REPORT ON THE ACTIVITIES
OF THE
JACKSON HOLE BIOLOGICAL RESEARCH STATION
SUMMER 1971

L. Floyd Clarke, Director

UNIVERSITY OF WYOMING
Laramie, Wyoming
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A Comparative Study of Communications in Big Game
Margaret Altmann
Professor of Psychology Emeritus
University of Colorado
Project Number 124

The long range study of the communication systems of wild ungulates was continued during the summer (May 20 to September 4, 1971) as planned. Our special interest was centered on the role of fear in the daily and seasonal life of the animals.

Comparative observations of the ethological and ecological patterns in elk, moose, and mule deer led to the analysis of the role of attenuated fear, the extinction of the flight reaction, and eventually to the establishment of familiarity in respect to disturbances. Manmade disturbances provided the most often occurring examples of intrusion into the herd and individual life of elk and moose.

Our observations confirmed our findings from previously collected research data that increased disturbance (mainly tourist pressure) leads to increased concentration of big game animals in the areas of lesser pressure. This in turn leads to overuse of food and shelter resources and to increased intra-species pressure (social interaction). At times, social herd organization was impaired and normal grazing and dispersion were modified.

The definite emergence of a new type of "big game" in the form of a tourist-tolerant, less reactive roadside game animal (moose, elk, deer) was found and studied in detail. Such a "park edition" of wild big game is, however, still a rare phenomenon, but their number will increase steadily, if ecological pressure is continued. Some National Park Service members have mentioned that this type of park game will be the unavoidable goal under denser tourist conditions.

The attenuation of the fear- and flight-reaction which may bring at first sight some advantages for the onlooker, will in the long run have a devastating effect on the social ecology of any wild species. Fear and flight in the big game animals serves as an important steering and distributing device in herd and individual movements. Without this device the tendency to congest in certain areas, to erode and overgraze their ranges is stepped up.

Excessive familiarity (erroneously called "tameness") with man also increases the incidence of roadkills and develops beggar animals to the point at which the game animal as well as the tourist is endangered.
Another approach of our research this year dealt with observations on the role of the subordinate animals in elk or moose groups. It appears likely that the subordinate animal serves in important signal functions and provides a replacement reserve. The further evaluation of our data will have to shed more light on all these questions.

Increased attention was also given to the olfactory-scent markings and their behavioral consequences in moose, elk, and deer movements.

Among the interested scientists visiting our research headquarters were Dr. Adolph Murie, Biologist, Moose, Wyoming, and Mr. Hugh B. House, Curator of Mammals, Bronx Zoo and New York Zoological Society.

Assisted by Miss Betty Erickson, a graduate student from the University of Colorado.
Behavioral ecology studies of avifauna have centered on foraging methods, time budgets and correlation of avifauna with the presence or absence of species of plants. Few studies have considered the relation of vegetation structure and species of avifauna present. MacArthur and MacArthur (1961) found foliage height diversity functioned as a predictor of bird species diversity. Sturman (1969) showed the abundance of Chestnut-backed Chickadees to be correlated with the upper story canopy volume and the average height of the upper story conifers. Both canopy volume and canopy height are components of the foliage height diversity. Anderson (1970a) utilized stepwise multiple linear regression analysis to correlate 52 vegetation structure components with the presence or absence of avifauna species in the Oregon white oak and Douglas fir.

To characterize and compare the avifauna and vegetation of the area around Jackson Hole, Wyoming, sampling transects were established through nine study sites: three aspen groves, three lodgepole pine groves, and three spruce-fir groves. Each area was sampled once a week during the months of July and August 1971. Early morning censuses were made of avifauna present by means of a modification of the sample count method (Anderson, in preparation). An irregular transect was established through each stand at least 150 meters from the edge. Ten sample points were spaced 95 meters among this transect. As I walked along the transect, all birds seen within 18 meters on either side of the transect were counted.

To compare and contrast the vegetation of the area and relate the vegetation structure to the avifauna present, each study area was randomly sampled twice a week during July for structural features of the vegetation. These features include: canopy volume, trunk height, position of primary and secondary branches, amount of vegetative matter present, density of trees and shrubs per acre, area of inner core of trees, amount of dead vegetation per acre, percent of conifers and deciduous trees per acre, height class of trees, index of openness, height from ground to lower canopy, diameter at breast height and type of bark on trees. Each area was sampled by the point-centered quarter method (Cottam and Curtis, 1956). A sampling point was located by random numbers in each 125-pace interval (95 meters) along a wandering transect 951 meters in length through the center of each area. The area around the sample was divided into four quarters and data were taken on the nearest tree in each quarter.
Results and Discussion

The three vegetation types studied in the Jackson Hole area presented a contrast in overall avian abundance. Much of the lodgepole pine was in uniform aged stands with the shrub layer at a minimum. Of the three areas studied total number of individuals and total number of species of birds was minimal in the pine areas. Several factors could be responsible for this. The variety of foraging sites would be minimal thus reducing the number of species that such an area could support. Further, the actual food available might be less in such a uniform community. Further analysis of the structural features of the vegetation which influence the abundance of the different bird species might give insight into this problem.

Another factor that must be considered in a survey of the lodgepole pine avian community is the influence of the bark beetle. Many large trees are dead or dying from attacks by this beetle. Alteration of the entire vegetation structure is occurring in many places e.g. reduction in canopy volume, increase in number of seedlings, branch structure change, etc., will influence the abundance of avifauna present. This topic warrants further study.

