were occasionally reported. During this period, however, some observations conflict with reports from the National Parks and Provincial Game Commission, and so have been treated with mistrust. For example, in 1930 the Superintendent of Yoho, Glacier, and Mt. Revelstoke National Parks reported "small numbers of caribou travel through" both Glacier and Revelstoke National Parks and the 1931 Report of the Provincial Game Commissioner states that in Kootenay and Boundary Districts "these animals are to be found in certain parts

of the Division, but not in any large numbers". But then in 1932, the Superintendent of the Parks report states "caribou are quite numerous" and the 1932 Game Commissioner reports "caribou are definitely increasing….caribou are to be found on practically every range within the Division". These inconsistent reports from the Parks Superintendent and Game Commissioner were during the same period when J. Sime reported that park warden Bob Mann (who later to become chief park warden) saw "large herds of caribou, in excess of 500 and some years as many as 1000 animals congregating on what he calls prairie hills…each fall normally October, throughout the years 1924 to 1936". In 1938, Bob Mann took J. Sime to the Prairie Hills and Sime shot one bull caribou out of a group of 56 animals. In October 1946, no caribou were seen on Prairie Hills (Sime 1975).

Similarly, Spalding (2000) reported a letter that mentioned a sighting of about 2000 animals on Isaac Lake in Bowron Lake Park in about 1918. Due to the extreme size of this group, the report was further investigated and it was confirmed that the sighting was by a police constable who later became a game warden and was a reliable observer. Spalding (2000) concluded that there was no reason to doubt that a large group of caribou were seen. Spalding (2000) also found a reference to a sighting of "about 1000 caribou crossed" Slim Creek, in the north Cariboo Mountains in around 1930.

Relating group sizes to population size and density.

Since 1988, biologists working on mountain caribou in B.C. have recorded the number of animals in 5565 groups. Most groups (62%) were observed in late winter when censuses were conducted and the animals are usually in open, parkland habitat where they are easily seen. The mean group size over the all seasons and herds was 5.7 animals and the median was 4. There was a significant logarithmic relationship between subpopulation size and the largest group seen in that subpopulation ($r^2 = 0.72$, $P < 0.001$; Fig. 2) and the largest group seen was 62 animals in the Hart Ranges in 2006 when there was an estimated 718 animals in this, the largest of the subpopulations

Many historical sightings were made in seasons other than the late winter when the caribou use high elevation areas and walk on top of a very deep snowpack. In seasons other than late winter, there was also a significant logarithmic relationship ($r^2 = 0.60$, $P = 0.001$) with the largest group seen being 25 animals, again in the Hart Ranges when there was 719 animals in that subpopulation. The trend between group size and caribou density was insignificant ($r^2 = 0.19$, $P = 0.12$).

Discussion:

Compared to most other large mammals, caribou are easy to enumerate from a helicopter in the late winter when > 90% are in the subalpine parkland and they

leave an abundance of tracks that are easily seen and can usually be followed until the animals are observed. However, it wasn't until 2002 that all mountain caribou subpopulations were censuses at approximately the same time using a standard method and a total population estimate was made. But even then, the Hart Ranges were not completely covered (Seip et al. 2006). It wasn't until 2006 that a complete census was done and resulted in a population size estimate of all mountain caribou. As we move backward in time from 2006, estimates become increasingly subjective and limited to smaller areas with poorly located subpopulation boundaries until they are largely guesses. It is unlikely that the number of mountain caribou before the 1980's will ever be know, but, it is clear that in the late 1800's and early 1900's, they were far more abundant and widespread that they area today.

The largest of the thousands of groups seen by biologists over the past 20 years was 62 animals in the Hart ranges that had over 700 animals in the subpopulation at that time. Groups of almost that size were seen in the Southern Selkirks in the early 1900's and larger groups were seen in the southern Monashees and Okanagan. The large group sizes seen plus the verbal descriptions of caribou abundance suggests that there were likely about as many animals in the South Selkirks in the early 1900's as there are in the Hart Ranges today and even more in the southern Monashee and Okanagan ranges.

Further north, there were likely far more caribou than in the more southern ranges at that time or the Hart Ranges today. The maximum group sizes recently seen in the largest subpopulations are much smaller than groups sizes recorded in the early 1900's. Groups of 18 and 19 are the largest recently seen anywhere in the autumn. How many animals were in the Glacier National Park area when Bob Mann saw more than 500 or even when J. Sime shot a bull out of a group of 56 in the autumn of 1938? If these sightings are believable, it is likely that there were far more caribou in northern Purcell and adjacent portions of the Selkirk Mountains in the 1930's than the 700 animals that are currently in the Hart Ranges.

