May 6, 1976

Mr. Thomas L. Thurow
G-9 Gault Hall
University of Idaho
Moscow, Idaho 83843

Dear Tom:

It's a pleasure to inform you that your proposal entitled "An Ecological and Taxonomic Investigation of the Subspecies Peromyscus maniculatus serratus" has been accepted by the Wilderness Research Center. 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

Received April 1, 1976

G-9 Gault Hall
University of Idaho
Moscow, Idaho 83843
Phone: 885-7181
March 29, 1976

Dr. Paul Dalke
Acting Assistant Director of
U of I Wilderness Research Center
28 FWR Building
University of Idaho
Moscow, Idaho 83843

Dr. Dalke

Herewith I repectfully submit this proposal entitled "An Ecological and Taxonomic Investigation of the Subspecies Peromyscus maniculatus serratus" for consideration by the Wilderness Research Center board of the University of Idaho. The report presents the main objectives of the proposal along with a discussion of the major criteria used in formulating this investigation and an outline of the procedure which will be used.

Should you wish to discuss any part of this research proposal with me I shall be happy to do so at your convenience and should appreciate your comments at that time.

Sincerely,

Thomas L. Thurow

Thomas L. Thurow

AN ECOLOGICAL AND TAXONOMIC INVESTIGATION OF THE SUBSPECIES *Peromyscus maniculatus serratus*

Thomas L. Thurow, University of Idaho, Moscow, Idaho

In 1939 William B. Davis announced that he had discovered a new subspecies of deermouse which he named *Peromyscus maniculatus serratus*. According to Davis (1939) this subspecies is endemic only to central Idaho, surrounded by *Peromyscus maniculatus artemisiae* to the north and *Peromyscus maniculatus sonoriesis* to the south. Davis' data and findings were excepted by the scientific community as valid and no further research was done concerning this subspecies until 1975. In the summer of 1975 Charles L. Elliott, sponsored by an honorarium from the Wilderness Research Center of the University of Idaho, conducted an investigation concerning the effect of altitude on reproduction and physical adaptations. The subject of this study was *Peromyscus maniculatus* with the supposed subspecies classification of *serratus*. After the data were collected and analysed, Elliott was surprised to find that according to body measurements he had taken, *P. m. artemisiae* instead of *P. m. serratus* represented his sample population. This is in direct contradiction with the range distribution presented by Davis (1939) and Hall and Kelson (1959) which both state that the two subspecies *artemisiae* and *serratus* are seperated by the Salmon River valley, with *artemisiae* to the north and *serratus* to the south (Fig. 1).

When this author analysed Elliott's data I discovered the promising possibility that both *serratus* and *artemisiae* are existing in the same general locale, separated by ecotypic preferences.