Spruce-fir forests in the Jackson Hole area consisted of Engelmann spruce, Douglas fir with scattered patches of alpine fir. Such forests were common on the slopes surrounding the valley. Birds in these areas were numerous. Many foliage nesting birds were found here with several hole nesters. The areas often had dense understory which provided further habitat for birds to utilize.

Aspen stands were common on the valley floor in moist areas. They were frequently very small; however, a large number of birds nested in these areas. Hole nesters were particularly common. Many birds appeared to nest in these small stands and disperse later in the season into the many different forest types in the area. The maximum number of birds in the areas studied was found in these areas.

The data gathered in this study will be analyzed by means of multiple stepwise regression analysis and principle component analysis in which the key vegetative features affecting avian abundance will be calculated by the computer. This should provide information on why avian species are present in numbers in some areas and absent from others. Information on niche breadth will be calculated using the formula: $Bi = 1/\pi^2$ (Levins, 1969). Further analysis will be made by comparing the results of this study with work done by the investigator in the forests of western Oregon (Anderson, 1970b) and the tropical forests of Costa Rica (Willson, Anderson, and Murray, in preparation). Differences in species between areas will be related.

Further studies are to be undertaken on the birds of the forests of Ohio.
Literature Cited


Supported by the New York Zoological Society.
Determination of Levels of Cesium 137 and Strontium 90 in Fleshy Fungi from Wisconsin and Wyoming

John W. Baxter
Department of Botany
University of Wisconsin-Milwaukee
Project Number 101

During June and July abundant material of three fleshy fungi (Helvella gigas, Caloscypha fulgens and Discina ancilis) was obtained in the Medicine Bow National Forest in southern Wyoming. Unfortunately, collecting in Jackson Hole during August was not so rewarding. Because of the extremely dry conditions, only one fungus, Cortinarius sp., was collected in a quantity sufficient for determination of levels of cesium 137 and strontium 90.

Because of the scarcity of fleshy fungi most of the period spent at the Jackson Hole station was devoted to collecting rust fungi and aquatic hyphomycetes. The following species were added to the list of aquatic hyphomycetes previously recorded for the Jackson Hole region:

- Tetracladium maxilliformis
- Dactyllela aquatica
- Centrospora angulata
- Actinospora megalospora
- Heliscus lugdunensis
- Heliscus submersus
- Clavatospora stellata

These are the first records of these species from the Rocky Mountain region.

Among the rusts collected was Puccinia subdecora, on Brickellia grandiflora, near Inspiration Point in Cascade Canyon. This species was previously known only from the type material, collected in Colorado, and a collection from the Wasatch Mountains in Utah.
The Ecology of Aspen
Alan A. Beetle
Division of Plant Science
University of Wyoming
Project Number 130

Study plots involving exclosures on Berry Creek, Gros Ventre River, Uhl Hill, the National Elk Refuge, Grey's River and Black Tail Butte, as well as a series of stands on Pacific Creek, have been used to study the ecology of aspen. For the sixth year the individual life histories of mature trees and hundreds of saplings have been recorded.

As a result of these studies the following conclusions have been strengthened:

(1) aspen is often a climax community in the Jackson Hole area
(2) aspen needs only protection from browsing to regenerate
(3) the history of fire in Jackson Hole is not a principal cause of the deterioration of aspen stands in Jackson Hole
(4) the primary cause of aspen deterioration is excessive utilization by elk.

Assisted by Keith Olson and Arturo Ibarra.
Supported by McIntyre-Stennis Federal funds.
Research concerning the elk lungworm, *Dictyocaulus* sp., was continued in the spring (late May-early June), summer (July), and fall (October) of 1971. A higher incidence of lungworm-positive elk was noted in these data (40% spring and 47% summer, see Fig. 1) than in those data of past years. Fall necropsy data were limited to lungs from Refuge hunter kills in mid-October. Seventy per cent of those lungs were positive for *Dictyocaulus* sp. adults. A 12% incidence was found in Big Game Ridge elk in mid-July.

Attempts were made to drive all summer resident elk from the National Elk Refuge during the summer. Elk thus removed returned to the refuge within 1-2 weeks. A similar removal procedure will be attempted in the spring of 1972 and/or treatment by medicated mineral block may be instituted.
Fig. 1  Per cent incidence of the elk lungworm, Dictyocaulus sp., in fecal samples of elk in each of two seasons during 1971. Grand Teton National Park, Wyoming.

Supported by University of Wyoming.
Survey of the Odonata of Wyoming with Emphasis on Their Altitudinal Distribution
George H. Bick, Biology Department
University of Notre Dame
and
Lothar E. Hornuff, Biology Department
Central State University, Edmond, OK
Project Number 182

This study on Odonata in Wyoming was part of a study including areas in South Dakota and Nebraska, also. Collections were made in South Dakota and Nebraska, and in eastern Wyoming in July of 1969. During July 1971, almost daily collecting of adults in the Teton area, but also at widely separated Wyoming localities, resulted in a total of 98 collections. Twenty new state records resulted for Wyoming.