One reason that the reliability of these sightings of very large groups may be questioned (McDonald 1996) is that they sometimes conflict with the annual reports of the Provincial Game Commission that most often suggest smaller herds of animals scattered throughout the interior mountains. However, the qualitative nature and great variability among years of the reports of the Provincial Game Commission indicates that the specific numbers, particularly when associated with a dead animal to confirm species, makes quantitative reports of park warden J. Sime, believable. The historical descriptions of great abundance and recorded sightings of very large groups in the Wells Gray Park area and the Cariboo Mountains to the north suggest that there were several if not many thousand animals in these areas (Seip 1990).

The timing of the decline of mountain caribou with respect to human activities and ecological change has been discussed in detail by Edwards (1954) Bergerud (1978), McDonald (1996) Spalding (2000) and mentioned by many others. Because three likely inter-related factors: overharvest, a loss of winter habitat, and increased predation rates, all occurred at approximately the same time, there has been little consensus on the relative significance of these mechanisms influencing the decline of caribou. Perhaps all three factors were ultimately due, at least in part, to the end of the little ice age in the mid 1800's (Luckman 2000, Hall and Fagre 2003). The climate warmed and glaciers reached their maximums around 1850 (Hall and Fagre 2003). In 1858, gold was found in the Cariboo region and Fraser River and, in 1863, it was found in the Kootenays and many people of European decent came to the B.C. interior to mine; and some of these and others began settling in and near caribou habitat. Partly due to the miners and settlers but also to the changes in climate, wildfires became increasing common in many parts of the caribou range that destroyed old forests with their abundance of arboreal lichen. The extensive wildfires not only destroyed a significant portion of the lower elevation winter habitat of caribou, but, perhaps in combination with changes in climate and predator control programs, enabled the "remarkable invasion" (Munro 1947) of moose or at least a huge increase in their numbers and distribution (Spalding 1990) as well as a great increase in mule deer (Edwards 1954, McDonald 1996). With the increase of deer and moose, there was a notable increase in cougar and wolves (Edwards 1954, Munro 1947) that would have also killed caribou.

Hunting appears to have been a significant factor influencing caribou numbers in some areas as these animals are notoriously easy to kill once they are located. Early settlers and miners, as well as skilful native hunters with newly acquired repeating rifles, and particularly those from the Kootenay area that had recently lost bison from their diet, killed many caribou (McDonald 1996). In addition to these sustenance hunters, there are many accounts from the early 1900's of sportsmen having very successful caribou hunts (McDonald 1996, Spalding 2000). However, hunting regulations were instated early to reduce caribou harvest. An apparent decline of caribou resulted in closing the hunting season in the Kootenay and Boundary Districts south of the Canadian Pacific Railway (CPR) in 1918. The population was though to increase in the Kootenay area to where the season was re-opened in 1933 but then only for 15 days each autumn until 1937 when it increased in length again. These early trends may suggest that hunting was the major limiting factor in some areas in the early 1900s but other factors were also significant. In the Okanagan, hunting was also closed in 1918 but not reopened. There, caribou numbers continued to decline and were extirpated by around 1960 (Spalding 2000). Group-living animals may be particularly prone to Allee effects or positive density dependence (Berec et al. 2007, McLellan et al. submitted), and perhaps in the Okanagan overharvesting reduced caribou numbers to where other factors, such as predation, became unsustainable.

Hunting closures were also instated further north. In 1940 the hunting season was closed in the Wells Gray Park area due to a dramatic decline in caribou numbers (Edwards 1954). The hunting season was shortened in the Cariboo in 1942 then closed in 1946 (Spalding 2000). With a few exceptions, the entire area between the CPR and CNR (Jasper to Prince George line) was closed in 1948 (Stevenson and Hater 1985).

The effect of the hunting closures on caribou numbers is confounded by the predator control program that was in effect from at least 1906 to 1962. That program paid bounties on up to 1659 wolves and 725 cougars in a year and many more were killed by predator control officers (Province of British Columbia Reports of the Provincial Game Commissioner, 1906 to 1962). Predator control officers were tasked with removing all types of vermin and strychnine in large horsemeat baits was the standard approach before 1950 although strychnine and cyanide tallow pills were also extensively used (West 1962). Between 1950 and 1955, the Predator Control Branch gradually switched to the use of Compound 1080 and it was used over an area of about 520,000 km^2, of which about half was wolf habitat (West 1962). Use of poison was not limited to government officials. Comments in early writings such as "there should be some control of the sale of poison to trappers. This business has reached considerable proportions in the Province, and it is almost impossible to catch any one using poison in taking game animals" (Robertson 1933) that suggests much more wide-spread use of poison. Closing hunting when combined with predator control appeared to cause a notable increase in caribou (Edwards 1954, Stevenson and Hatler 1985, Spalding 2000, Bergerud 1978) in most areas except the Okanagan.

