THE COMMUNITY ECOLOGICAL MONITORING PROGRAM ANNUAL REPORT 2012

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Executive Summary

The Community Ecological Monitoring Program (CEMP) arose in 2005 as an extension of the Kluane monitoring project to begin a regional assessment of the health of the Yukon boreal forest ecosystem. This is the sixth annual report to summarize the data on white spruce cone crops, ground berry production, small mammals, snowshoe hares, and carnivore abundance at Kluane Lake, Mayo, Faro, Watson Lake, and Whitehorse. White spruce cone counts were near zero everywhere in 2012, following a similar low year in 2011. Ground berries in the forest were low in 2012 with some variability from site to site. Red-backed voles remained at low numbers in 2012 at most sites and were moderately common only at Kluane and Whitehorse. Snowshoe hares remained at their cyclic low in 2012 showing almost no increase in the summer of 2012 so they remain at the bottom of their 10-year cycle. The next hare peak in the Yukon will not occur before 2015 or 2016. Mushroom production was low at all sites in 2012. Soapberries were moderately abundant at Mayo in 2012 but low at Kluane and Whitehorse. Snow track counts in winter for mammalian predators are being done at Kluane, Mayo, Whitehorse, Watson Lake, and Faro. At Kluane all mammalian predators remained low or declined during 2011-2012 including marten and weasels which had increased greatly since 2000. Local knowledge interviews were completed at Mayo by Mark O'Donoghue in February 2012 and summarized, an important step in bringing local knowledge of trends together with our CEMP data. As additional data are added in the years to come, the regional patterns of ecosystem changes will become more evident.

Introduction

Since we began work in the Kluane boreal forest in 1973 we have been monitoring the ecological integrity of the Kluane region, and have over the years improved the monitoring methods being used. In 2005 we were able to expand some of the monitoring protocols to Mayo, Watson Lake, and Whitehorse, and in 2007 we began collecting data at Faro. This has permitted us to focus on regional trends in measures of ecosystem health. The Community Ecological Monitoring Program (CEMP) is a partnership between researchers at the Arctic Institute Research Station at Kluane Lake, Environment Yukon, and Yukon College. Additional monitoring in the Yukon is being done by Parks Canada and other research groups but we have not tried to summarize all of this monitoring here. We concentrate here on the CEMP monitoring being carried out in the central and southern Yukon.

There are two approaches ecologists are using to answer the broad question about changes in ecosystem integrity over time. First, sit and count, wait and see. This is the simplest approach to describe the system as it changes and it is useful as a first step. By itself it does not permit any management actions to thwart changes, since, by the time you see changes, it is too late to do very much about them. Nevertheless, this approach is important because we carefully document what is happening here and now. Second, we can identify key components of the ecosystem that appear to be responding rapidly to climate change and target them for both model building and experimental attack to try to understand the underlying ecosystem complexity. This requires intense multi-year research, carried out by university students, regional biologists, and Parks personnel. This is our approach. We have picked ecosystem variables like ground berry production and spruce cone production that are commonly thought to be under the control of weather, and we are building predictive models that we can test to predict (for example) the abundance of ground berries from temperature and rainfall data in particular months of the previous year. We can then test these models from year to year to see if they are accurate and to change them as needed. By itself this approach will not solve the broad problem of ecosystem change, but it is a start and in combination with the first approach we will gradually improve our understanding of where we are headed with climate change.

This monitoring program has several interrelated objectives. First, it provides long-term monitoring data that provide important baseline information on undisturbed forest sites, and this information is of value to many research programs as well as providing control data for assessing impacts of industrial developments, and for park and forest management in the Kluane region. Second, it constitutes an early warning system of significant changes taking place in the central and southern Yukon boreal forest ecosystem. The early detection of these changes should guide medium to long-term planning and biodiversity management and research. Third, CEMP monitors the long-term processes that drive the boreal forest ecosystem. The Kluane Boreal Forest Ecosystem Project documented important interactions and ecological processes during the ten years of its existence, 1986 to 1996 (Krebs, Boutin and Boonstra 2001). However, we still do not understand the longer cycles and processes that drive boreal forest ecosystems on a landscape scale and help to protect its biodiversity. CEMP is helping to document some of those patterns and processes.

An important part of CEMP is the community involvement by way of traditional and local knowledge. Interviews are carried out each year at Mayo, and community involvement in Dall sheep and arctic ground squirrel censuses at Kluane are part of this work. We will report on this work briefly in this report.