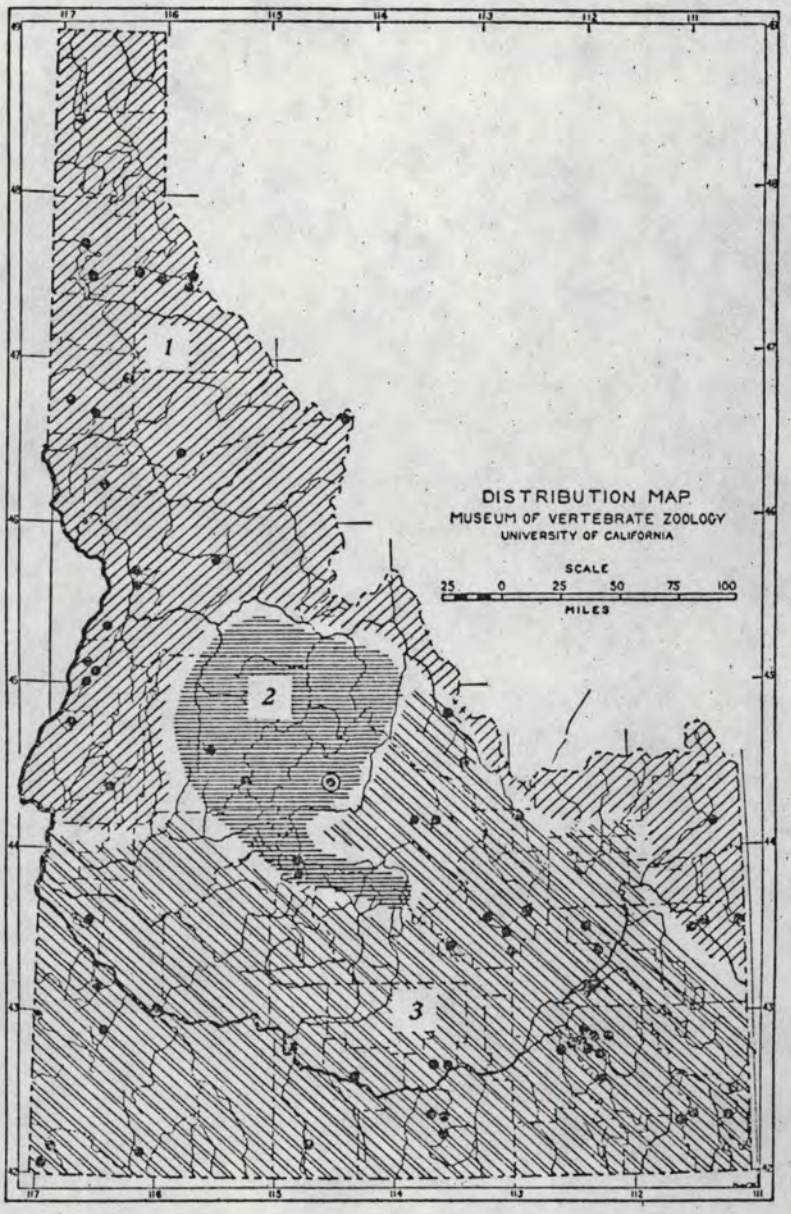

Fig. 1. Map showing the distribution of the deermouse in Idaho. Dots indicate localities where specimens have been examined or recorded. 1. Peromyscus maniculatus artemisiae, 2. Peromyscus maniculatus serratus, 3. Peromyscus maniculatus sonoriensis. Adapted from Davis,1939.

A basis for this analytical possibility is presented later. Nevertheless the fact remains that artemisiae is present in large numbers in an area previously not considered part of its range. Also, the range of serratus does not extend as far north as originally thought (Elliott,1976), or else is present in

reduced numbers and/or limited to specific habitat types.

The objectives and goals of this proposed study of the subspecies P. m. serratus are as follows:

1) Determine if Peromyscus maniculatus serratus still exists. Conclusions presented by Elliott (1976) suggest that serratus is absent from the Taylor Ranch, an area which is supposedly in the heart of the serratus range.

2) Determine the approximate range distribution and general habitat preferences of existing P. m. serratus. If serratus is not found in the range illustrated by Davis (1939) and Hall and Kelson (1959) the deermouse present in place of serratus will be taxonomically identified.

3) Preserve all specimen skins and skulls taken in the course of gathering data for the above two objectives. These will be contributed to the University of Idaho for the purpose of establishing a collection of small mammals representative of central Idaho. Such a collection does not exist at this time and may serve in the future as valuable reference material.

DISCUSSION

This study in part has sprung from the work done by Charles Elliott in the Primitive Area last year (1975). The goal of Elliott's study was to observe the relationship of elevation to reproduction. An unexpected byproduct of the research was the discovery that the subspecies P. m. artemisiae was present at the Taylor Ranch area rather than the expected subspecies P. m. serratus. The stimulus for the bulk of the study is to build upon this finding.

The data collected by Elliott offers the possibility for three plausible explanations. He interpreted these data by taking a measurement of the tail to head and body (THB) and calculating a ratio for all adult mice he collected. If a THB ratio of about 80% was obtained this would indicate that the subspecies caught was P. m. artemisiae. If the THB ratio equalled 92%, a population

of P. m. serratus would be represented (Davis,1939). Elliott determined a THB mean ratio of 84.2% for his data and concluded that artemisiae was the subspecies of P. maniculatus present.

