



Arctic ground squirrel recovery: habitat enhancement and population reintroductions

Project Completion Final Report



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INTRODUCTION TO THE PROBLEM

The disappearance of small mammal populations from Canada's northern montane boreal will have wide ranging consequences for how energy moves through food webs. Arctic ground squirrels (*Urocitellus parryii plesius*) were once so plentiful as to be responsible for approximately one quarter of the energy flow at the herbivore level (Boonstra et al. 2001; Fig. 1). These ground squirrels are also a culturally important source of traditional harvest for First Nation peoples throughout the Yukon. However, recent local extirpations of this species over the past decade serve as a clear example of how northern regions may now be in dramatic flux.

The goal of this project was to promote the recolonization of arctic ground squirrels in several areas known to support a long tradition of First Nation harvest. Details concerning the proximate causes and ecological consequences of population collapses of this species are detailed elsewhere (Werner et al. 2015a-c).



Figure 1: A successfully translocated female arctic ground squirrel

PROJECT OBJECTIVES

In response to the widespread disappearance of ground squirrels from natural low-elevation habitats near the communities of Haines Junction, Silver City, Destruction Bay, and Burwash Landing we set out to bring population numbers back to a level that will support moderate sustained harvest by 2016. As a means of refining our efforts over this multi-year

project we also chose to use an adaptive experimental approach. Results from one year would then be used to modify our enhancement methods in the next year.

PROJECT ACTIVITIES

Between 2013-2015 we experimentally reintroduced squirrels into several large (~100 Ha) historical meadow habitats. One of these meadows was chosen by Kluane First Nation government. The Duke meadow system is situated on settlement land (61°23'21.35"N 139°6'13.86"W; Fig. 2) and up until several years ago supported a seasonal harvest (G. Pope pers. comm. 2012). This projects secondary purpose is to clarify if and why habitat quality has been reduced to the point where these meadows can no longer support viable populations (Fig. 2). A portion of these translocated squirrels were fitted with radio collars (Holohil pd-2C units; n=105) in order to monitor their habitat use, minimum daily movement distances, and active season survival (Fig. 4). Source populations were taken from the Burwash Landing airport (61°22'5.85"N 139°1'43.10"W).



Figure 2: The Duke Meadow system near Burwash Landing, YT.

As a means of increasing the strength of inference to be drawn from this reintroduction project, one meadow was converted into a large (13 ha) choice experiment (Table 1). I



manipulated grass height and visibility (short grass and long grass treatments) and the number of available burrows. Treatment units were 50 x 50m in size, oriented in a 5 x 10 pattern using a randomised block design. For the short-grass treatment, vegetation height was reduced to 10 cm (range 0–23 cm) using

gas-powered string trimmers and a push lawnmower. The tall grass treatment consisted of un-manipulated grassland with a mean height of 94 cm (range 15–114 cm). To alter burrow density, artificial burrows (50 cm deep and 7 cm in diameter) were dug using both gas and hand powered augers. The low density treatment was 50 burrows/ha (approximately the number of natural burrows found *in situ*) and the high density treatment was increased to 200 burrows/ha. A group of 22 adult females were also chosen for ‘soft release’ into cages. These individuals were kept in a safe enclosure protected by electric fencing and were provided water, rabbit chow, and natural forage for two weeks prior to release. The purpose of this enclosure was to allow the animals to habituate to their new surrounding. A second reintroduction project was initiated in 2014 at the Bear creek meadows several kilometers north of Haines Junction. This second project used fewer experimental interventions and was intended to clarify whether ground squirrels would take to a new site with a minimum of enhancement effort (Fig. 5). Individuals were captured from municipal lands in Haines Junction at locations where government employees had identified their burrowing activities as constituting an issue for infrastructure. All activities described in this report were completed in accordance with relevant permits and animal care certificates.

<i>Release Type</i>	<i>Summary</i>	<i>Approx. number</i>
Hard	Morning capture; immediate transport (~1hr); release from cages at reintroduction site.	150
Firm	Morning capture; immediate transport as family groups (~1hr); released into separate artificial burrows with supplemental food (apple, sunflower seeds); burrow entrance plugged temporarily (~2hr); all individuals released into one of 16 50x50m grids, each containing either short (cut) or tall (natural) grass, and 200 (augmented) or 50 (natural) burrows per ha.	150
Soft	Morning capture; immediate transport (~1hr); housed in separate cages (1.8 x 1.2 x 0.75m) for 2-week acclimatization period; cages were situated within the release meadow, arranged in a 5x5 pattern 20m apart; food (rabbit chow, apple, natural forage) and water provided <i>ad libitum</i> ; all cages protected from large mammalian predators with an enclosed 5 strand electric fence.	45

Table 1: Description of reintroduction processes. Most individuals were telemetered and monitored every other day July 5 through August 10, 2013-15.