Why Monitoring is needed

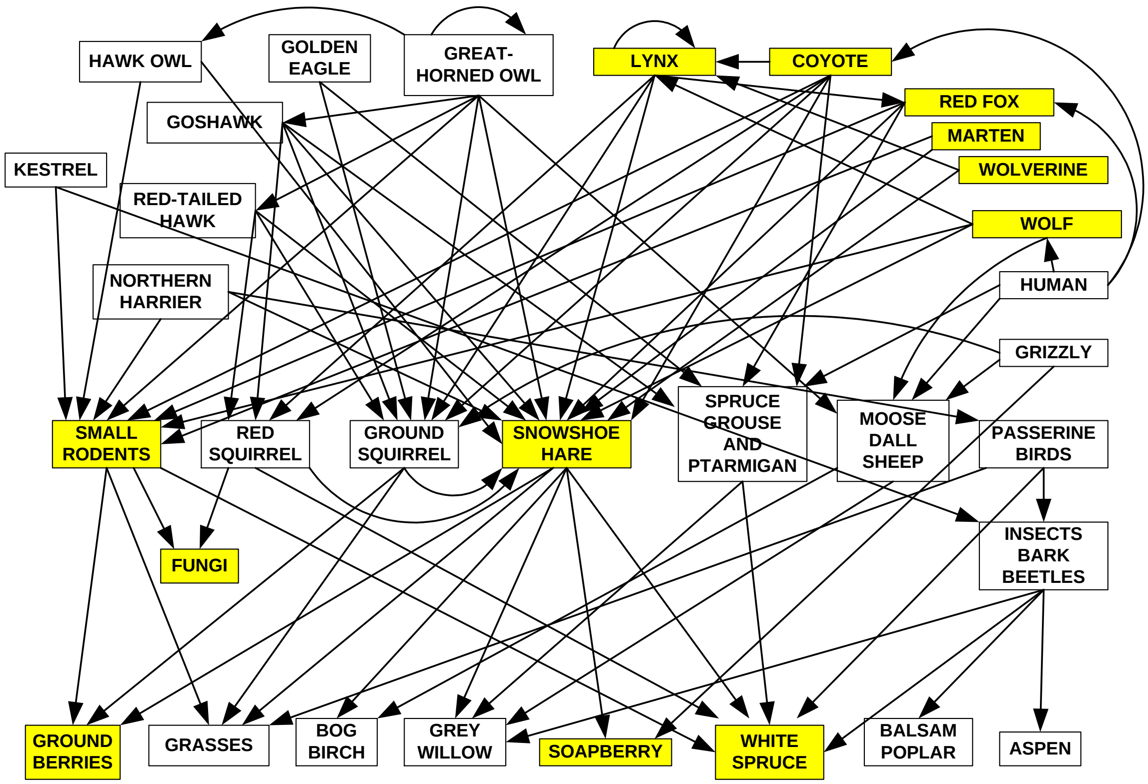
What are the goals of this monitoring program? It is important to keep in mind where we are headed in any monitoring design. The key question we need to be able to answer is *how will the Yukon's ecosystems respond to climate change*? The answer to this simple question is not simple. Some parts of our Yukon ecosystems like spruce cone crops are directly dependent on climatic variables like temperature and rainfall. Others, for example snowshoe hares, depend immediately on the abundance and hunting success of predators like lynx, so that the question then becomes will climate change affect lynx hunting success and if so how?

The key to these approaches is to have a comprehensive monitoring program in place that gathers data year after year. We cannot start and stop monitoring programs for a few years any more than we can stop and start reporting on the stock market for a few years. The need is thus for a commitment in funding and in people to carry these goals forward. This is what we have begun in the CEMP program and we summarize here what we have so far achieved.

Protocols Monitored and Cooperating Research Programs

Figure 1 shows the food web of the southern and central Yukon boreal forest region. If we wish to monitor ecological integrity, we need to measure key components in each of the levels of this food web. However, we cannot monitor everything, and we have concentrated our efforts on 7 significant indicators. We believe that these indicators constitute a start for obtaining early warning of ecosystem change, establishing baseline data on the natural range of variation of key ecosystem components, evaluating forest management practices, and advancing our understanding of the dynamics of boreal ecosystems. The 7 indicators that are being monitored are listed below. The species that are being monitored are indicated by shading in Figure 1.

Figure 1. Food web for the boreal forest in the southern and central Yukon. The species being monitored in at least two of the CEMP sites are shaded. Only the major feeding linkages are shown.



A brief description of what we measure in each protocol and why we measure it is given below:

1. **White Spruce Cone Production.** Measurements: annual rates of cone production are documented. Rationale: major food for red squirrels, passerine birds, and mice.
2. **Ground Berry and Soapberry Production.** Measurements: berry production is recorded each year for the major berry producers in the Yukon boreal forests – crowberry, bearberry, red bearberry, toadflax, cranberry, and soapberry. Rationale: major food supplies for small mammals, bears and birds.
3. **Mushroom Production:** Measurements: standing crop of mushrooms is recorded in early August each year as an index of mushroom fruiting. Rationale: important food for red squirrels and other mammals, highly variable in production from year to year.
4. **Small Mammal Abundance.** Measurements: population density estimates calculated from live trapping mice and voles twice per year at Kluane and Whitehorse, and once per summer at other CEMP sites. Rationale: major prey for many predators; these small mammals create a 3-4 year population cycle as well as major irruptions in the area.
5. **Arctic Ground Squirrel Abundance:** Measurements: population density estimates from live trapping once or twice per year at Kluane. Ground squirrels do not occur in forested areas at the other CEMP sites, and are most common in alpine areas that we do not sample. Rationale: major prey item for many predators.
6. **Snowshoe Hare Abundance.** Measurements: population density estimates calculated from live trapping hares twice per year at Kluane and by counting fecal pellets once per year at all CEMP sites. Rationale: the keystone species of the boreal forest with a 9-10 year population cycle.
7. **Predator Abundance**. Measurements: index of relative abundance of coyotes, lynx and other predators from winter track transect is being carried out annually in the Kluane Lake area, at Mayo and now have been started at Whitehorse, Watson Lake and Faro. Rationale: an index of major terrestrial predators in the system.

We have prepared a separate handbook of the details of the monitoring protocols for each of the species groups listed above (CEMP Monitoring, 2012, available on the web at http://www.zoology.ubc.ca/~krebs/kluane.html).

In addition to these 7 protocols, a number of research and management projects are being conducted in the Yukon (e.g. the Breeding Bird Survey, Christmas Bird Counts, Owl Surveys). Through cooperation and partnerships, these projects contribute important additional information that is valuable for long-term monitoring in the Yukon.

Two general questions underlie this monitoring program. First, is there synchrony among sites in these indicators? Regional synchrony can be achieved by ecological indicators responding to weather variation that has a widespread regional signature, or by large-scale dispersal of animals like lynx and coyotes. Second, are there regional patterns of variation in the density or productivity of indicators? For example, snowshoe hares may be on average more abundant in some areas than they are in others. In turn, all these regional similarities or differences need to be explained ecologically.