Upon looking at these data I was impressed by the fact that such a wide variation existed in the THB ratio (ranging from 67% to 109%). Also when all the data was graphed, the curve appeared to be slightly skewed toward the larger values (Fig. 2A). Calculating the 95% confidence limits for Elliott's data I concluded that if the mean of the population was to fit the THB ratio of 80% given by Davis, a mean value ranging from 78.3% to 81.7% would be acceptable. Since the ratio mean Elliott derived from his data was 84.2% the null hypothesis, assuming that the population is made up entirely of P. m. artemisiae, must be rejected.

In defense of Elliott's conclusion I will state that the ratio given by Davis is only an approximate value to be used as a guide rather than a rule. If the race of artemisiae at the Taylor Ranch is slightly above the norm for that subspecies, a mean of 84.2% would be entirely feasible. Nevertheless the THB ratio curve is skewed slightly towards the larger values which would be those of serratus. With this in mind I will now present another possible analysis of Elliott's data.

Assume for the sake of discussion that the population sampled by Elliott contained a small number of P. m. serratus. If this is true the THB ratio curve would be skewed slightly toward the larger values and would also raise the THB ratio mean. Thus this possibility would explain the discrepancy between Elliott's and Davis' values.

To test the hypotheses that P. m. artemisiae and P. m. serratus

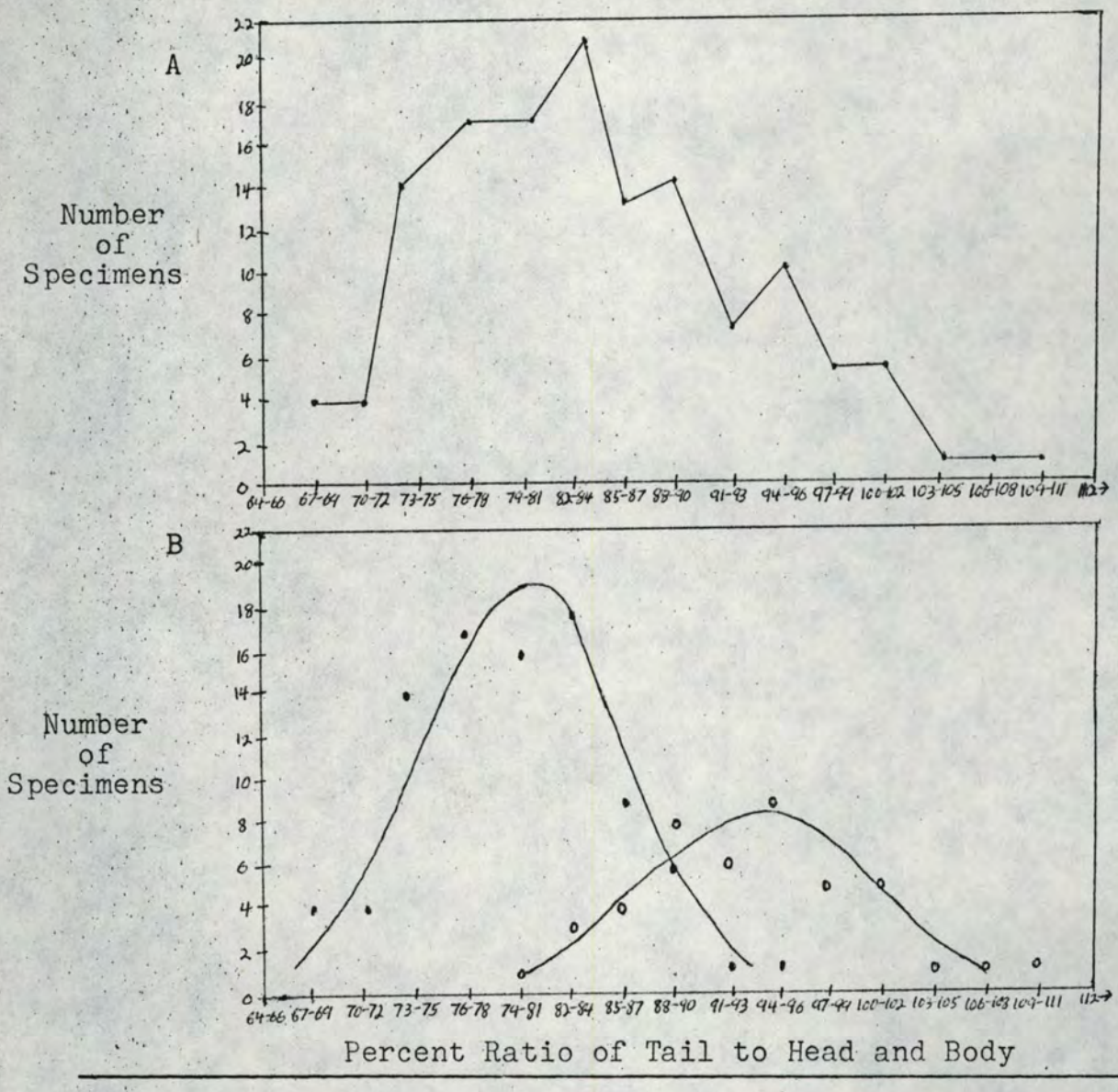

Fig. 2. Graph A illustrates the THB ratio distribution of adult Peromyscus maniculatus collected by Elliott during 1975. Graph B represents two postulated populations within the data collected by Elliott. Postulated P. m. serratus population curve: o—o
Postulated P. m. artemisiae population curve: •—•

were both included in Elliott's collection I postulated two normal populations within Elliott's data which are graphically illustrated in Fig. 2B. According to these projected values the population of the subspecies artemisiae with a THB ratio mean of 79.7% is very close to Davis' THB ratio mean of 80%. Using the value given by Davis', confidence limits of 78.8% and 81.2% were calculated for

this postulated population. As expected the 79.7% THB ratio mean falls between these two values, enabling us to accept (fail to reject) the null hypothesis. These calculations were also conducted for Davis' serratus THB ratio of 92% compaired with my postulated population for this subspecies. The postulated serratus population has a ratio mean of 93.3% but this still falls within the confidence limits of 90.1% and 93.9%. So we can accept the null hypothesis for this population also. In my opinion this interpretation is at least as plausible as the arguement presented by Elliott.