Although population trends were based only on general observations and word-of-mouth, the caribou populations across most of the area south of the CNR and east of the Fraser River the area were thought to have recovered sufficiently for an either sex hunting season in 1955. In 1956 however, the bounty program on predators ended and in 1962 poison baits were no longer used in wilderness areas (Archibald 1989). The either sex caribou hunting season remained until 1967 in a few areas but most often remained until the early 1970's when the hunt became limited to males only. Towards the southern end of their distribution, Russell et al. (1982) reported that between 1964 and 1971, the hunter sample indicated that 110 (54% male) and 89 (60% male) were killed by hunters in the Central Selkirk and South Purcells respectively, and he thought that this harvest contributed directly to the decline of caribou. In the Yellowhead Highway area towards the northern end of the mountain caribou distribution, Burgerud (1978) reported what he called a clear example of overharvest, where an estimated 558 caribou were shot between 1967 and 1977. In 1967 an estimated 121 animals were shot, and, although access improved, only 12 animals were shot in 1977. Hunter success declined from 34% in 1967 to 4% in 1975. The history of hunting and predator control and the apparent response of caribou to changing management actions suggests that one or both of these factors had a significant

effect on caribou numbers because caribou populations appeared to respond when they were changed.

While wildlife managers have used hunting regulations and predator control to keep caribou and other game animals abundant, climatic conditions where also changing and likely having a powerful effect on the ecosystem. After a period of about 6 decades of generally cold, wet years when glaciers in the Rocky Mountains expanded (Luckman 2000, Hall and Fagre 2003), temperatures warmed. There were notable drought years in the late 1800's as well as the well known droughts of the 1920's and 1930's (Luckman 2000, Watson and Luckman 2004, Pederson 2006) with 1917 to 1941 being the greatest dry event since 1550 in Glacier National Park, Montana (Pederson et al. 2006). These climatic trends likely resulted in an increase in wildfires (Westerling et al. 2003, Pederson et al. 2006). Because mountain caribou feed primarily on arboreal lichen that is most abundant on old trees and forest fires convert an old to a young forest, the direct implications of forest fire on caribou habitat has been known for a long time. Baillie-Grohman (1900) suggested that the great forest fires in the Kootenay region that were "the inevitable result of mining prospectors …drove them (caribou) from their haunts to regions further north". Forest fires, sometimes associated with prospecting and railway construction in the late 1800's and early 1900's had a significant impact on the amount of old forest in areas and when combined with land-clearing and lumbering such as in the Okanagan, led to statements such as "all the mature timber at high altitudes in the southern areas was burned in the 1930's" (McDonald 1996). Apps and McLellan (2006) found pine leading, 40 to 140 year old forests were the major differences between landscapes where caribou were historically and where they remained in 2006, reflecting the impact of wildfires in the late 1800s and early 1900s on caribou.

Forest harvesting soon replaced fire as the major factor converting old to young forest. Logging was a significant factor in northern Idaho early in the 20th century where logging activity peaked between 1907 and 1922 (Evans 1960). In southeastern British Columbia, the amount of logging was significant in areas between 1920 and 1940 (McDonald 1996) but across the range of mountain caribou, it was not causing a significant loss of habitat until about 1970 (Spalding 2000), long after the major declines in caribou numbers.

The implications of large forest fires in the Wells Gray area on caribou is described in detail by Edwards (1954). His interpretation of how these fires affected the caribou is the root of a long-standing debate on the relative importance of the loss of winter habitat versus an increase in predation caused by increasing habitat for other prey species on caribou populations (Bergerud 1978, Stevenson and Hatter 1985, Ritcey 1988, Bergerud 1988). Because this debate remains important for management is worthy of discussion, although factors influencing populations almost a century ago will unlikely be resolved.