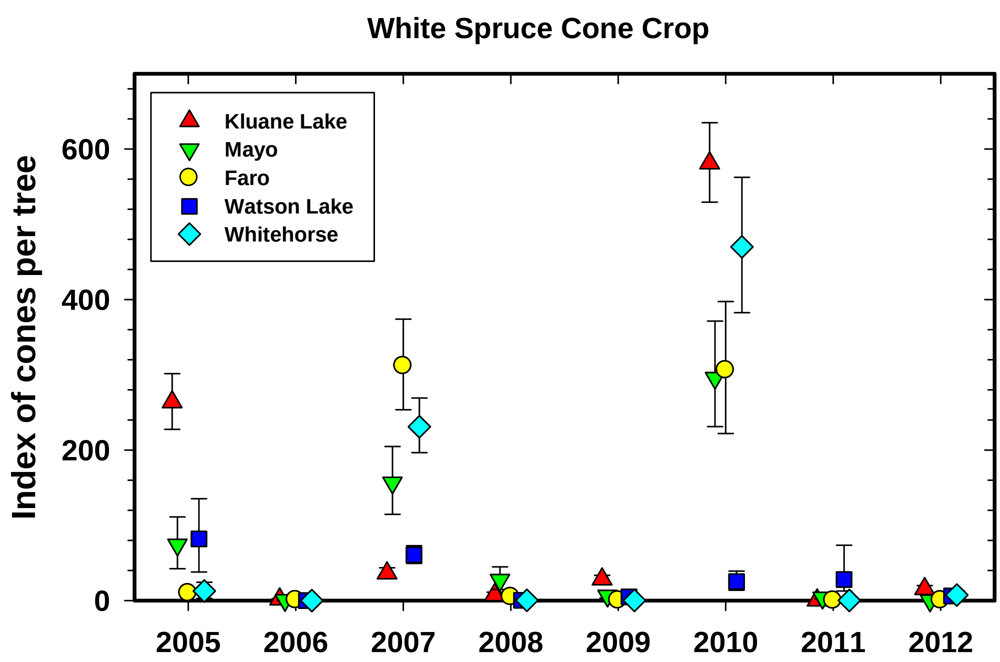
Results and Discussion

For the purpose of this Annual Report, we would like to discuss some of the findings from 7 of the protocols. We maintain on the web site http://www.zoology.ubc.ca/~krebs/kluane.html a detailed EXCEL file (*monitor.xls*) that has all the summarized data from all our monitoring efforts at Kluane since 1973. As indicated in Table 1, many of the protocols have been developed for CEMP only since 2004 and thus regional comparisons within CEMP are limited to the years 2005 to 2012. In the figures that follow we report means and 95 % confidence limits unless indicated otherwise.

(a) White Spruce Cone Production

White spruce trees produce a variable number of cones each year, and at irregular intervals very large crops are produced in mast years. We have been counting cones on spruce in the Kluane area since 1986, and Figure 2 shows the cone counts over the CEMP sampling sites since 2005. The 2005 and 2007 cone crops were moderate, but the 2006, 2008, 2009, 2011, and 2012 cone crops were nearly a complete failure at Kluane, Mayo, Watson Lake, Faro, and Whitehorse. If years of high cone production are driven by weather variables, we should soon be able to correlate our weather data with these cone production events. There is a suggestion of a cycle in cone crops in the Kluane area, but this cyclic interval is so variable it does not allow for prediction of when the next large cone crop should be expected. We have data on cone crops at Kluane Lake since 1987 and we have recently developed a statistical model to

Figure 2. Average white spruce cone counts on CEMP sites for 2005 to 2012. Green cones are counted from the top 3 m of a tagged set of trees each August. Only the cones visible from one side of the tree are counted, so this is an index of cone production, not an absolute measure. There was a complete cone failure in 2006, 2008, 2009, 2011 and 2012 at all sites. The 2010 count was the largest we have seen during the last 25 years.



predict cone crops in the Kluane region from summer temperature and rainfall of the previous 2 years (Krebs et al. 2012). In future years we will be able to check this statistical model with further data, and develop comparable models for the other sites.

What is surprising about Figure 2 is that all the 4 regional counts show the same pattern of high and low years, and there were very high crops in summer 2010 at all sites except Watson Lake. The suggestion from this is that the regional climate of the southern and central Yukon may coordinate years of high and low cone counts. Further data are required to quantify the regional synchrony in cone crops. Cone counts are highly variable, as Figure 2 shows, and different sites within a region can be quite variable. Some of this variability will be reduced when we can achieve larger sample sizes. Because of this variability in cone production, it will take a series of several poor years (> 7) in a row for us to conclude that cone production is falling. Red squirrels and seed-eating birds might provide a more responsive index of detrimental cone crop changes.