Distribution

The twenty new state records for Wyoming may be grouped into two categories: 1. The collection fills a gap in the distribution of Anax junius, Somatochlora hudsonica, Libellula forensis, Libellula pulchella, Plathemis lydia, Leucorrhinia intacta, Calopteryx aequabilis, Hetaerina americana, Argia alberta, Argia fumipennis violacea, Nehalennia irene, Enallagma carunculatum, Enallagma hageni, Ischnura damula. 2. The collection is near the limits or extends the range of Ophiogomphus~erus montanus, Aeshna californica, Ischnura cervula, eastward, and ~estes forcipatus, Enallagma antennatum, Ischnura verticalis, westward.

Elevation

Ten sites at 8,100-9,600' were sampled. Eight were bog ponds, one a bog lake, and one a bog creek. No odonates were seen at the three locations above 9,100'. Species present and the number of collections of each were: Aeshna eremita (2), Aeshna interrupta interna (1), Aeshna juncea (2), S. hudsonica (2), Somatochlora semicircularis (3), Leucorrhinia borealis (2), Leucorrhinia hudsonica (1), Leucorrhinia proxima (1), Lestes disjunctus disjunctus (1), Coenagrion resolutum (4), Enallagma boreale (5), Enallagma cyathigerum (1). A. juncea alone was restricted to these higher elevations, and Hess (1940) found it only at approximately 9,700' in the Pikes Peak area. However, this circumboreal species does have a greater altitudinal range in other parts of the world. The other species were not restricted to elevations higher than 8,000', i.e., they are not an obligatory high altitude group. Even boreale, the most frequent of these, also occurred regularly at much lower elevations. Although Hess collected Aeshna palmata, L. pulchella, O. severus, Tarnetrum corruptum, and Sympetrum danae above 8,000', and although these were present in our area of most intensive collecting, we did not find them.
above 8,000'. The contrast must be due to a multiplicity of habitat factors rather than to altitude per se.

**Habitat**

The array of species collected at hot spring areas, bogs, and lotic water was of particular interest. In the Teton, four sites fed by warm to hot water springs were sampled: a very small, well vegetated creek, a large, well vegetated pond with a small creek flowing from it, and a large thermal area consisting of a rocky creek, adjacent boggy areas, and a very small pond. Each habitat had unusually large amounts of algae. Nymphs were not collected, but adults of many species were associated with these areas. The species and the number of collections of each were: O. s. montanus (1), Somatochlora minor (1), S. hudsonica (1), L. forensis (2), Libellula quadrimaculata (2), Libellula saturata (4), P. lydia (2), L. hudsonica (2), Erythemis collocata (2), C. aequabilis (1), Lestes dryas (1), A. alberta (2), Argia vivida (4), Amphiaignon sp. (4), Enallagma anna (3), E. cyathigerum (1), I. cervula (1). Of these, montanus, saturata, alberta, vivida, and collocata were collected only at hot spring areas. However, we have found the first four at habitats other than hot springs in other parts of the U.S., and Gloyd (1958) collected collocata in Texas at both hot and cold springs. In our experience, the often recorded association of vivida with spring fed water holds whether such water is hot or cold. Of the species listed above from hot spring areas in Wyoming, the following are reported by others from such habitats: forensis, lydia, cyathigerum (Kennedy, 1917), cervula, vivida (Walker, 1953), collocata (Gloyd, 1958), saturata (Kennedy, 1917; Gloyd, 1958).

The greatest diversity of species was associated with ponds or small streams bordered by wet areas with dark soil containing abundant organic matter. We combined all such collections under the term bogs without considering pH, plant composition, or quaking substrate. These areas, common in the Tetons, yielded 21 species. However, most of these were also recorded from other habitats. We calculated the degree of species-habitat association for species represented in five or more collections. Among these 18 species, the majority of collections for 10 were from bogs. These and the per cent occurrence at bogs were: L. borealis (100), L. proxima (100), Cordulia shurtleffii (100), C. resolutum (94), S. semicircularis (93), L. hudsonica (71), L. quadrimaculata (64), E. boreale (63), L. d. disjunctus (60), L. dryas (57).

In contrast with the diversity of species at bogs and thermal areas, very few were associated with lotic water. Odonates were entirely absent along the cold rushing melt waters of streams such as Wind River, Pilgrim, Pacific, Lava, and Cascade Creeks. They were present only at the much more moderately flowing streams, where only Argia emma and E. anna were characteristic.
A paper on this study is being prepared for publication and includes a list of all species collected in Wyoming along with brief habitat notes.

LITERATURE CITED


Supported by New York Zoological Society.
The summer months of 1971 ended the 19 month intensive study period for this project. However, the project will be continued as time permits over the next two years.

Fourteen active coyote dens were located this season and denning behavior was observed in detail at two dens, one of which was occupied by two pairs of adults and nine pups and the other by one pair of adults and eight pups. Territories were positively identified for three packs of coyotes during the winter months and at least two of these were maintained through the month of June. Territorial interactions between members of these three packs were described as well as the social hierarchy of members in one of the packs.

No trapping or marking was conducted in 1971 and identification of individuals was done from natural marking as well as from the coyotes that were trapped, marked, and released in October of 1970.

This work was, in part, funded by the New York Zoological Society, an NDEA Title IV Fellowship, and aided by the National Park Service in the form of a collaboratorship. I would like to thank these organizations as well as the personnel of the National Elk Refuge and the U.S. Forest Service for their cooperation.

Supported by the New York Zoological Society and NDEA through the University of Wyoming.
Uinta ground squirrels \textit{(Spermophilus armatus)} occupy several different kinds of habitat in Jackson Hole. This study is comparing squirrel populations in two conspicuously different habitat types in order to determine the nature of consequent differences within the squirrel populations themselves.