The southern Wells Gray area is where the Chilcotin and Shuswap Indians fought over the right to hunt caribou and Glynn-Ward (1926 – cited from Spalding 2000) stated that when observing the caribou it was "impossible to count them; we could only guess at their hundreds". In 1926, an intense wildfire burned 520 km^2 of mostly low-elevation (< 1200 m), old-growth cedar and hemlock forests in the Clearwater Valley and an additional 466 km^2 were burned in the 1930s. Edwards (1954) reported that a few years after the burns, the area supported an abundant growth of willow, birch, and aspen and there was "a spectacular increase in mule deer which almost swarmed in abundant browse" and cougars and coyotes became common. He went on to state that moose were unknown before the fire but colonized in the early 1930's and increased until 1945 and with the establishment and increase of moose, wolves increased markedly from a previously low numbers. By 1953 deer numbers had declined as had cougars and coyotes, but moose remained very abundant. According to Edwards (1954), caribou did not become rare immediately after the 1926 fire, but the decline likely took place in the early 1930s and there were alarmingly fewer by 1935. Edwards (1954) thought it was a reduction of low-elevation winter range that caused the decline of caribou. Bergerud (1978), however, found the lag between the fire and when the caribou declined plus the observations of Edwards and Ritcey (1959) that caribou in at least the southern part of this ecosystem, rarely descended to valley bottoms, suggested that the increase in predators was the probable cause of the decline in caribou numbers. Bergerud (1978) suggested that if the caribou had starved because of lack of habitat, then the caribou would have declined immediately after the fire, not several years later.

Before the 1926 and 1930s fires in the Wells Gray area something limited the large number of caribou. Predation by wolves, cougar, bears, as well as indigenous peoples would have removed some animals. But, because caribou use high-elevation ridge tops for many months each winter where snow fall is frequent and deep, predators would have been inefficient at that time of year and their numbers, without alternative prey during winter, would have be low in as was suggested by Edwards (1954). The apparent abundance of caribou before 1926 suggests that they were likely more food limited than they currently are. Caribou that spent the early winter in the area that was burned in the fires would have likely moved elsewhere and, perhaps depleting arboreal lichen even further and cause malnutrition and reduced reproduction and an eventual decline in caribou numbers. Given the inter annual variation of density independent conditions such as snow depth, penetrability, and riming on trees, it is possible that a loss of 520 km^2 of low-elevation habitat may not have resulted in an immediate collapse of the population due to mass starvation, but a collapse spread over a few years due to increased food competition and food depletion elsewhere and thus Edwards (1954) interpretation may be at least partially correct. However, Burgerud (1978) suggestion that it was the increase in cougar and wolf predation several years after the fire and following the increase in deer and moose numbers undoubtedly also a significant factor. It is likely that both increased predation and reduce habitat causing increased concentration of

caribou and more intense food competition caused the dramatic decline in caribou numbers in the Wells Gray area in the 1930s, although the relative contribution of reduced habitat and increased predation cannot be quantified.

Of importance for understanding today's situation may not be the relative importance of food limitation and predation in causing the decline in Wells Gray caribou almost a century ago, but that the ecosystem once sustained likely thousands of caribou, and most of the broader, wet-belt ecosystem did not burn and was not intensively logged until the 1970's. Old trees currently growing on the southern, high-elevation plateau portion of Wells Gray Park and adjacent areas often have heavy Bryoria loads within 2 m of the ground (McLellan unpublished data). If snow and Bryoria conditions were similar a century ago to what they are now, then many caribou would not have needed to move to valley bottoms to feed on the relatively sparse lichen in the low elevation ICH forests (Serrouya et al. 2006) in early winter as there would be lichen accessible on the wide plateau that didn't burn. Recent telemetry data suggested that the few remaining caribou in this area do not drop to valleys during the winter, but remain on the plateau. The fires, likely caused both a major change in the predator/prey system and greater crowding of caribou leading to intense competition and depletion of lichen, caused the great decline in caribou. However, if lichen on trees in the broad plateau area had been depleted, it would have recovered in the decades following the fires. Although much of the remaining low elevation forests have been logged since the 1970's, most of the higher elevation, plateau areas have not; much of this area is in the park. If there was sufficient lichen for the relatively large number of caribou in the Wells Gray area in the late 1800s, there is certainly ample lichen for the approximately 20 animals (Furk 2006) that currently winter on the southern plateaus of this park. More recent work by Seip (1992), Kinley and Apps (2001) and Wittmer et al. (2005a, 2005b, 2007) suggest that predation by cougar and wolves are important factors in recent declines and were likely important in the previous declines. The close association between caribou declines and increases in moose and deer has been noted for decades (Edwards 1954, Cringan 1957, Evans 1960), but these early observers seemed to miss the implications of apparent competition through a shared predator.