(b) Ground Berry Production

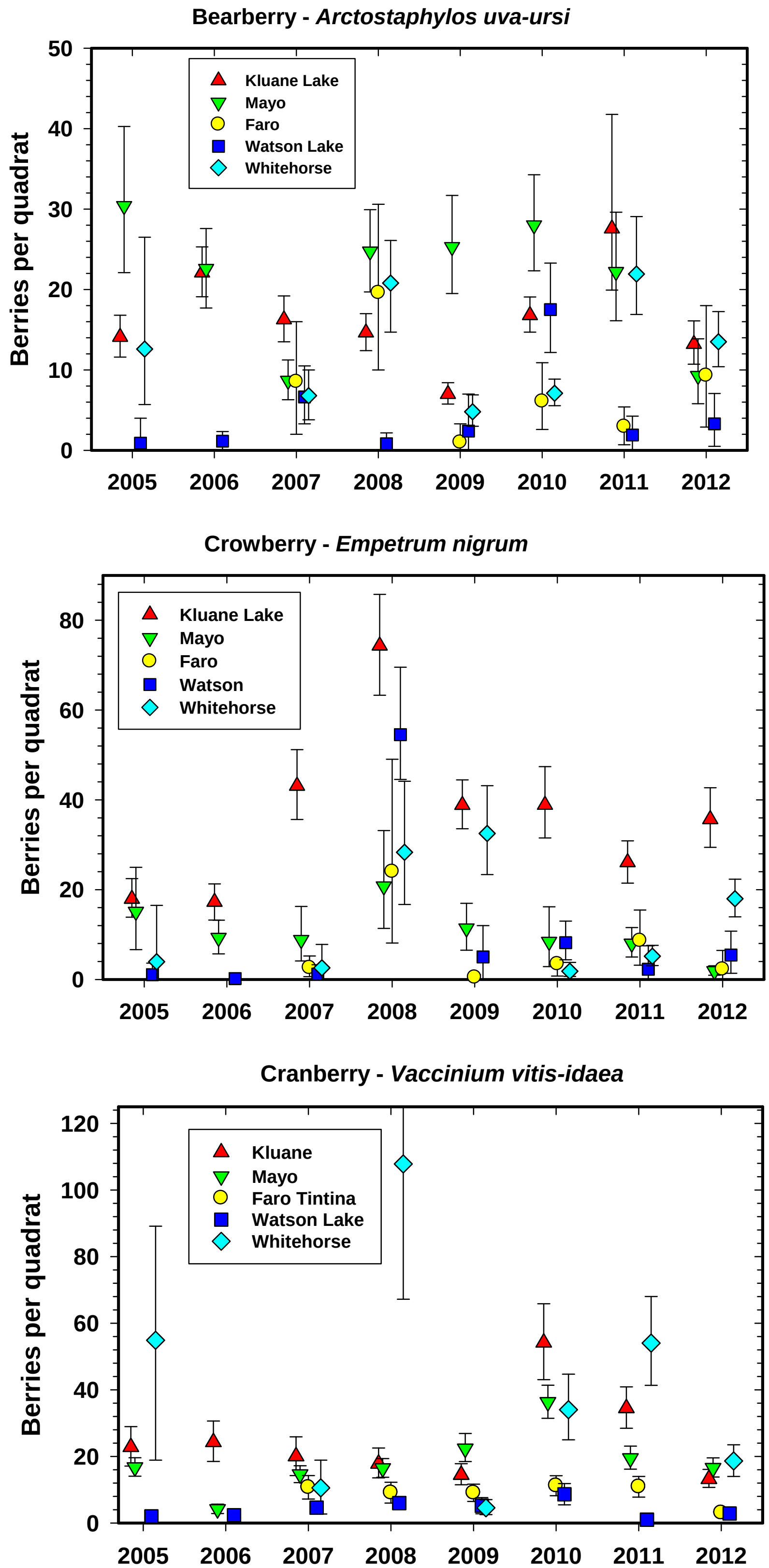
Five species of ground berries are counted in permanent quadrats each year. The major berry-producing plants are bearberry (*Arctostaphylos uva-ursi*), red bearberry (*A. rubra*), crowberry (*Empetrum nigrum*), toadflax (*Geocaulon lividum*), and cranberry (*Vaccinium vitis-idaea*). For each of these species green berries are counted in late July or early August before the berries are harvested by bears, mice, and chipmunks. Figure 3 shows the data we have accumulated on three of the species of ground berries since 2005.

Bearberry counts are highly variable among the five monitoring areas. In particular Watson Lake sites had very few bearberries for all these years until 2010. Mayo has the most consistently high counts of bearberries (which could account for the stability of small rodent numbers). There was considerable variation in bearberry numbers between sites and years in 2010 and 2011, but less among sites in 2012. The variation is large enough to require more data to see if there is a clear pattern or if local processes (e.g. at Mayo) determine berry production in this species. At the present time it looks like local processes determine bearberry crops.

Crowberry counts show a clearer pattern of agreement among most of the sites with a high production year only in 2008 and low counts in the other 6 years. The average production of crowberries at Kluane is 2-3 times that of each of the other 4 sites for these eight years of data. Crowberry counts on all sites except Kluane and Whitehorse were low in 2012.

Cranberry counts show yet a different pattern with low to very low production at all sites in 2012.In 2012 Whitehorse was similar in production to the other sites, while in 2011 Whitehorse had higher cranberry counts than all the other sites.

Figure 3. Average berry counts for 3 species of ground berries at CEMP sites from 2005 to 2012.

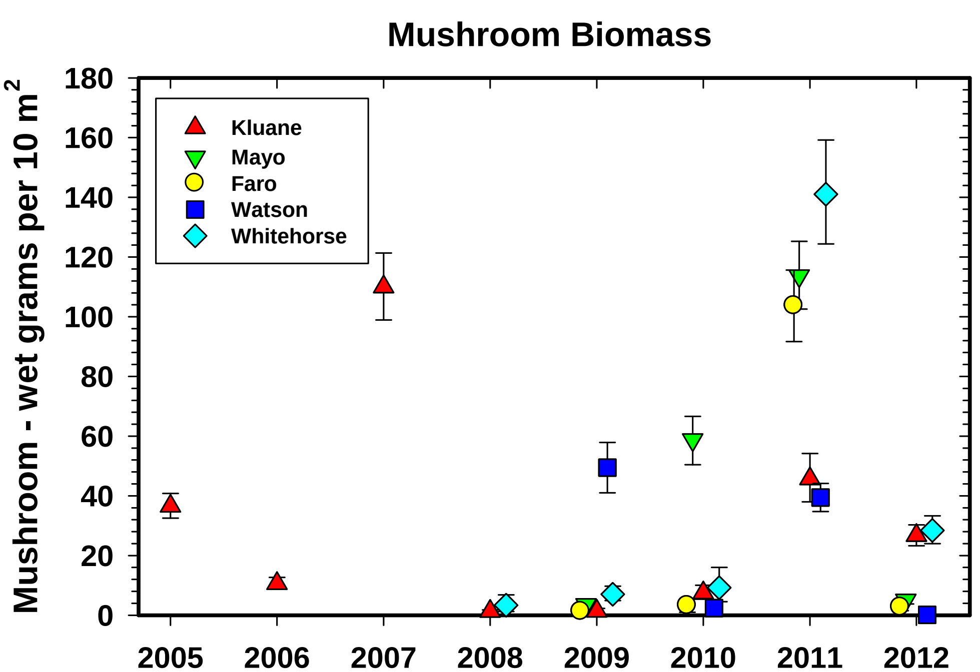


We have analyzed the climatic controls of ground berry production in the Kluane region from data gathered over 1994 to 2008 resulting in equations relating berry production to climate (Krebs et al. 2009). Each species of ground berry in the Kluane area responded to different signals of temperature and rainfall, and there was no general climate pattern to which all the species of ground berries responded. Future data will permit us to evaluate whether these predictive climatic equations that seem to operate well in the Kluane area also apply to the other CEMP sites. Our working hypothesis is that ground berries respond to regional weather patterns but that individual berry species require a different suite of weather variables (monthly temperatures, monthly rainfall) from the current and previous years in order to produce a large berry crop.