The summers of 1969-1971 (April-August) have been spent comparing squirrel populations in the two areas with regard to: (1) population density and structure, (2) food habits in relation to available vegetation, (3) energy dynamics, (4) the nature of predation and interspecific competition, (5) general behavior, (6) timing of activity (daily and seasonal), (7) burrow structure and distribution and (8) distribution, home range and dispersal movements of individuals.

The study is essentially a live-trapping operation in which captured squirrels are classified as to sex and age-class, weighed, examined as to condition (of pregnancy, etc.), toe-clipped for individual identification, and followed to a burrow upon release. Burrows are marked and mapped. Reproductive tracts are collected and analyzed. Stomach contents are examined and compared with canopy coverage analyses of available vegetation. Observations are made concerning the timing of activity, general behavior and the nature of predation. Caloric values are being worked out for plant species and stomach contents. In 1972 assimilation efficiencies will be determined for different plant species.

One more year of study (April-August 1972) is planned.

Supported by NSF Summer Traineeship.
Studies on the Mathematical Relationships Between Productivity and Phytoplankton Density
Raymond L. Czaplewski
Zoology and Physiology
University of Wyoming
Project Number 185

The purpose of this project was to find the relationship between photosynthetic rate and phytoplankton density in Two Ocean Lake, Grand Teton National Park. Since there is only a finite rate of incoming light energy, it was proposed by the investigator that the photosynthetic rate would reach a maximum value and not exceed that value in spite of increased phytoplankton density. Figure 1 shows this hypothesis graphically.

A major objective of this project was to fit one or more mathematical functions to the data. Several functions have been suggested:

\[
\begin{align*}
\mu &= \frac{\mu_m P}{k + P} \\
\mu &= \mu_m (1 - e^{-kP}) \\
\mu &= \mu_m [1 - \left(\frac{\pi}{2} \arctan(10k(P-k))(1-P/k)\right)]
\end{align*}
\]

\(\mu\) = photosynthetic rate

\(\mu_m\) = maximum photosynthetic rate possible under the existing environmental conditions

\(k\) = a constant

\(P\) = phytoplankton density

The major portion of the summer was spent developing field procedures to artificially manipulate phytoplankton density in a productivity experiment. In the end, a somewhat acceptable technique was developed. A water sample was hydrostatically filtered through HA Millipore filters. The filtrate was used to dilute field samples. The portion concentrated in the filtering process was used to increase phytoplankton density. Each manipulated sample was incubated in situ in 300 ml. B.O.D. bottles with three light bottle replicates and three dark bottle replicates. Net productivity was calculated using the change from the initial to final readings of the light bottle oxygen levels. Respiratory rates were calculated in a similar manner using the dark bottle data. Gross productivity was taken to be the net productivity plus the respiratory rate.
Figure 1

[Graph showing the relationship between photosynthetic rate and phytoplankton density]
Although the necessary statistical analysis has not yet been performed, the data suggest that the hypothesized curvilinear relationship between photosynthetic rate and phytoplankton density was found. It has not yet been determined which of the above mathematical functions give the best fit to the data.

It may be possible to gather the same type of data using a productivity vs. depth profile. In this case, the phytoplankton density would be the sum of all phytoplankton above the sample depth. Density would be in biomass/square surface area. This approach was not undertaken this summer for lack of time.

Supported by the University of Wyoming.
Raven Distribution, Population Dynamics, and Ecology in Grand Teton National Park
Jane L. Dorn
Zoology and Physiology
University of Wyoming
Project Number 176

The second period of study began on February 2, 1971, and was terminated August 20, 1971. During February and March most of the ravens were concentrated near food sources, including the Kelly and Jackson-Wilson town garbage dumps or where fresh animal carcasses were available. The carcass pile on the National Elk Refuge was an important feeding site. Some sexual behavior was observed in early February, but actual nesting did not begin until early April.

Thirty-four active nests were located. Most of these were accessible, and were checked several times to determine clutch size and number of young leaving the nest. Average clutch size was 5.4 eggs per nest; average number of young leaving the nest was two. Twenty-four young of the year were marked with orange patagial tags and U.S. Fish and Wildlife Service leg bands.

Regurgitated stomach pellets were collected beneath active nests for later analysis. Some of the calls of adults and young were recorded with a portable recorder and parabolic reflector. These sounds will be used to make sonagrams.

Supported by the New York Zoological Society and the National Science Foundation.
Life Habits, Population Dynamics, and Ecology of Mule Deer in Grand Teton Park
Robert D. Dorn
Zoology and Physiology
University of Wyoming
Project Number 177

The second summer of field work concentrated on food habits, distribution, vegetation type use, population structure, and natality.

Forbs remained the most important forage group followed by browse. Use of vegetation types in percent was as follows: sagebrush 32.4, aspen 14.7, lodgepole pine 13.2, willow 10.3, sedge 10.3, lodgepole pine and aspen parks 8.8, cottonwood 7.4, and grassland 2.9. An edge situation was involved in 80.7 percent of the observation.

The deer population was considerably smaller than the previous summer. Sixty-three animals were observed including 20 males, 29 females, 2 fawns (twins), and 11 unidentified. Most of the unidentified were probably females. Only one female was observed with fawns and these were twins.

Supported by the University of Wyoming.
Ecological, behavioral, and nutritional aspects of the Wyoming pika, *Ochotona princeps ventorum*, were studied in June, July, and August of 1971.