Because there are so few mountain caribou remaining, their ecological significance has declined. Although elk were once more widespread in B.C. than they are today (Spalding 1992), they were unlikely plentiful in the interior wet belt during the little ice age where even now, the snowpack in the valleys can be excessively deep. Before there was an abundance of moose and deer in the interior wet-belt mountains, caribou were likely the most abundant ungulate and perhaps a keystone species somewhat like moose are today. Their ability to live for many months on high-elevation subalpine ridges where snow is deep and often unconsolidated was likely an effective anti-predator strategy that would have limited the effectiveness of wolves and cougar for much of the year. In the absence or relative rarity of moose and deer, these predators would have limited alternative prey during the winter and were unlikely to be abundant enough to

significantly limit caribou. It is possible that in such a system where predators were limited by access to caribou during the winter, that the predators could have effectively stopped moose and deer from expanding into these wet-belt areas beyond low numbers where there was adequate escape terrain. Predators may have been sustained primarily by caribou, but in winter, would kill any ungulate they encountered in low elevation areas. The wildfires in the late 1800s and early 1900's, perhaps combined with predator control, enabled moose, and to a lesser extent deer, to greatly increase in numbers. After predator control ended, wolves and cougar fed primarily on moose and deer, and their numbers expanded to where they kill enough caribou incidentally in summer, when their habitat use overlaps to limit or extirpate mountain caribou (Seip 1992, Wittmer et al. 2005, Wittmer et al. 2007). Today, the predator/prey system has flipped. Moose and deer are common and caribou are rare and in decline, where a century ago, caribou were common and moose and in places, deer were rare.

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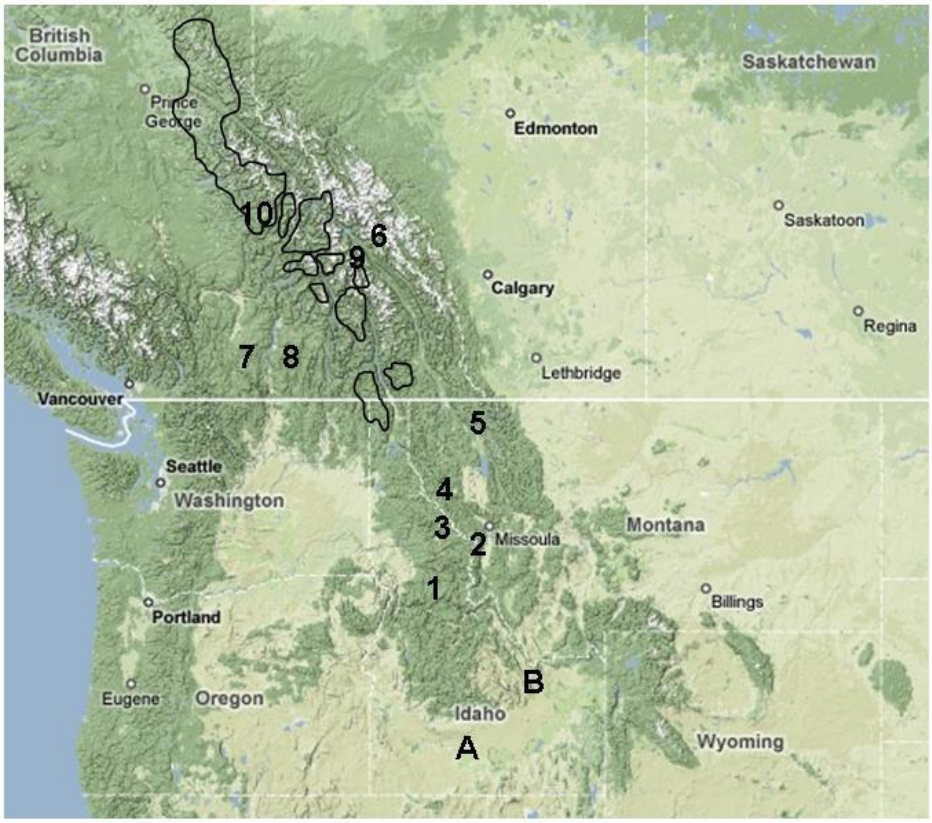


Figure 1. Map of the 2008 distribution of caribou within the black lines, and extreme distribution of prehistoric (letters) and historic (numbers) locations of mountain caribou remains, sightings, and historic places of interest. A. Shoshone Falls, B. Birch Creek, 1. Elk City, 2. Lolo, 3. St. Joe, 4. Cabinet Mts., 5. Galton/Whitefish Ranges, 6. Blaeberry, 7. Missezula Lake, 8. Grayback Mt. 9. Prairie Hills, 10. Battle Mt. and Fight Lake.