(c) Mushroom Production

Since 2008 we have begun monitoring aboveground mushroom production on several of the CEMP sites. Data on mushroom production from Kluane Lake has been collected since 1995 and we have published a climate model to predict mushroom crops (Krebs et al. 2008). Figure 4 shows the aboveground biomass of mushrooms for the CEMP sites. Mushrooms were extremely abundant at all sites in 2011, but low in abundance in 2012. Our statistical model for mushroom abundance uses June rainfall of the current year and May rainfall of the previous year to predict production. As we accumulate more data from all the CEMP sites in the next few years we will be able to test the climate model developed for Kluane to determine its generality for other sites in the southern and central Yukon.

Figure 4. Aboveground mushroom production measured in early August (g wet weight per 10 m^2). Mushroom production was low in 2012 in spite of much rain.

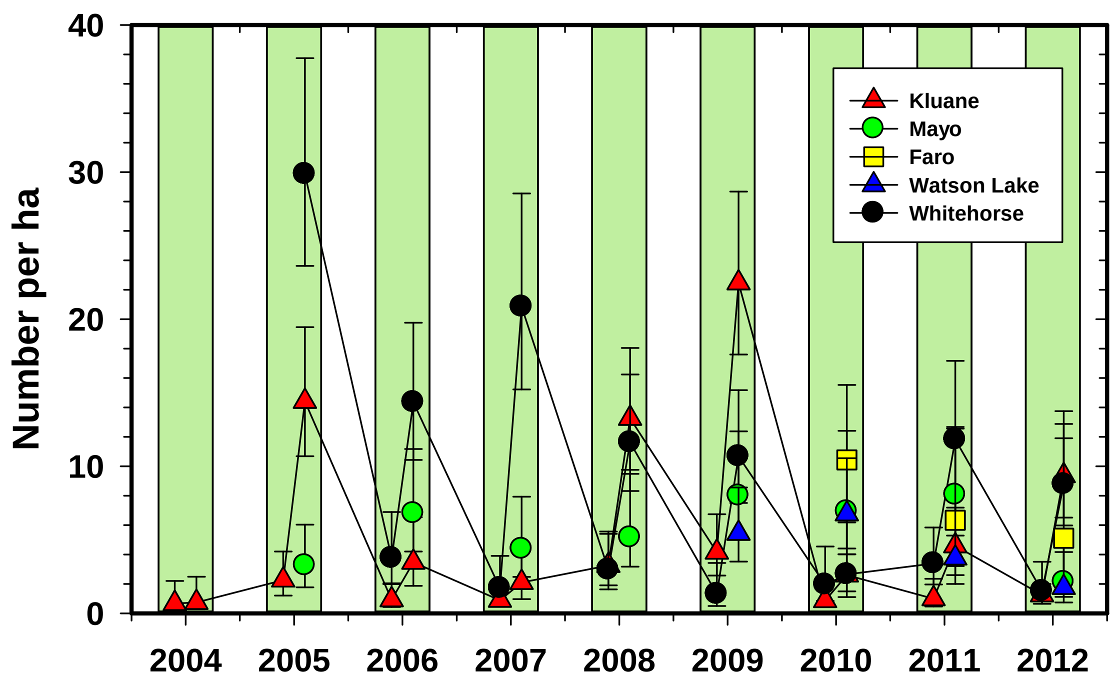


(d) Small Rodent Numbers

The most common rodent on all of the CEMP sites is the red-backed vole (*Myodes = Clethrionomys rutilus*), and we have estimated the abundance of this species by live trapping, marking, and releasing individuals. Live trapping at Kluane and Whitehorse is done in spring and late summer, and at Mayo, Faro, and Watson Lake only in late summer. Figure 5 shows the changes in red-backed vole numbers for the period 2004 to 2012.

Red-backed voles at Kluane have fluctuated in 3-4 year cycles for the past 25 years and this pattern is shown in Figure 5 with peak years of 2005 and 2009. But Mayo populations have been nearly stable from 2005 to 2011, dropping to a low point in 2012. Whitehorse populations were extremely high in the late summer of 2005 and again in late summer 2007, moderately abundant in 2008 and 2009, at low ebb in 2010, and

Figure 5. Population estimates for red-backed voles in five CEMP areas, 2004-2012. Trapping grids have an effective trapping area of about 3 ha. Summer months are shaded green.



rising again in 2011and 2012. The pattern to date does not suggest any clear synchrony in fluctuations of red-backed vole numbers in the southern and central Yukon. Further data are needed to determine if this asynchrony continues in red-backed vole populations at the different CEMP sites in subsequent years.

The only other small mammal that is common to many of the CEMP sites is the deer mouse, *Peromyscus maniculatus*. At present the number of captures of this rodent species is too low on most of the sites to discuss any common patterns of population change. Deer mice remained between 1-3 per ha on all sites from 2005 to 2012, and in general tend to be stable in numbers from year to year.

