May 6, 1976

Mr. Steve Peck
Rm. G-9 Gault Hall
University of Idaho
Moscow, Idaho 83843

Dear Steve:

It's a pleasure to inform you that your proposal entitled "A Proposal to Study the Columbian Ground Squirrel "Citellus columbianus) in the Idaho Primitive Area During the Summer of 1976" has been accepted by the Wilderness Research Center with the provision that you revise and refine your objectives and plan of work with Jerran Flinders before you begin field work. We hope you can begin on this project at least by early June. We will expect you to register for 3 credits of special problems, FWR 499, for the summer. The project report will be due in polished draft form five weeks after the start of the fall semester. We then expect the reports will be ready for publication by the end of fall semester.

Half of your $600 honorarium will be paid before you register for summer session and the other half near the end of the summer. Arrangements for food, lodging and transportation should be made with Ken Sowles.

Congratulations on a well-written proposal.

Sincerely,

John H. Ehrenreich
Dean

JHE:ms

Rec'd Apr. 5, 1976

A Proposal To Study The Columbian Ground Squirrel (Citellus columbianus) In The Idaho Primitive Area During The Summer Of 1976.

Steve Peck

Rm. G-9 Gault Hall

University of Idaho

The Problem.

For a population to successfully perpetuate in an environment that periodically becomes menacing, that population must develop some technique which will enable it to cope with the limiting situation. One such adaptive mechanism is dormancy. In the Columbian Ground Squirrel (Citellus columbianus) this ability is particularly highly developed. Certain individuals have been recorded to remain dormant for up to 238 days (Shaw,1925a). For this ground squirrel, dormancy exhibits the qualities of both estivation and hibernation, and it is primarily adaptive in dealing with a protracted period of food shortage.

The demands placed on ground squirrels during dormancy are surmounted via special physiological adjustments and behavorial traits. They are meticulous energy conservationists. For instance, in order to most efficiently utilize the limited period of activity available to them, the reproductive organs of both sexes reach their peak operational stage upon emergence. Thus, breeding occurs almost as soon as the females appear (Shaw,1926a). The subsequent periods of gestation and young development are relatively terse (Shaw,1925b). Improvident practices like aggression and far-ranging dispersal are either avoided or minimized (Betts,1974). These measures accommodate the individual's endeavor to accumulate the massive lipid reserves which are so essential in providing the fuel needed to maintain organismic viability throughout dormancy.

What consequences would result if the fat supplies within an individual were to expire prematurely during torpor? Simple conjecture suggests that the squirrel may perish. In fact, overwinter mortality accounted for the major cause of death among a population of Richardson's Ground Squirrels (Citellus richardsoni) studied in Saskatchewan (Michener,1973). However, the immediate cause of death was nowhere stated. Overwinter mortality is also known to occur among Yellow-bellied Marmots (Marmota flaviventris), especially in areas where the insulative qualities of a deep snow cover are lacking or are minimal (Svendsen,1974). Once again, however, it could not be ascertained whether the death was directly attributable to fat depletion.

Are Columbian Ground Squirrels within wild populations known to expire because their fat reserves run out during dormancy? The answer is unclear. Shaw (1926a) found that individuals emerged from dormancy with surplus fat remaining. However, it must be noted that Shaw dealt either with captive squirrels, which were provided with sufficient food supplies prior to the dormant period, or else with squirrels in the Palouse region, an environment which is considered favorable habitat for ground squirrels. Food, most likely, was not a problem for these squirrels. It must also be added that these ground squirrels were found to depend upon this excess fat throughout the period of breeding and young rearing (Shaw,1926a; Betts,1974). In fact, Betts (1974) found

that the adult females almost depleted their fat reserves during the periods of gestation and lactation. This evidence provides an entirely new parameter to the situation. Perhaps, if fat supplies are too low upon emergence, the reproductive success of certain individuals may be inhibited.

Let's step back from this rather nebulous situation and examine another aspect. What are the factors which determine the quantity of fat that will be remaining at the end of the dormant period? There are three: the metabolic rate of the organism during dormancy, the length of dormancy, and the initial fat supply. The metabolic rates of different squirrels may be relatively similar throughout torpor. However, this assumption should be scrutinized, particularly for wild hibernators. Varying den temperatures may produce varying metabolic rates which will result in differential utilization of fat reserves.

It also seems logical that evolution should have provided most of these squirrels with the ability to prevail through an average dormant period. However, prolonged dormancy may have a detrimental effect on the fat reserves of some squirrels.

The final consideration, the prehibernatory fat supply of the squirrel, may conceivably vary. This is largely determined by the quality and the quantity of the food available to the squirrel during the active period, along with the time available for consumption. A squirrel faced with a low quality diet in meager amounts with a minimal amount of time available to consume it will confront a severe hin-

derance to weight gain. It is a well established fact that Columbian Ground Squirrels occur in a variety of habitats throughout a wide range of elevations which afford both different vegetational types and periods available for consumption (Howell,1938; Manville,1959; Moore,1937). Perhaps certain squirrels are forced to utilize marginal habitats, especially in times of high population densities, in areas where diverse habitats exist. Weight gain in such squirrels may be limited.

Objectives.

I, therefore, propose to conduct in the Idaho Primitive Area during the summer of 1976 the following investigation: Populations of Columbian Ground Squirrels living in different habitats will be selected and the weight performance of certain individuals within those populations will be monitored throughout the course of the summer. Special attention will be paid to the time of entrance into dormancy and the weight of the squirrels at this time. Essentially, I will attempt to determine whether or not a correlation exists between prehibernatory weight and habitat. I do not in any way suggest that this experiment is designed to prove that overwinter mortality or reproductive failure occurs in Columbian Ground Squirrels as a result of premature fat depletion. I will only try to demonstrate that a factor may or may not exist which could ultimately influence the post-hibernatory condition of certain squirrels.