Four study areas were established: near Grassy Lake; on the west shore of String Lake; at the base of Granite Canyon; and on top of Rendezvous Peak. These four sites were chosen because of their diverse types of habitat. The four areas were compared with respect to differences in ecology, nutrition, and behavior of its inhabitants.

These plants were observed to have been eaten during the study period:

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<th>Grassy Lake</th>
<th>String Lake</th>
<th>Granite Canyon</th>
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<tr>
<td>Lodgepole pine</td>
<td>Potentilla sp.</td>
<td>Poa sp.</td>
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<tr>
<td>Potentilla sp.</td>
<td>Aspen</td>
<td>Poa sp.</td>
</tr>
<tr>
<td>Carex geyeri</td>
<td>Carex sp.</td>
<td>Aspen</td>
</tr>
<tr>
<td>Carex hoodii</td>
<td>Serviceberry</td>
<td></td>
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<tr>
<td>Carex sp.</td>
<td>Poa sp.</td>
<td></td>
</tr>
<tr>
<td>Wild raspberry</td>
<td>Wild raspberry</td>
<td>Unknown</td>
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Pikas at the Rendezvous Peak site were never observed to eat or "hay" up until the middle of August when the study was terminated.

In addition to this, a study of the mineral dynamics of the talus slope (the habitat of the pika) was made with respect to the plants inhabiting the slope and soil in and near the slope.

Analysis of plant and soil samples is being done at this time at LSUNO, but any conclusions at this time would be premature.

Thanks are extended to Bob Wood of Grand Teton National Park for assistance in locating sites, and to Bob and Jane Dorn, University of Wyoming, for identifying plant samples.

Supported by the New York Zoological Society.
This is part of a continuing study of the comparative nesting behavior of solitary wasps (Hymenoptera Aculeata), with particular reference to the genus Philanthus (Sphecidae). This year most attention was devoted to P. zebratus, a relatively large and showy member of the genus that nests in several places in Jackson Hole. The major study area was below the Snake River Overlook, 9.5 miles south of Moran Junction. About 100 nests were present here between July 10 and August 5, all in an area about 5 x 15 meters in sandy soil near the Snake River. Forty nests were marked and followed until completion. In no case did the females involved make a second nest; they continued to make cells on the original nests until their death. The maximum number of cells found was 14, provisioned each with 4-9 paralyzed bees or wasps (including other species of Philanthus). Observations were also made on male behavior. Males are not territorial, as previously assumed, but rest at various places around the colony, showing little tendency to return to the same perch again. Males also have a "high flight", not previously described, in which they rise slowly in the air to a height of 3-5 meters and then descend obliquely to the ground after 10-60 seconds.

Seven hundred feet of motion picture film (16 mm, color) were taken of the behavior of Philanthus zebratus. This will soon be developed and edited, and it is hoped that it will be possible to prepare a concise film on this reasonably typical member of the genus as a basis for comparison with other species.

In addition, a few notes were taken on Philanthus pulcher and P. pacificus, two species studied earlier in Jackson Hole, as well as on several other ground-nesting wasps.

A secondary project consisted of placing "trap nests" on trees, stumps, fences, and buildings in order to obtain nests of species normally nesting in hollow twigs or holes in timber. These were of two kinds. One consisted of pieces of seasoned pine, 1 inch square and 6 inches long, with a hole bored through one end for most of the length. These were placed in a horizontal position, 1 to 8 feet high, and were accepted by species normally nesting in hollow twigs or in beetle borings in logs. Two boring diameters were used: 4 mm and 6 mm; 100 of each diameter were employed.

The second type of trap nest consisted of 6 inch lengths of Sambucus (elderberry) stem, placed usually in a vertical position and attractive to
wasps that normally nest in the pith of elderberry, rose, sumach, and similar plants. One hundred of these were used. Of the 300 trap nests used altogether, 150 were put out at or near the Research Station, 150 along Pilgrim Creek, in Teton National Forest.

Trap nests of the first type were highly successful, slightly over 75% being accepted by wasps and bees. Filled nests were split with a jackknife and the contents recorded; specimens of prey and larvae were preserved for future study. They were then put together again with elastics and saved for the emergence of the adults and their parasites. The major genera of wasps involved were Symmorphus, Ancistrocerus (Eumenidae), Trypoxylon, and Passaloecus (Sphecidae). (Nests filled by bees were turned over to Stephen Clement, a ranger-naturalist in Yellowstone who is doing a thesis at the University of California, Davis, on solitary bees.)

Nests of the second type (containing pithy centers) were less successful, only 5% being accepted. Presumably this is because few of the wasps in this area are adapted for nesting in this situation; other persons have had much success in areas where there are many brambles, sumach, and other plants having pithy centers.

Supported by the Museum of Comparative Zoology, Harvard University.
During August a series of about 175 animals was trapped at various sites to assess reproductive parameters of the population. Approximately 95 blood plasma samples were taken and frozen for a later androgen assay in the Laboratory. Material was saved for ageing.

Attention was concentrated throughout September and into mid-October on several sites selected for further study on the basis of August trapping. Population estimates were made at two sites by a capture-recapture procedure. Data obtained during this period on home range were then supplemented by following with a scintillation probe selected animals tagged with subcutaneously injected irradiated tantalum (Ta-182) wire. Observations were made of live animals in the field under filtered light at traps and tracking stations. Some behavioral tests were made in the field and in the laboratory. At the end of the study an attempt was made to trap-out each area.