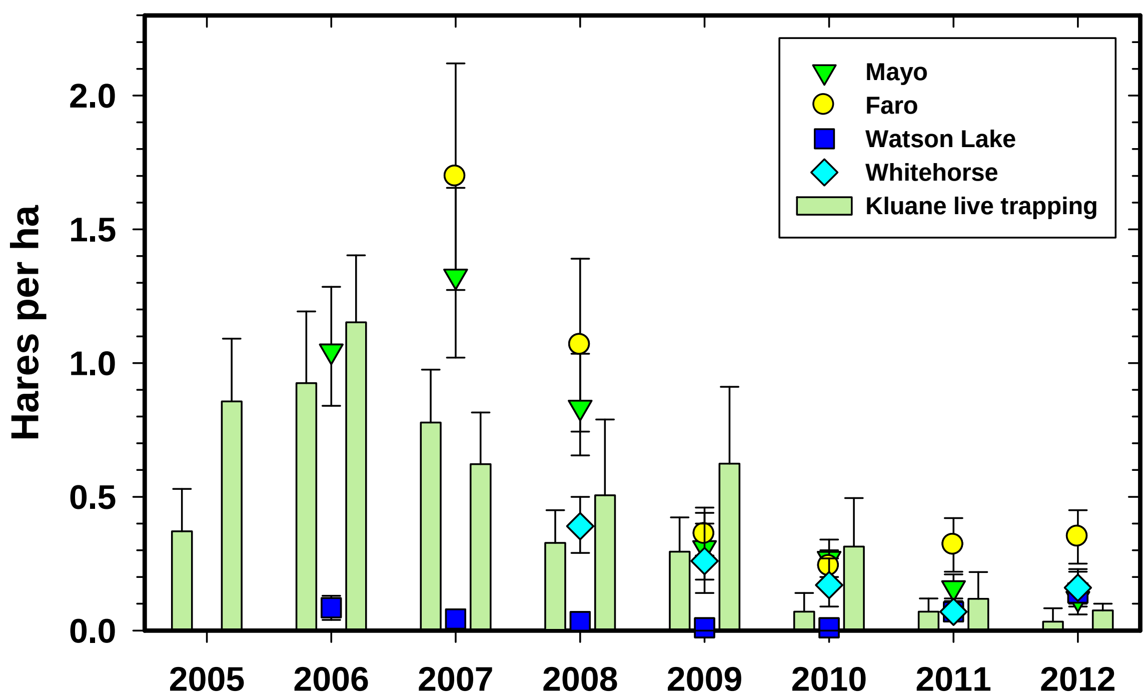
(e) Snowshoe Hare Numbers

The snowshoe hare is a keystone species in much of the boreal forest because it is the prey of so many predators (see Figure 1). Snowshoe hares fluctuate in 9-10 year cycles throughout the boreal zone. At Kluane we have estimated the abundance of snowshoe hares by live trapping, marking, and releasing individuals. We developed a simple census method for hares by the use of fecal pellet counts carried out once a year in early summer (Krebs et al. 2001) and this technique has been used at all the CEMP sites for comparative data. Figure 6 shows the changes in hare numbers since 2005 at the CEMP sites.

Two points stand out in Figure 6. First, Watson Lake sites had almost no snowshoe hares in any of the first five years but in 2011and 2012 showed a slight increase. Second, all other CEMP sites are following the Kluane hare cycle closely, with peak populations in 2006-7 and declining populations in 2008, 2009, and 2010. The hare population at Kluane showed a strong increase over the summer of 2009, but this increase was trimmed back to low numbers by the spring of 2010, and the same pattern occurred in 2011 and 2012. The summer of 2012 showed almost no increase.

Regional synchrony is well established in snowshoe hares in much of the Yukon,

Figure 6. Population density estimates for snowshoe hares in CEMP areas, 2005-2012. Mark-recapture data from Kluane are given as histogram bars, and estimates from fecal pellet counts at CEMP sites are given as points (95% confidence limits). Note that the data from fecal pellet counts integrate hare density over the previous year.



but as we get more regional details we find that not all areas in western Canada and Alaska are in phase. Figure 6 shows that Mayo and Faro reached a peak in 2006-7 at the same time as Kluane. We have summarized the hare data from the Yukon, Alaska, northern BC and the NWT in a paper in review (Krebs et al. 2013). This analysis of regional synchrony strongly suggests a travelling wave of hare peaks that moves from northern BC into the Yukon and then north and west into Alaska. For example, in southern interior Alaska hare numbers were at a peak in 2008 and 2009, when Kluane and Mayo hares were declining. Inuvik populations were at a peak in 2009 when Mayo and Kluane hares were already finished declining. On the Kenai Peninsula hares were already high in 2010 and at a peak in 2011, completely out of phase with Kluane and Mayo hares that are low.

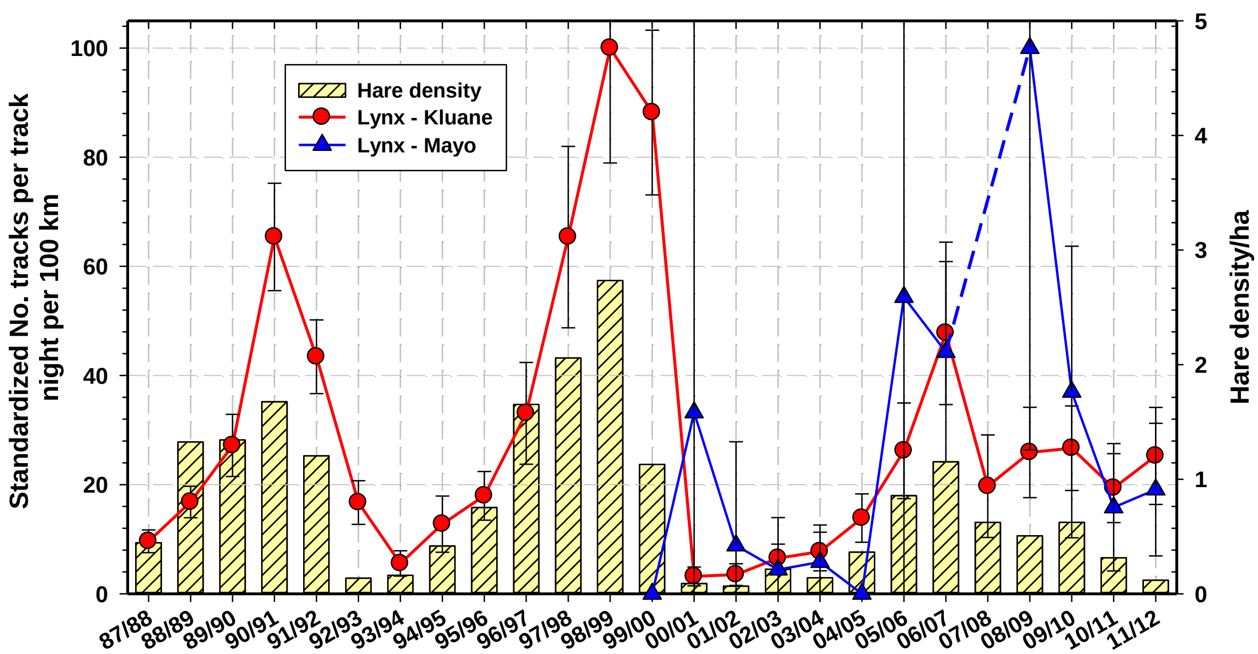
The significance of these regional differences in the hare cycle lies in the movements of predators like lynx and great-horned owls from one high hare area to adjacent ones that are low or starting to recover. The most promising explanation for regional synchrony involves predator movements, and depending on the geometry of the highs, such movements could produce a travelling wave of density changes.