Methods.

When selecting populations to sample I shall, essentially, try to compare squirrels in ''good'' habitats to

those in ''poor'' habitats. The habitat qualities will be based on the vegetational types, vegetational abundances, moisture levels of the vegetation, slope, exposure, and elevation. Shaw (1925a) found that estivation in Columbian Ground Squirrels is brought on by plant dessication. This theme was further reiterated by others (Barash,1973; Howell,1938; Manville,1959). These ground squirrels derive their moisture mainly from plants (Shaw,1925c). Hence, plant moisture will be an important criteria in selecting habitats which contain ground squirrels. The total number of habitat sites selected will depend basically on the availability of traps.

After the various sites have been chosen, the following parameters will be monitored:

1. Ground squirrel weight, sex, age category, and plot density. Ground squirrels will be live-trapped, weighed, ear-tagged, sexed, aged, and given a pelage marking with a coat-coloring agent. The size of the sample area will depend on the ground squirrel density. About 20 to 25 individuals will be trapped on each site. Trapping will occur at each location approximately on a weekly basis. Can traps will be utilized because of their inexpensiveness and their light weight. Nyanzol A or possibly some other hair dye will be used for pelage marking. This marking will be performed so that the feeding areas of the selected squirrels can be easily observed in order to establish at which sites vegetation sampling should be implemented. Baits, scales, and other required materials will be discussed later. In addition to

live-trapping, some snap trapping will be carried out, primarily to investigate the reproductive state of females of different weights in different habitats. Embryos and placental scars will be counted for each. This may provide some evidence to support the contention that fat supplies influence reproductive potentials. Snap-trapping will also lend additional data on the age and sex structures of the populations.

2. Wet weight and dry weight of the plant species found on the feeding areas of the sampled squirrels. Careful vegetation analysis will be conducted. This analysis will take place on the feeding area of the ground squirrels being observed. Squirrel populations having a variable feeding area in terms of vegetational types will be avoided. Initial sampling and statistical testing will be conducted to determine the proper number of samples required to obtain 10% accuracy at a 0.05 confidence limit (see Giles,1971). Quadrats will be placed along randomly selected transects at given intervals. Wet weight and dry weight determinations will be made for each specis growing on each quadrat. The weight estimation method outlined by Tadmor et al. (1975) will be used because it conserves time, it allows large sample sizes, it minimizes habitat damage, and it is statistically sound and can become quite accurate with practice. A standard Daubenmire plot (20x50 cm.) will be used since this provides a good size for forb and grass sampling which is typical ground squirrel habitat, the weight estimation method requires a plot

size which can be easily scanned, and it is widely accepted. This vegetation analysis will be conducted periodically at about 25 day intervals at each site throughout the active period of the squirrels living in that area.

3. Slope and exposure, elevation, and weather conditions. Slope, exposure, and elevation are parameters which further describe habitat characteristics. Weather conditions affect both ground squirrel activity and vegetative productivity. Precipitation amounts, temperatures (daily high and low), and daily sky conditions will be recorded. An attempt will be made to obtain weather data from the first of the year for that area.

Materials.

I will be able to provide many of the materials required. However, I will be unable to furnish the following items:

1. Scale. A spring scale that has a maximum capacity of 1000 grams and is accurate to 0.1 grams will be needed. This should suffice for both vegetation and ground squirrel weighing.

2. Traps. Mouse snap traps serve as a mechanism to close the door of the can traps. A minimum of 20 to 25 will be needed, but a more preferable number would be between 80 to 100. I will be able to provide the cans, workmanship, and other materials required for the construction of the can traps. About 25 larger rat-type traps will be needed also for the snap-trapping.

3. Bait. This may provide some problem. Columbian Ground Squirrels prefer moist foods. In captivity they were found to be fond of foods like carrots and apples (Shaw,1925c).

Rolled oats may be taken; however, when vegetation is green and lush such dry bait may be avoided.

4. Dissecting scope. This will be required for plant identification.

Finally, one may question the validity of conducting this study within the premises of the Idaho Primitive Area. After all, Columbian Ground Squirrels are common in more readily accessible localities. This is a fair assertion which deserves accountability. First of all, this study is designed so that a region containing a great diversity of habitats is a necessary prerequisite. The Primitive Area is such a place. Differences in elevation and slope provide a multi-dimensional array of almost all habitat factors concerned.

Second of all, Columbian Ground Squirrels must be well established in many different environmental situations, particularly in regards to the degree of succulence contained within the vegetation, in order for this study to be successful. Once again, the Primitive Area has been found to possess a large population of these ground squirrels which occurs in a host of habitats from grassy fields to open forests and from wet meadows to rocky slopes. In fact, Wing (1969) found the Columbian Ground Squirrel to be a major herbivore, along with Elk and pack animals, in the mountain meadows within the Primitive Area.

Finally, individuals more pragmatic than myself have often questioned the practical value of a wilderness. I would say to these people that a wilderness area furnishes

a standard, or a mirror, if you like, which provides a reflection of what man's world has become, of what it formerly was, and, unfortunetly, of what it will never be again. Only by understanding the life within such a pristine relic and the interactions of that life with the land, can we as men truly appreciate the mistakes we have made as organisms living in a world that knows only limits.

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