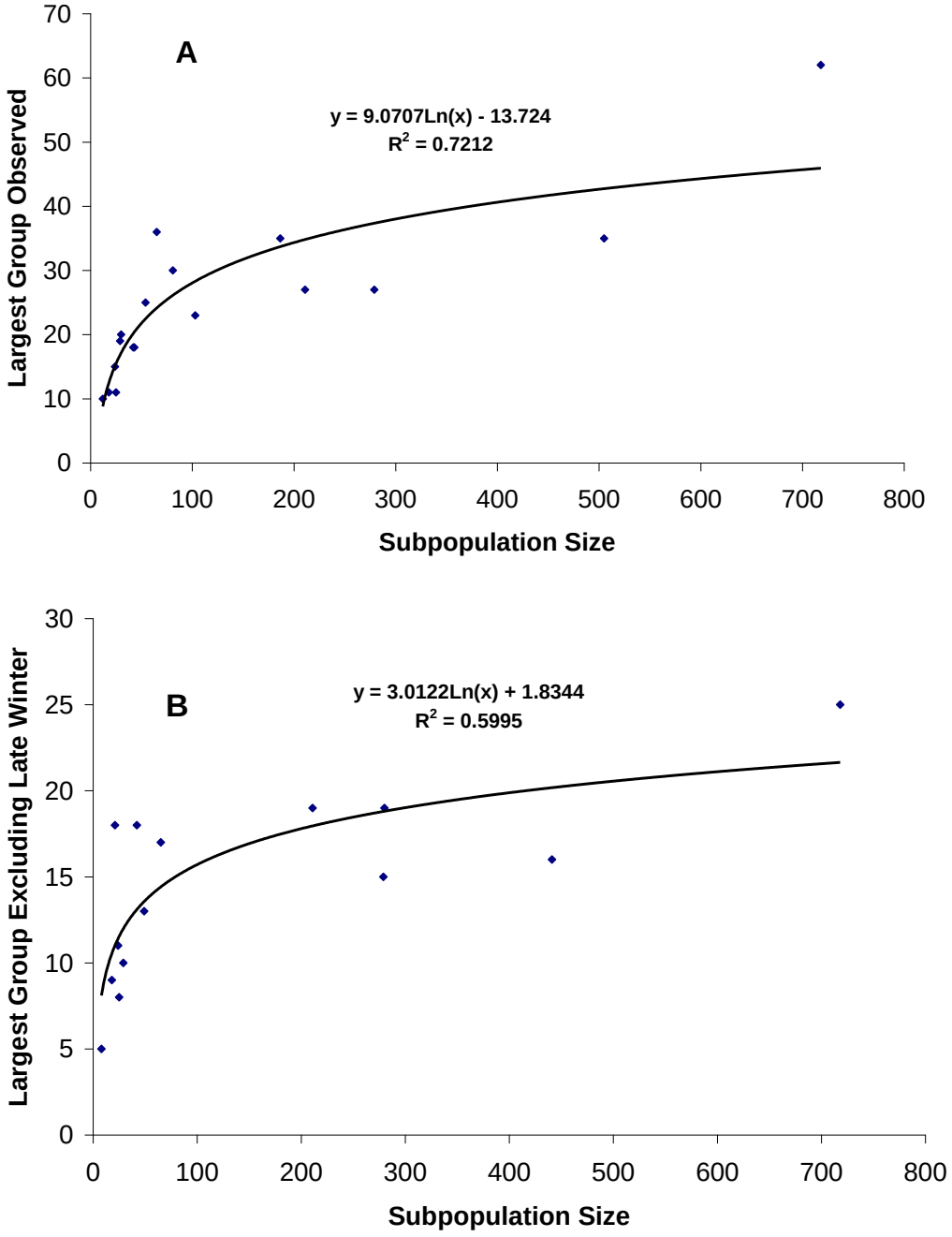