We must now question the mechanism which would enable both serratus and artemisiae to live in the same general local and yet maintain their integrity as distinct subspecies. Ecological isolation often separates two related populations which live in the same geographical area but are restricted to different habitat types (Blair,1950). In the Illinoian Biotic Province (Dice,1943), for example, Peromyscus leucopus inhabits groves of hardwood trees, while Peromyscus maniculatus bairdi lives in the surrounding grassy fields (Dice,1922). These two species often meet along the forest edges (Blair,1940). In the winter they may even share the same nests (Howard,1949). The ecological barrier between these two species thus does not completely separate them. Nevertheless since no hybrid young are produced other kinds of reproductive barriers must prevent their interbreeding (Dice,1933).

Geographic races of the same species of Peromyscus may also live in the same area separated only by an ecological barrier (Blair,1953). Murie (1933) sites an example of two subspecies of Peromyscus maniculatus living in the same part of western Montana. The subspecies artemisiae inhabits the forest on the

mountains, while the subspecies osgoodi is restricted to the grassy plains which extend eastward. These two subspecies meet along the forest edge, but so far as is known they do not interbreed.

In northern Michigan two other subspecies of P. maniculatus occur together in some areas, likewise separated only by a habitat barrier (King and Dice,1968). The subspecies bairdi inhabits open fields and lake beaches, while gracilis lives in the hardwood forests (Dice,1932; Hooper,1942). The two subspecies usually strictly adhere to these ecotypic preferences (Wecker,1964). No natural hybrids have been discovered although fertile offspring have been produced in the laboratory (Foster,1959). Osgood (1909) and Dice (1931) briefly site other subspecies pairs of Peromyscus maniculatus which possibly coexist without breeding. In all cases the two subspecies which overlap in geographic range are presumed to differ at least to some degree in their habitats (King and Dice, 1968).

It is my opinion that there is a good possibility that the type of ecological isolation described above can be found in the Idaho Primitive Area. I base the possibility for such a statement upon the following facts. Out of 133 adult specimens collected by Elliott, 23 had a THB ratio of 94% or over. These should all be serratus according to Davis' criteria. Of these 23 specimens over half (13) were taken in one particular ecotype, which can be characterized as a forested situation with dense understory along a creek bottom. This ecotypic situation occurred rarely in Elliott's samplings as most of his trapping was conducted on the

more arid benchs where plants such as Balsamroot (Balsamorphiza sagittata) and Bluebunch Wheatgrass (Agropyron spicatum) are dominants. However, when traps were set along water courses with the accompaning forest vegetation all specimens trapped have the possibility of being serratus. The lowest THB ratio of any deermouse trapped in this densely forested situation was 86%.