(f) Lynx Abundance

We have been following lynx abundance in the Kluane region since 1987 by means of winter snow tracking along established routes. We expanded this predator tracking to Mayo in 1999. We count lynx tracks crossing snowmobile routes after fresh snowfalls each winter, depending on wind conditions. On average about 300 km are tracked each winter at Kluane and about 125 km at Mayo.

Figure 8 shows the changes in abundance of lynx in Mayo and Kluane as measured by snow tracks. Because our winter snow tracking cannot be done in identical habitats in all areas, we do not expect the absolute number of tracks to directly indicate lynx density but only trends in density .Consequently we have standardized track counts by setting the maximum count observed in each area to 100. Three points are quite striking in this graph. First, the last lynx peak at Kluane in 2006-07 was the

Figure 8. Snow tracking abundance estimates for Canada lynx at Kluane and Mayo, 1987 to 2012. Lynx abundance was standardized for each area to a maximum of 100 to indicate trends in numbers.



lowest we have seen, coincidental with the lowest hare peak we have seen at Kluane. Second, lynx at Mayo appear to be out of phase with lynx at Kluane by a delay of 1-2 years. Third, lynx abundance during the low of the hare cycle at Kluane during the last 5 years is higher than we have seen in a hare low previously. There are more lynx in the Kluane area during the last several years than could ever be supported on the existing hare population. These lynx must be transients headed for starvation or have been able to switch to alternate prey like red squirrels. We do not know which of these scenarios is correct.

By contrast, marten at Mayo have been increasing during the last 2 years from a low in 2009-10 while marten at Kluane have been declining from a peak in 2009-10.

(g) Brief Notes on Other Monitoring Measurements

We are in the process of coordinating the monitoring at each of the five CEMP sites. Changes in personnel have complicated keeping the protocols for data collection in the field completely standardized. Fortunately 2012 was a time of improvement in coordination of the monitoring program, and we are now trying to adjust to the differences among the sites and the data needs of each site.

Soapberries are a favourite food of grizzly bears, and are being counted at Kluane and Mayo. We have evaluated the feasibility of expanding these counts to the other three CEMP areas in 2012. Soapberry counts began at Mayo in 2010 and at Whitehorse in 2012. We place a high priority on counting soapberries in all sites but there are few soapberries on some of our sites which make this a challenge. In 2012 soapberries were at moderate abundance at Whitehorse and at Kluane but were twice as abundant on bushes at Mayo.

Red squirrel numbers have been studied extensively at Kluane for years by Stan Boutin's group, and we are evaluating the possibility of using midden counts or call counts as indices on the other CEMP sites. Snow track counts in winter for mammalian predators are critical for understanding predator changes and are being done at Kluane, Mayo, Whitehorse, Watson Lake and Faro. The longest time series for predator snow tracking are from Kluane and Mayo, and we will collate all the other site data in 2013 for the next annual report.

Coyotes and lynx follow the hare cycle closely. Marten and weasels have become much more abundant since 2000 at Kluane and may be affecting the dynamics of the hare cycle. More information is being gathered from the other CEMP monitoring sites on predator numbers and this will give us regional patterns in the coming years.

Bird surveys in the Yukon are being done by other groups, but we would like to coordinate owl survey counts with the BC Owl Survey in future years to get coverage at all CEMP sites.

There is general interest among Yukon and Alaskan biologists to implement a program of regional monitoring of the major mammal and bird predators of the boreal forest. This could be achieved with satellite radio collars or possibly by geolocators (Bachler et al. 2010, Stutchbury et al. 2009). It would require a large investment of time and money to analyze this large-scale monitoring of movements of major predators.

Our goal in this monitoring program is to develop statistical methods of estimating the abundance and productivity of our six indicators of ecosystem health for the Yukon boreal forest. We expect all of these to change as the climate alters, and we need to be able to predict how climatic variables do or do not affect our indicators. There are only three ways to determine the impact of climate change – to observe what happens (the passive approach), to monitor changes and try to explain them ecologically, and to develop and use models which include climatic variables to predict what will happen (our active approach). Long-term data sets are essential to this endeavour and we learn as we go along from year to year.

(h) Local Knowledge Interviews

An important part of our overall CEMP proposal has been to link these specialized ecological measurements with local knowledge interviews in each of the communities. These two approaches provide an important broad way of determining ecological integrity of the Yukon environment. We have planned to conduct these interviews in all the monitoring sites but a shortage of funds has limited the amount we could do with local interviews. Mark O'Donoghue has recently summarized local knowledge interviews in Mayo (O'Donoghue 2013). The strength of the local knowledge interviews is that they give insight into many environmental changes that we best monitor by local knowledge and on the impacts of these changes on rural people. They also place the results we find from our technical monitoring in the larger context of the whole regional landscape. Many examples are illustrated in the Mayo report – changes in the abundance of wolves, wolverine, moose and deer, as well as changes in the availability of fish and berries for the local population. Changes in winter ice conditions in relation to climate change can be evaluated, as well as general human impacts on wildlife. The summary taken from the Mayo document from interviews in February 2012 about conditions in the previous year illustrates the additional information that can be obtained by local knowledge interviews about a variety of topics of interest:

Almost all people interviewed noted that summer 2011 was very wet, and most found it cooler, windier, and with more storms than usual. Most people interviewed noted that autumn 2011 was a fairly warm, wet, and windy fall, with very little to an average amount of snowfall. Snowfalls came late this fall towards the end of October. From November 2011 to January 2012 the winter was warm, fairly windy, with lots of snow and some freezing rain. Cold snaps were very brief at this time.