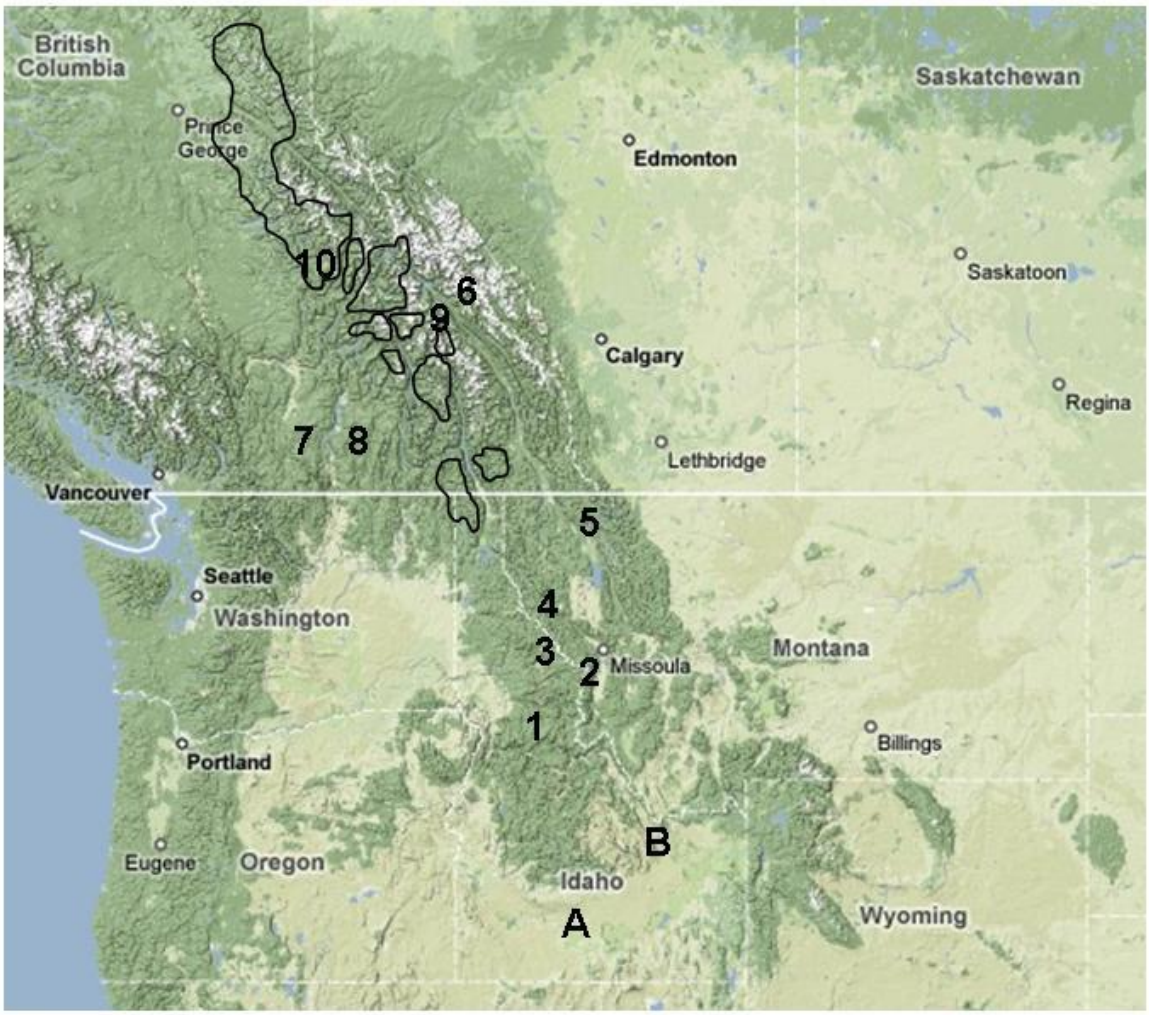