The above description of the habitat where most of the possible serratus were caught is encourgingly similar to the habitats where Davis trapped his serratus. All Davis' trap lines were set "near log piles and brush heaps along the creek". These facts hint at the possibility that serratus is a subspecies of deermouse which is found in an ecotype of dense vegetation near water.

Unfortunately no concrete speculations can be formulated at this time because the skins of the specimens taken by Elliott were not preserved. Basing his assumptions on the ranges presented by Davis (1939), Rust (1946), and Hall and Kelson (1959), Elliott thought he was trapping serratus and did not discover until after he returned that a sizeable portion of his population had to be of the subspecies artemisiae.

If the skins were available, the large white subauricular patches combined with a THB ratio of 92% would conclusively identify serratus. The subspecies artemisiae has no subauricular patch and a THB ratio of 80%. P. m. sonoriensis does have small white subauricular patches but the THB ratio is a comparatively small 73%. Because of these combinations plus the large size, Davis states that the characteristics of serratus "appears to

have reached a higher stage of development" than either artemisiae or sonoriensis. Davis also states in support of my theory on ecological isolation of this subspecies that "although serratus occupies territory geographically intermediate between the ranges of sonoriensis and artemisiae it does not appear to be a race that intergrades or hybrids between the two." This statement is directly challenged by the possibility of secondary intergration.

Secondary intergration occurs when two subspecies meet in a well-defined zone forming a hybrid population with greatly increased variability. Such a population often contains the entire spectrum of character combinations (Mayr, Linsley and Usinger,1953) and implies random interbreeding within the zone . This possibility would explain the wide range of THB ratio values collected by Elliott and the THB ratio mean for these data (84.2%) which falls between the expected THB ratio's given for artemisiae (80%) and serratus (92%).

The facts that have been presented above thus raise many possibilities and leave a number of intriguing questions unanswered. If serratus is not found at the Taylor Ranch can it be found anywhere? Is serratus found only in dense vegetation near water as Elliott's data might suggest? It is now known that artemisiae is found south of the Salmon River in the range previously supposed to be that of serratus. Do these two subspecies live together in direct competition where their ranges meet or are they separated by an ecological barrier or do they hybridize in the zone of contact? These and other related questions have a direct value to the scientific community and much could be answered over a summers research. It is my objective to solve these questions and I will now give an outline of how I propose to accomplish this.

PROCEDURE AND STUDY AREA

The proposed study area is the recorded range of serratus in central Idaho and activity will be centered at the Taylor Ranch Wilderness Field Station (Taylor Ranch) located on the Big Creek River in the Idaho Primitive Area. During the summer months there will be approximately 100 days during which research may be conducted. Fifteen days are subtracted to provide a little leeway for trapping nights missed due to inclement weather or travel between trapping stations. This leaves 85 days during which trap lines may be expected to be set. Eighteen stations will be sampled. Each station will have three trap lines each consisting of 50 museum special traps (Wiener and Smith,1972) spaced 3.05 m. (10 ft.) apart in a line transect (Larrison and Johnson,1973). Each station will be maintained three nights (Johnson,1976) and checked twice daily to remove the catch and rebait the traps. Each trap will be baited with a mixture of peanut butter, rolled oats, suet, and cooking oil (Stickel,1948; Holdenreid,1954; Taber and Cowan,1971).

I mentioned above that each station will have three trap lines. These three trap lines will be situated in the following habitats:

1) Near water under a forested situation with substantial undergrowth.

2) An open grassland situation.

3) A forested situation removed from water with moderate undergrowth.

Habitat type will be evaluated through implementation of the line intercept method (Canfield,1950; Baker,1968; Smith,1974). The reason for selecting these broad habitat types is to test the ecotypic relationship between serratus and its environment.