Reproduction data obtained at the study sites were supplemented by additional trapping elsewhere to document the cessation of breeding. Some animals were collected to add to the laboratory colony at Cornell.

Supported by a Ford Foundation Ecology of Pest Management Traineeship; the New York State Wildlife Research Unit (U.S. Bureau of Sport Fisheries and Wildlife), and a travel grant from the Society of the Sigma Xi.
A Preliminary Study of the Effect of Stress on Snails and Their Larval Trematode Parasites
Glenn A. Noble
Biological Sciences Department
California State Polytechnic
Project Number 103

Most of the mammals and birds of Jackson Hole harbor trematode parasites. The usual intermediate host in the life cycle of these flukes is a snail. My work during the past few years has dealt with stress on vertebrate hosts and its effect on their parasites. During the summer of 1971 I turned my attention to the invertebrate hosts of trematodes in a preliminary effort to determine if stress on these snails would be reflected in a change in the numbers of their larval fluke parasites. The work was done in the southern end of Grand Teton National Park.

Method

One hundred aquatic snails were placed in a plastic screen cage in the same location of a pond where they were found. Another one hundred snails, in a similar cage, were placed in a nearby area in the same pond but where there were no snails. Apparently a more rapid flow of water in this area was the major factor in discouraging snail establishment. Snails were examined and parasites counted every two weeks from each enclosure and from the surrounding natural pond habitat. At the end of seven weeks all remaining snails in the enclosures were examined and compared to those in the natural habitat.

Results

During the 7-week period the snails in the swifter water maintained the highest number of parasites but the snails rapidly died. By the end of the seven weeks all but two had disappeared. Thirty-five snails remained in the other enclosure. These were compared with thirty-five snails (controls) just outside the enclosure. Thirteen of the enclosed snails were negative compared to twenty-three of the controls. The numbers of larval flukes in each snail were given a numerical value based on a scale designation of 0, +, ++, +++ for no infection, light infection, medium infection and heavy infection. The enclosed snails possessed larger numbers of parasites. Presumably the stress of confinement was the major factor involved. A single classification analysis of variance showed a probability of less than 2.5% that the difference in infection between the two groups was due to chance. This highly significant figure is encouraging but the experiment must be repeated with larger numbers of snails, a record kept of the weight of each snail, and some refinements in techniques.
Studies on the Kinetics of Uptake of Nitrate and Ammonium by Phytoplankton
Michael Parker
Zoology and Physiology
University of Wyoming
Project Number 165

Several experiments to evaluate rates of nitrate and ammonium uptake by phytoplankton were conducted using methodology described in the 1970 report. Because of breakdowns of the mass spectrometer most experiments have not been analyzed. However, preliminary data from Swan Lake indicate that the hypothesized relation between nutrient concentration and $K_t$ may hold; as dissolved nitrate concentrations decreased from 24.3 $\mu$M/liter to 2.5 $\mu$M/Liter, $K_t$ decreased from 1.17 $\mu$M/liter to 0.0004 $\mu$M/liter. Phytoplankton counts are nearing completion, and in conjunction with autoradiographs should aid in interpreting the data on a species or generic level as well as on the community level.

Work was begun on biochemical predator defense in algae. Algae were collected and aqueous extracts made. Zooplankters showed marked behavioral changes in the presence of the extract. Experiments will shortly be under way to evaluate whether the zooplankters are attracted to, or repelled by the extracts.

Supported by the University of Wyoming and National Science Foundation grant GB-16847.
Effects of Environmental Variables on Some Physiological Responses of Microtus montanus under Natural Conditions

Aelita J. Pinter
Touro Research Institute
and
Louisiana State University in New Orleans
Project Number 173

This is a continuation of a long term study of multiannual cycles in population density of Microtus montanus in Jackson Hole. Attempts are being made to determine whether a link exists between such cycles, several environmental variables, and the physiological responses of Microtus to such variables. The present report summarizes field data collected during 1971. Methods employed in this work were essentially the same as those outlined in the 1969 report.

Field observations.

In 1971 field observations at the Research Station were carried out over two study periods: spring (May), and summer (July and August).

The populations of Microtus montanus in Jackson Hole had undergone a precipitous decline ("crash") during the winter of 1969-70. The study period covered by the present report therefore represents the second year following the crash. This is an important phase in the multiannual population cycle of Microtus. It not only expresses the immediate recovery rate of the population from its minimum levels, but also suggests some of the principal mechanisms whereby such recovery is achieved.

Spring study period.

As expected, Microtus populations were still at low levels in the spring of 1971. A number of observations substantiated this expectation:

(a) Trapping success was significantly higher than that in the spring of 1970, yet still remained significantly below the 1968 and 1969 levels.

(b) In the meadows voles still occurred in small localized groups, a situation characteristic of low population densities.

(c) Large amounts of dead herbaceous vegetation could be found in the meadows following snow melt off. The relatively small over-wintering population of M. montanus apparently had not consumed the grass crop. This was in sharp contrast to the conditions recorded in the spring of 1970 when the meadows were virtually denuded of all vegetation.
Nevertheless, evidence was present already during the spring study period that the population of *M. montanus* was headed for a rapid buildup during the 1971 breeding season:

(a) Reproduction on a population-wide scale had begun considerably earlier in 1971 than in 1970. By the end of the spring study period of 1970 (late May–early June) only 75% of the females were found to be pregnant. In contrast, during the 1971 spring study 100% of the females were already pregnant between the second and third week in May.