Figure 2. Relationship between the largest group sizes of mountain caribou observed by researchers in British Columbia and the estimated size of the subpopulation: A) the largest group size seen in any season, and B) the largest group seen in any season except late winter.


British Columbia
Saskatchewan
Prince George
Edmonton
Saskatoon
Calgary
Regina
Lethbridge
Vancouver
Seattle
Washington
Montana
Missoula
Billings
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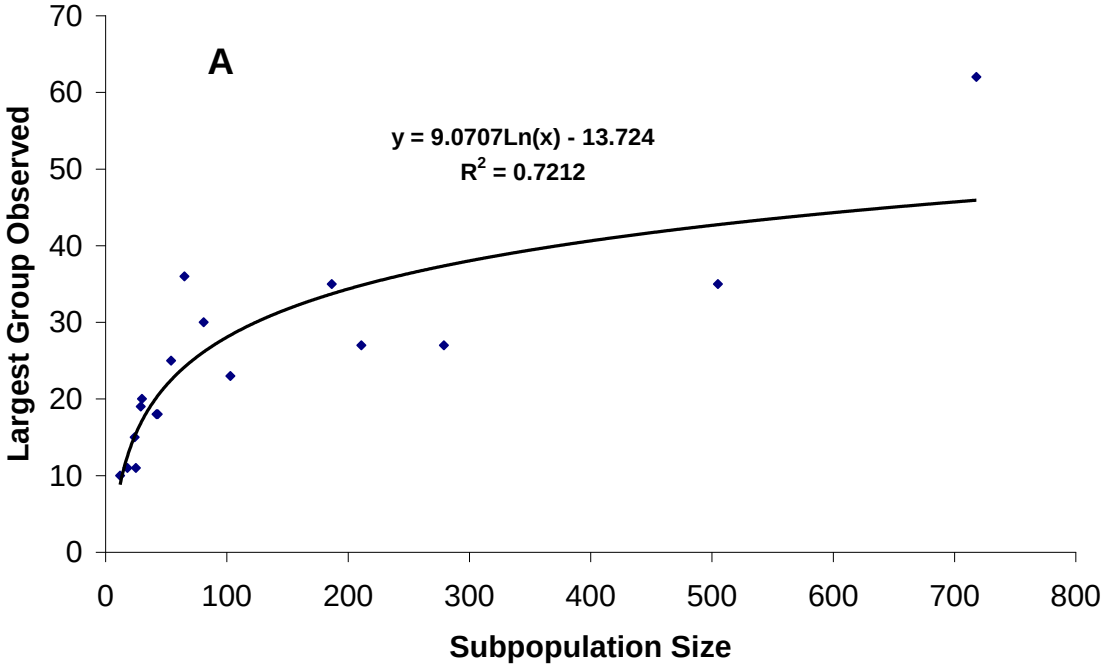
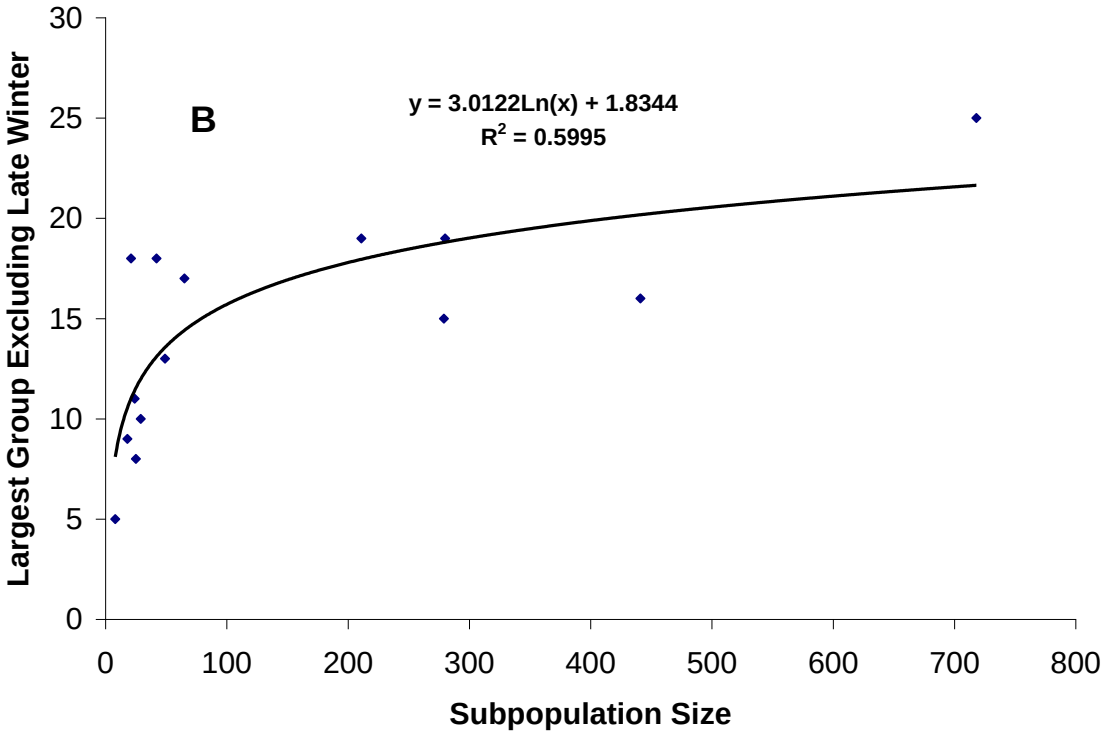
1
B
A


A
y = 9.0707Ln(x) - 13.724
R2 = 0.7212
Largest Group Observed
Subpopulation Size
0
10
20
30
40
50
60
70
0
100
200
300
400
500
600
700
800


B
y = 3.0122Ln(x) + 1.8344
R2 = 0.5995
Largest Group Excluding Late Winter
Subpopulation Size
0
5
10
15
20
25
30
0
100
200
300
400
500
600
700
800