During the multi-year enhancement period over 400 ground squirrels were trapped, marked, moved, released and monitored. These activities were accompanied by a voluntary moratorium on hunting (Fig. 3), which is to be lifted in spring 2016. Because the project's goal is both to



Figure 4: A radio collared ground squirrel is reintroduced to the study site and monitored for 6 weeks.

support continued traditional harvest and to clarify the possible causes of recent population collapses, enhancement efforts are now evaluated in terms of practical success and scientific knowledge gained.

PROJECT EVALUATION

In 2012 the Duke meadow system harboured virtually no ground squirrels, despite prolific evidence of past occupation (high density burrow systems) and hundreds of historical fire pits used by Kluane First Nation peoples to cook and process them (Fig. 5). Over the span of three years (2013-2015) the survival of reintroduced animals gradually improved as we employed more sophisticated methods to ensure their survival. Population surveys conducted during August 2015 indicates that close to 70 adults and young are the Duke meadow today. Individuals are dispersed over several square kilometers but the highest concentrations were to be found in areas where the reintroductions took place. The presence of young, which



Figure 5: One of many fire pits used to cook gophers are to be found in the Duke meadows.

indicates that reproduction is naturally occurring, is a very positive sign. At the present time our enhancement efforts for this region are viewed as a great success. Continued population growth over the coming years will be necessary, however, to safeguard against repeated extirpation. In

contrast to the success of the Duke meadow project, our attempt to start a new population in the Bear Creek system to the south was not successful (Fig. 6). By spring 2015 all of the translocated squirrels had either perished or left the meadow system, and no signs of activity have been



Figure 6: One of over 122 squirrels released into the Bear Creek meadow system near Haines Junction, YT.

recorded despite intensive population surveys and trapping efforts. Be it noted, however, that ‘hard release’ methods were used almost exclusively at the Bear creek site in order to avoid any threatening activities that might harm an endemic plant species at risk.

SCIENTIFIC FINDINGS

Several themes are now emerging from the data collected during the enhancement project. First, active-season survival of translocated individuals was generally low (0-50%) and nearly all

sources of mortality (>90%) were from predation by coyote (*Canis latrans*) or red-tailed hawk (*Buteo jamaicensis*). A major complicating factor is that reintroductions often fail because translocated animals exhibit low site fidelity (Armstrong and Seddon 2008). Our efforts were not unique in this respect as over half of the animals moved away from the release site into surrounding forest. All of the dispersers from 2013 perished—prompting me to initiate soft release methods (e.g., the use of pre-release cages provisioned with food, water, and electric fencing; Tabe 1, Fig. 7) during subsequent years as a means of promoting site fidelity (see Table 1 for specific reintroduction details). In general, only those squirrels that settled in or near the experimental treatments survived their first summer.

Second, the use of larger release group sizes during 2014-15 resulted in a corresponding shift from reintroduction failure to success (~50% annual survival). This is consistent with the extinction thresholds predicted by predator-prey theory (Sinclair et al. 1998), and with the patterns previously observed in the monitoring data. Minimum group-size effects can be the result of social facilitation (i.e. Allee effects), as has been recorded for other rodent species (e.g. Brashares et al. 2010). Future experiments will be necessary to disentangle what mechanisms are responsible for these group-size effects (Werner 2015).

Third, during post-reintroduction monitoring unmarked ground squirrels from unknown sources were observed moving to, and settling in, the reintroduction area. Regular monitoring of five nearby control plots (to monitor immigration) indicated that areas further from the reintroduction site remained unoccupied, despite the presence of adequate forage and burrow shelters. This points to the potential importance of patch occupancy and to the role that conspecific attraction (Smith & Peacock 1990) may play in the settlement decisions of dispersing squirrels. In another study Weddell (1991) reported that marked Columbian



Figure 7: Jeff Werner setting up nest boxes and electric fencing for the soft-releases at the Duke River meadow reintroduction site (KFN settlement land).

ground squirrels (*Urocitellus columbianus*) will visit many suitable empty meadows but will settle only in areas containing other squirrels. Given this preference, the natural recolonization of extinct patches is probably a very rare occurrence. For this reason, we expect slow population recovery in areas where colonies have been extirpated. During July-August 2015 I formally

tested the conspecific attraction hypothesis by monitoring (using camera traps) caged females



Figure 8: Using nest boxes to attract dispersing squirrels, July 2015.

placed in vacant meadows (Fig. 8). The data will be analyzed during 2016, but the preliminary results suggest that caged females placed in vacant meadows for several days will cause migrant squirrels to preferentially visit these meadows and, in some cases, take up residency.