Through this approach an accurate evaluation of the small mammal population will be obtained, and since all three trap lines at each station will be set at the same time, external factors beyond the researchers control (ie. weather) will have a minimal effect on the population variation between the habitat samples (Gentry et. al.,1968).

Seven of the 18 trapping stations I plan to sample are located within the Idaho Primitive Area near aircraft landing strips. The airstrips to which I would like to be flown and a tentative order of travel to these areas is as follows:

1) Begin trapping at Taylor Ranch. Pick up at Taylor Ranch; drop off at Big Creek airstrip.
2) Pick up at Big Creek; drop off at Chamberlain airstrip.
3) After three nights of trapping at Chamberlain I will hike to my next proposed trapping station which is north of Root Ranch. From Root Ranch I will hike to Cold Meadows trapping station. These three sites will be covered over a two week period.
4) Pick up at Cold Meadows; fly to Flying "B" airstrip.
5) Pick up at Flying "B"; drop off at Pistol Creek airstrip.
6) Pick up at Pistol Creek and fly out of Primitive Area.

Assistant Dean Kenneth Sowles (manager of Taylor Ranch and pilot) was consulted in the selection of these airstrips and he confirmed the availability and safety of these landing areas. Most of these airstrips are not too far out of the way for the pilot who periodically flys to the Taylor Ranch and so few problems should be encountered in getting to these areas.

As I already mentioned this only a tentative schedule constructed to facilitate the convenience of the pilot and the efficient use of time. A total of approximately 45 days will be spent in the Primitive Area assuming a flight between stations occurs at close to one week intervals. Two three day trapping sessions will be run in the areas where one week is spent.

The remaining eleven stations are outside the Idaho Primitive Area and I will provide my own transportation to these areas. Included in these eleven stations are the four areas trapped by Davis in 1936 which produced the subspecies serratus. The remaining seven areas were chosen as strategic points near the expected boundary of the serratus range. The location of the eighteen areas to be sampled forms a logical grid-like pattern which is conducive to maximum efficiency for the points sampled (Fig. 3).

I plan to begin the summers activities by first trapping the stations inside the Primitive Area. The reason for this decision is so the roads leading into the backcountry will have a chance to dry out before I attempt to traverse them. I will begin my fieldwork as soon as I can be flown into the Primitive Area and will terminate the field study in time to return back to the University of Idaho for the 1976 fall semester.

RESOURCES REQUIRED

1) Transportation to and inside the Primitive Area. (I have been informed this is provided by the University).

2) 160 Museum Special snap traps. (If this quantity for some reason cannot be procurred the smaller Victor mouse traps will suffice).

3) A scale for recording the weights of the specimens caught.

4) Skin preservative, cotton, and wire needed to preserve the specimens for museum collection.

SUMMARY

The research objectives presented in this proposal are ideally suited for the type of undergraduate study sponsored by the Wilderness Research Center of the University of Idaho. The subspecies Peromyscus maniculatus serratus is endemic only to central Idaho