(b) Litter sizes (based on embryo counts) were significantly higher in the spring of 1971 than in the spring of 1970. These were first litter pregnancies of the year (none of the females were lactating or showed placental scars). Since litter sizes in the spring of 1970 also represented the first litters of the year only, the data from the two years are strictly comparable.

The high level of reproductive activity in the population of spring 1971 alone would lead to a considerable increase in animal numbers. In addition, however, the breeding season started early. This means that offspring from the first litters would be able to enter the breeding population earlier in the season and could produce more litters during the 1971 breeding season.

**Summer study period.**

As expected, the most remarkable aspect was a significant increase in the population density of *Microtus* over the levels recorded in the summer of 1970. Although voles still occurred predominantly in small groups, there was a definite trend toward decentralization. Furthermore, for the first time since the crash extensive runways could once again be located. This feature was virtually absent during the summer of 1970.

Litter sizes were determined on the basis of embryo counts and/or placental scars. For adult females mean litter sizes did not differ significantly from those observed during 1970. However, litter sizes for subadult females were significantly higher than those observed for this age group in 1970. In *Microtus montanus* litter size is related to the parity of the female (increase in litter size up to the fifth litter). It might be argued that the earlier onset of breeding might have resulted in a smaller number of primiparous females at a comparable time in 1970 and in 1971, and that the increase in mean litter size is an artifact due to the fact that more subadult females would already be pregnant with their second litter. However, this explanation is not valid, since the increase in litter size was found both in primiparous and in multiparous females.
The rate of population growth in 1971 was therefore speeded by two factors: (1) a significantly greater breeding population in 1971 than in 1970, and (2) a significant increase in the mean litter size (females of both age groups considered together). The impact of these two parameters was actually reflected in the population density of Microtus. By the end of the summer the population had approximately quadrupled over the 1970 levels.

Another factor that undoubtedly contributed to the population buildup was possibly some decrease in predation pressure. Weasels (Mustela erminea and M. frenata) were very abundant in the study areas in 1969 and 1970. A significant decrease in the weasel populations had apparently occurred during the winter of 1970-71. This is in agreement with well documented observations that predator cycles lag behind those of their prey by approximately one year.

Materials collected during the spring and summer of 1971 are currently being processed at Louisiana State University in New Orleans. The results were not yet available at the time this report was due. Consequently, no data are available that would enable a correlation of reproductive responses of Microtus to environmental variables.

Note: In the summer of 1969 a mutant M. montanus male was collected from one of the study areas. Breeding experiments are not yet complete, however, results obtained so far indicate that this mutation (white spotting) is dominant and that the original animal was heterozygous for the condition. Several dominant white spotting mutations are known in mammals. However, the one now being studied in Microtus does not appear to be homologous to any known coat color mutation. There is also some indication that the homozygous dominant condition may be semilethal. Individuals of this genotype are pure white with black eyes. They are significantly smaller than their littermates (both spotted and wild type). Many of them die shortly after birth and a deviation from the expected ratio suggests that some individuals may die in utero. White individuals that do attain adulthood appear to be sterile.

Assisted by Mrs. Janet R. Smith and Mr. K. Dale Engler.
Supported by the New York Zoological Society.
The Ecology of Sagebrush on the Glacial Outwash Plains
in Grand Teton National Park
Darold Sabinske
Botany Department
University of Wyoming
Project Number 169

During June and July of 1971 sampling was completed on the 21 sites which were established in the summer of 1970. In addition, there were ten new sites established. These ten were added in the low sagebrush, big sagebrush on alluvium, and big sagebrush-bitterbrush areas. This was done in order for there to be a more adequate sampling in each of these three types.

The 31 sites, 100 x 200 feet in size, were each sampled as follows:

1. Forty one-foot square, randomly placed quadrats were used to sample the understory species of plants with presence indicated for transitory species such as annuals, counts made on the more persistent species such as perennials, and percent cover on grass species, bare soil, pocket gopher activity, and clone forming species such as Antennaria.

2. Ten line transects spaced at 20-foot intervals were used to measure percent cover due to any shrub species present.

3. At four random places, except in the six sites sampled in the summer of 1970 when three random places were sampled in each site, soil samples were taken from 0-4 inches and 4-8 inches.

The data are presently undergoing analysis. The information obtained will be written up as a master's thesis at the University of Wyoming.

Supported by the University of Wyoming.
The Paleontology of the Colter Formation
John F. Sutton
Systematics and Ecology
Museum of Natural History
University of Kansas
Project Number 181

Study of the vertebrate faunas of the Colter formation was begun this summer using the biological station as a base of operations. The Colter formation itself is composed primarily of Miocene volcanic sediments derived largely from the Yellowstone-Absaroka volcanic field. The extent of the study area was not large, with localities in the Gros Ventre mountains, near Cunningham cabin, and along both forks of Pilgrim creek. Most of the field season was spent prospecting these areas for deposits of vertebrate fossils. Some collection of the promising areas was undertaken, but a concentrated program of washing and screening the sediments was not carried out during this field season. The field season revealed many localities with fragmentary remains of vertebrate fossils and three localities with fair vertebrate faunas.