During 2011 most people noted another big increase in the amount of mining exploration and associated aircraft activity, and use of ATVs also increased. Most people interviewed noted less highway tourism than usual for the fourth year in a row. Use of ATVs and mining exploration caused the biggest concerns about their effects on wildlife and subsistence activities of all the activities considered. Most people interviewed thought that there were cumulative effects of all human activities on wildlife in the Mayo area.

The infestation of leafminers in aspen trees continued to affect many trees in 2011, but it seemed less severe than in the previous four years. Most people interviewed saw more or about the same number of mushrooms as usual in 2011. As in 2008, the wet summer weather led to higher numbers of mushrooms.

Cranberries and blueberries are consistently the most frequently picked berries in the Mayo area but a wide variety of others including raspberries, strawberries, black and red currants, high-bush cranberries, cloudberries, soapberries, blackberries (crowberries), bearberries, bog cranberries, and Saskatoon berries are also picked.

Most people interviewed who picked berries in 2011 met their berry needs, although some said it was too wet.

Four fish species—Chinook salmon, grayling, lake trout, and pike—are consistently the species most harvested in the Mayo area, but there has been a noticeable decline in the percentage of people fishing for salmon . Salmon are the main subsistence species for First Nations people, harvested using nets. The other species are harvested by angling and ice fishing. In 2011-12, four of the eleven people interviewed who fished did not meet their fish needs, and said that a lack of enough salmon was the reason they came up short. Salmon numbers are low and fish are small in recent years.

Moose are important for food in the Mayo area. Most people interviewed thought 2011 was an average year for moose calving based on what they saw during the summer. Most hunters saw fewer moose and fewer bulls than usual in fall 2011; but all were able to meet their needs for moose, some by getting meat from outfitters. Most moose harvested were in good shape, but several people noted that the moose they shot were in poor or fair shape. Warm and wet weather conditions and high numbers of other hunters were listed as the main factors affecting numbers of moose seen. Most people noted that the timing of this year's rut was about normal or later than usual. Bulls seen were average sized to smaller compared to those seen in other years. People interviewed were mixed in their observations of calf numbers in the fall.

Similar to 2010-2011, most people interviewed noted that they had seen more or the same numbers of spruce and ruffed grouse in the last year compared to other years. Observations of ptarmigan were more variable, as has been the case in all years of these interviews. People interviewed gave variable responses about the number of ducks and geese they saw in 2011, depending on where they spent their time on the land. Most thought that numbers of ducks had stayed the same or increased and that numbers of geese had stayed the same. More swans were seen than usual in 2011 and people saw variable numbers of cranes.

Numbers of kestrels are declining throughout North America. Most people interviewed saw few or some kestrels in 2011 and most felt that there were about the same number of birds compared to other years.

Numbers of rusty blackbirds have declined by about 85% since the mid-1960s in North America. Most people interviewed saw few blackbirds in 2011, and responses were mixed about numbers compared to their observations in other years. Most people see these birds in the spring and fall when they are grouped up for migration. We also asked people interviewed about the numbers and trends in numbers of common bird species—chickadees and gray jays—so that we have a baseline to compare their trends with those of the species of concern. People interviewed consistently saw some or lots of chickadees and gray jays in all years and mostly indicated they saw about the same numbers from year to year.

Most people interviewed saw lots of mice and voles and saw about the same number or more than the year before. Most people interviewed reported seeing some or lots of red squirrels in 2011-12, and the same number or more than the year before.

Red squirrels seem to have responded positively to the boom year in spruce cones in 2010.

People interviewed were clear that numbers of snowshoe hares were still low in 2011-12 but that a slow increase in numbers seems to have started. The last cyclical peak in hare numbers was around 2006. Muskrat numbers may have also increased since most reported that numbers of muskrats were increasing in 2011-12 compared to previous years. Beaver observations were mixed. Most people interviewed reported that they had seen lots of and more porcupines in 2011-12, maintaining the high numbers we have seen since 2004.

Marten numbers appear to be generally increasing in the area. A few mink and otter were seen along with a few wolverine and weasels but no trends were clear. People interviewed saw few or some lynx, and their numbers seem to be starting to increase in response to rising numbers of hares. Foxes are fairly commonly seen, and most foxes are seen around the communities. Few coyotes are seen in most years in the Mayo area and people saw no clear trend in numbers. For wolves in contrast to previous years, most people interviewed saw few or some wolves, and thought numbers had stayed about the same or declined since last year. There was no consensus on changes in grizzly and black bear numbers in the Mayo area.

This year, six of the people interviewed trapped. The trappers mostly thought it was a good year because the price of fur was fairly good, most found enough animals, and the weather was warm. Numbers of lynx were low but slowly increasing and marten abundance was generally going up as well in most areas.

It is important that we attempt to continue to utilize local knowledge to help provide the larger picture of changes in Yukon's ecosystems as the climate continues to warm.

Conclusion

In this report we have presented a few of the time series of monitoring results that we have obtained from the CEMP program since it was begun in 2005. With only 8 years of data, our conclusions to date must be tentative, but we have a firm foundation for coordinating these regional data sets. We need to proceed to answer two questions:

1. How much correlation is there between the Kluane Lake sites and other sites at Mayo, Faro, Watson Lake, and Whitehorse? We have seen that, for example, mushroom abundance (Figure 4) can vary greatly between sites, yet snowshoe hare numbers (Figure 6) are highly correlated among sites.
2. How much correlation is there between climatic measurements and biological measurements? For example, can we develop a predictive equation for cone crops from temperature and precipitation data that will apply across all CEMP sites?

The database management system for CEMP is well set up, and we have developed a good group of workers with skills to make the needed measurements. With the data we have gathered and will continue to gather, we can begin to address the important management issues for the southern and central Yukon and to provide a detailed assessment of how climate change is affecting biodiversity in the boreal forest ecosystem in this part of the Yukon. In connection with local knowledge interviews a broad picture of how the environment is changing will emerge from these efforts.

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