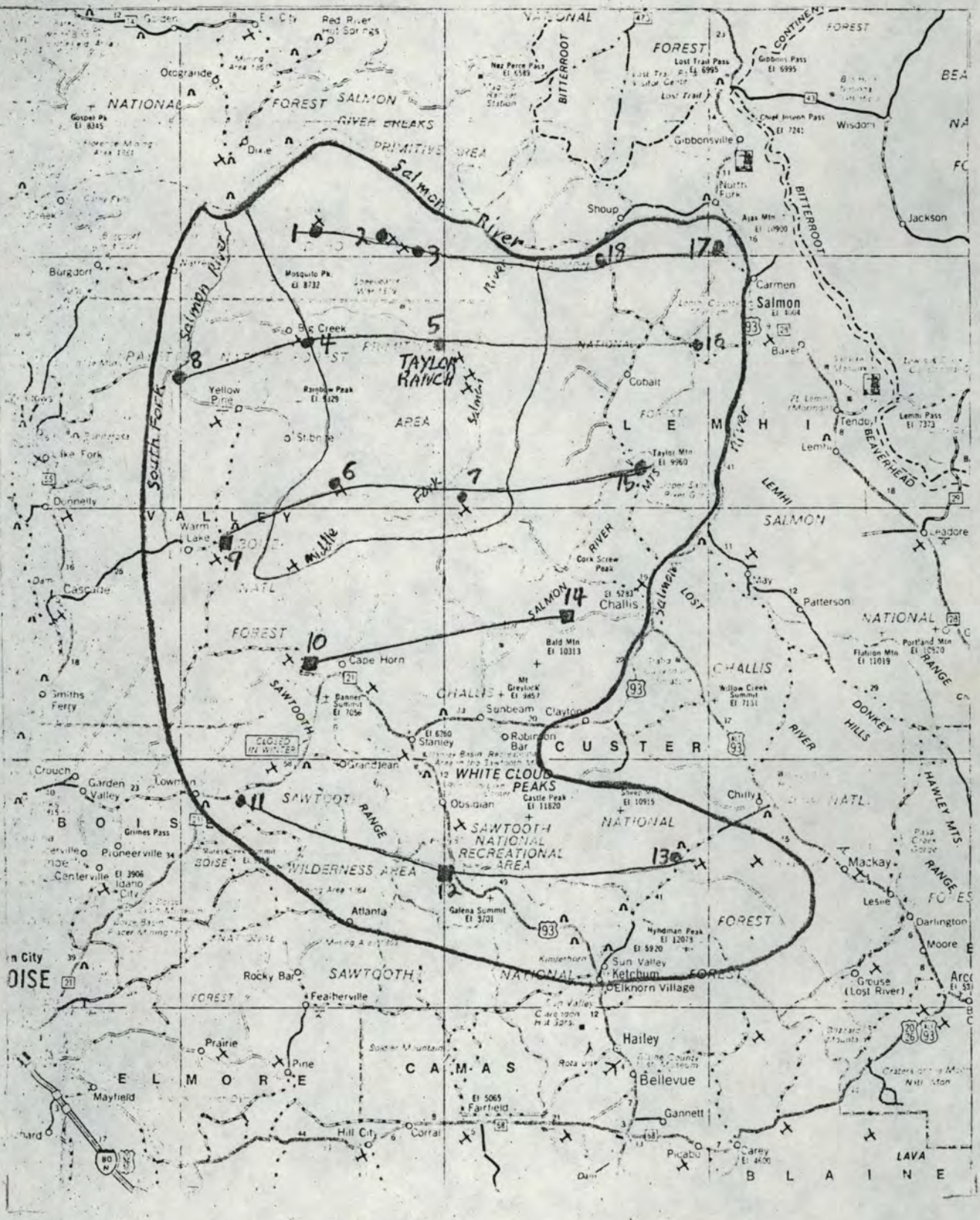

Fig. 3: The accepted range of P. m. serratus adapted from Davis(1939) and Hall and Kelson (1959). Squares (numbers 9,10,12,and 14) indicate the areas where serratus was recorded by Davis (1939). The numbers indicate the 18 areas which I plan to sample.

with the Idaho Primitive Area supposedly constituting a major portion of it's range. The specific range of this subspecies is questionable and further complicated by the ecological ramifications of two subspecies possibily existing in the same geographic location. An investigation of these and related questions could be adequately conducted during the three month time span of a summer vacation. Special equipment needed for such an investigation is minimal. The information collected, regardless of what is found, would be of significant value to the scientific community. Therefore this study will be submitted to the Journal of Mammalogy for publication upon completion. The specimens taken and preserved during the course of this study can be used to serve as valuable reference material of the small mammals of central Idaho.

I have spent a great deal of time formulating and researching this proposal and certainly do not expect a monetary profit from this type of summer employment. Nevertheless the additional experience gained through such an opportunity would be priceless. If there are any questions or difficulties relating to any part of this proposal I will be more than willing to discuss them with those concerned.

LITERATURE CITED

Baker,B.D. 1968. Techniques for measuring shrub crown intercept when employing the line intercept method of sampling range vegetation. Colo. Game and Fish Dept. Spec. Rept. No. 64.:1-2.

Blair, W.F. 1940. A study of prairie deer-mouse populations in souther Michigan. Amer. Midland Nat., 24:273-305.

_____. 1950. Ecological factors in speciation in Peromyscus. Evolution, 4:253-275.

_____. 1953. Factors affecting gene exchange between populations in the Peromyscus maniculatus group. Texas Jour. Sci., 5:17-33.