COMMUNICATIONS

During 2015 this project published three articles in peer reviewed science journals. These articles acknowledge financial and logistic support from the YFWET:

Werner, J.R. 2015. Factors Governing the Distribution and Abundance of Arctic Ground Squirrels. *Arctic*. 68(4): 521-526. doi: 10.14430/arctic4537.

Werner, J.R., Krebs, C.J., Donker, S.A., and Sheriff, M.J. 2015. Forest or meadow: the consequences of habitat on female arctic ground squirrel condition. *Canadian Journal of Zoology*. 93: 791-797. doi: 10.1139/cjz-2015-0100.

Werner, J.R., Donker, S.A., Krebs, C.J., Sheriff, M.J., and Boonstra, R. 2015. Arctic Ground Squirrel Population Collapse in the Boreal Forests of the Southern Yukon. *Wildlife Research*. 42: 176-184. <http://dx.doi.org/10.1071/WR14240>.

Three additional publications are planned for 2016.

During the last year our findings have also been presented at two conference proceedings, one poster presentation, and as part of a larger yearly progress report submitted to managers and research biologists of the Yukon government, BC government, First Nation governments, and local communities. *All of these communications gratefully acknowledge financial support from the Yukon Fish & Wildlife Enhancement Trust.*

For copies of any of the material presented in this report, including photographs, contact Jeff Werner, werner@zoology.ubc.ca

THE BIGGER PICTURE

Our ongoing work has wider relevance because processes driving the altered population dynamics of arctic ground squirrels are likely implicated in larger patterns of ecosystem change. Climatic warming of northern ecosystems is predicted to intensify the role of predation in regulating small herbivores (Legagneux et al. 2014). The mechanisms behind both food and predator driven changes to wildlife populations are sure to upset the trajectory of other medium body sized prey. If the loss of this herbivore from the boreal forest is not naturally reversed, predator pressure on other herbivores of the montane boreal zone is likely to change significantly. Local regimes of soil disturbance, nutrient cycling, and plant diversity are also expected to change as processes such as tunnel building, food caching, and selective foraging are lost. As a consistent source of traditional food the importance of having gophers accessible in lower elevation meadows has been identified by the Kluane First Nation government (pers. comm. Geraldine Pope). We hope that our conservation efforts will result in continued opportunities for traditional hunting in the Duke meadow system.

ADDITIONAL IMAGES



Monitoring terrestrial predator and ground occupancy using camera traps.



Acclimatisation cages and protective electric fencing were used to promote site fidelity during the critical first two weeks.

FINANCIAL STATEMENT

The following is a summary of the projected budget and the final realised costs. Receipts in support of the amount claimed was submitted to the Enhancement Trust during the winter of 2015. The overall budget was approximately on target, due in part to our accumulated experience with translocating acquired in previous years. Equipment and radio collar refurbishments are claimed in lieu of AINA fees as those fees were charged directly to an institutional account during 2015. Gas receipts are claimed rather than mileage, allowing for a positive balance to cover the transportation of field techs from Vancouver to the Yukon.

Requested Funds from Enhancement Trust

Item	Anticipated	Actual Claim	Description (actual)
AINA	3,375	0	1 person x 2.5 months accommodation x \$45/day
Truck costs	2,025	1,235	gas receipts
Accommodation	0	453	Travel to/from enhancement site
Radio Collars	0	1,775	radio collar refurbishments
Equipment/Supplies	0	556	To build retention cages, trapping supplies
Food	0	386	Grocery + food during Whitehorse trips
Travel	0	1,020	Transporting field assistants YVR to WH
Total Requested	5,400	5,425	

Total Project Costs

Item	Anticipated	Actual	Description (actual)
AINA	9,450	10,465	2 people 3.5 mo + 1 person 0.75 mo x \$45/day
Travel	1,200	1,340	2 x \$670 air fare Van--Whitehorse
Truck costs	2,925	3,240	6500 km x 45¢/km
Salary assistant	8,800	8,800	4 months x \$2,200/month (May—August 2013)
Salary grad student	8,000	8,000	5 months x \$1,600/month (May—September 2013)
Radio Collars	4,000	1,775	50 x \$80 refurbish
Bear Spray	100	118	4 x \$25 (225g canister)
Materials & Supplies	0	2,100	
Total Costs	34,475	35,838	

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