Canfield, R.H. 1950. Sampling ranges by the line interception method. Res. Rept. No. 4, Southwestern Forest and Range Exp. Sta., Forest Service, U.S.D.A., Tucson, Arizona. 28 pp.

Davis, W.B. 1939. The recent mammals of Idaho. Caxton Printers, Inc., Caldwell. 400pp.

Dice, L.R. 1922. Some factors affecting the distribution of the prairie vole, forest deer-mouse, and prairie deer-mouse. Ecology, 3:29-47.

_____. 1931. The occurrence of two subspecies in the same area. J. Mamm., 12:210-213.

_____. 1932. Mammals collected by F.M. Gaige in 1919 at Lake Cushman and vicinity, Olympic Peninsula, Washington. Murrelet, 13:47-49.

_____. 1933. Fertility relationships between some of the species and subspecies of mice in the genus Peromyscus. J. Mamm., 14:298-305.

_____. 1943. The biotic provinces of North America. University of Michigan Press.

Elliott, C.L. 1976. The effect of altitude upon various physical and reproductive factors in a population of Peromyscus maniculatus. Undergraduate Research Report, Student Wilderness Study Program. 13pp. Unpublished.

Foster, D.D. 1959. Differences in behavior and temperament between two races of the deer-mouse. J. Mamm., 40:496-513.

Gentry, J.B., E.P. Odum, M. Mason, V. Nabholtz, S. Marshall, and J.T. McGinnis. 1968. Effect of altitude and forest manipulation on relative abundance of small mammals. J. Mamm. 49(3):539-541.

LITERATURE CITED (con't.)

Hall, E.R., and K.R. Kelson. 1959. The mammals of North America. Ronald Press Co., New York. 1083pp.

Holdenreid, R. 1954. A new live-catch rodent trap and comparisons with two other traps. J. Mamm. 35:267-268.

Hooper, E.T. 1942. An effect on Peromyscus maniculatus Rassenkreis of land utilization in Michigan. J. Mamm., 23:193-196.

Howard, W.E. 1949. Dispersal, amount of inbreeding, and longevity in a local population of prairie deermice on the George Reserve, southern Michigan. Contrib. Lab. Vert. Biol. Univ. Mich., 43:1-50.

Johnson, D.R. 1976. Personal Communication. Dr. Johnson is with the Dept. of Zool., University of Idaho, Moscow, Idaho.

King, J.A., and L.R. Dice. 1968. Biology of Peromyscus (Rodentia). Special publication no. 2. The American society of mammalogists. 593pp.

Larrison, E.J., and D.R. Johnson. 1973. Density changes and habitat affinities of rodents of shadscale and sagebrush associations. Great Basin Nat. 33(4):255-264.

Mayr, E., E.G. Linsley, and R.L. Usinger. 1953. Methods and principles of systematic soology. McGraw-Hill Book Co., New York. 328pp.

Murie, A. 1933. The ecological relationship of two subspecies of Peromyscus in the Glacier Park region, Montana. Occ. Pap. Mus. Zool. Univ. Mich., 270:1-17.

Rust, H.J. 1946. Mammals of northern Idaho. J. Mamm. 27(4):308-327.

Osgood, W.H. 1909. Revision of the mice of the American genus Peromyscus. N. Amer. Fauna, 28:1-285.

Smith, R.L. 1974. Ecology and field biology. Harper and Row Pub., New York. 850pp.

Stickel, L.F. 1948. Effects of bait on mice entering traps. J. Wildl. Manage. 12:211-212.

Taber, R.D., and I. Cowan. 1971. Capturing and marking wild animals. Pages 277-319 in R.H. Giles, Jr., ed. Wildlife management techniques. 3rd. ed. Edwards Brothers Pub., Inc., Ann Arbor. 633pp.

LITERATURE CITED (con't)

Wecker, S.C. 1963. The role of early experience in habitat selection by the prairie deermouse, Peromyscus maniculatus bairdi. Ecol. Monogr., 33:307-325.

Wiener, J.G., and M.H. Smith. 1972. Relative efficiencies of four small mammal traps. J. Mamm. 53(4):868-873.