Along Ditch creek in the Gros Ventre mountains two exposures of the Colter formation produced fossil wood and a few unidentifiable bone scraps. Some of the bulk samples taken from these exposures have not been processed yet and it is possible that they may produce a microfauna.

The locality near Cunningham cabin was suspected to be middle Miocene in age based on the vertebrates collected there in 1967. Our preliminary data from this season suggest that the locality may be somewhat younger, possibly late Miocene, based on the discovery of Merycodus, an ancestral antilocaprid, Monosaulax, a primitive beaver, and a late Miocene representative of the horse Merychippus. Other fossil elements found at this locality are not fully identified as yet and most of the bulk sample from this locality has not yet been processed.

The north fork of Pilgrim creek was prospected with no success. Several areas produced one or two pieces of badly worn bone, but nothing identifiable was found. Along the east fork, however, two localities with vertebrate fossils were found. The first of these localities had been prospected in the past and produced two skeletons in 1947 and a horse jaw in 1967. This locality was extensively prospected this summer and some bulk samples were taken. The surface prospecting yielded only two horse teeth which are tentatively assigned to Merychippus sp. The bulk sample was washed and screened. Picking of most of the material has turned up only two teeth of the rodent Proheteromys.
The other locality on the east fork of Pilgrim creek is located at the base of the section near the eastward limit of the exposed Colter formation. The locality is unique in that it is a siltstone which is not present at any of the other Colter localities. Fossils are not plentiful, however some teeth were found, enough to assign a tentative age to this part of the section. The genus Cylindrodon is represented by two teeth. This genus is exclusively early Oligocene in its temporal distribution. Other Oligocene genera represented in this fauna are Mustelavus and Palaeolagus. The majority of fossil material from this locality is fragmented and represented by bone scrap only. On the basis of this scant information, it is likely that this locality is not part of the Miocene Colter sequence, but rather is part of an earlier sequence of Oligocene deposition.

It is important to point out that these results are preliminary at best and further work must be done in the areas discussed above. The first field season, just completed, was primarily a prospecting season with more intense collection at the discovered sites to follow later. Thanks are extended to Dr. J. D. Love of the U. S. Geological Survey for his help and advice in locating exposures of the Colter formation and offering the benefit of many years of experience in the Teton area to my project.

The Colter Fauna

Insectivora
   Fam. Soricidae
      Domnina Cope, 1873
   Fam. Talpidae
      Scalopoides isodens (?) Wilson, 1960

Lagomorpha
   Fam. Leporidae
      Palaeolagus Leidy, 1856

Rodentia
   Fam. Ischyromyidae
      Cylindrodon Douglass, 1902
   Fam. Eomyidae
      Pseudotheridomys Schlosser (1926)
   Fam. Sciuridae
      Miospermophilus Black, 1963
         Protospermophilus Gazin
   Fam. Heteromyidae
      Proheteromys (2 species) Wood, 1932
   Fam. Castoridae
      Monosaulax Stirton, 1935
   Fam. Zapodidae
      Pleisosminthus Viret, 1926

Carnivora
   Fam. Mustelidae
      Mustelavus Clark, 1936
Perissodactyla
Fam. Equidae
  Merychippus (2 species) Leidy, 1857
Fam. Hyracodontidae
  Hyracodont sp.

Artiodactyla
Fam. Merycoidodontidae
  Merycochoerus Leidy, 1858
  Brachycrus Matthew, 1901
  Merychyus Leidy, 1858
Fam. Camelidae
  Oxydactylus Peterson, 1904
Fam. Antilocapridae
  Merycodus Leidy, 1854

Supported by University of Kansas Museum of Natural History.
PHYSICAL FACILITIES

The major improvement of the physical facilities involved an electrical rewiring project. As a result of a continued increase in the use of electrical equipment and also the expansion of the use of electricity for heating, it became necessary to rewire the Station to take care of the increased load. This involved an extensive program of underground wiring as well as the addition of electrical heating in the washhouse and director's residence, and an increased power supply to the laboratories, the shop, and gas pump. It is hoped that with this major addition to the electrical power, we can supply the ever increasing need of electrical power at the Station for several years to come.

Other activities involved various maintenance projects and other improvements.
COOPERATION WITH OTHER AGENCIES AND INDIVIDUALS

The following were among the most important cooperative activities with other agencies and individuals.

1. Teton Sciences Field Biology School.
   High school students under the supervision of Mr. Ted Major visited at the Research Station for a full day on July 21st. During this visit the students had an opportunity to become acquainted with the operation of the Station and its purposes and its functions, as well as to observe many of the research projects which were currently under way.

   A second group under the supervision of Mr. Major visited the Station in early August. This group consisted of some college students and other adults who were interested in conservation and field biology. Also, Mr. Major and his students participated in almost all of the evening seminars at the Station.

2. Close cooperation with the Grand Teton National Park continued, especially with Biologists, Peter Hayden and Bob Wood. Both were very helpful to the research workers in connection with both aquatic and terrestrial ecology studies at the Station. Also, Mr. Charles McCurdy, Chief Naturalist, was very cooperative. The Research Station appreciated the continued cooperation of Grand Teton National Park personnel.

   In addition, contacts were continued with the Forest Service biologists and Wyoming Game and Fish Department personnel.

3. As usual we had a large number of visits by scientists and other people interested in the operation of the Station. The director of the Station as well as the other research workers supplied what information they could to these visitors about the Station and its operation.

   Mr. Hugh B. House, Curator of Mammals at the Bronx Zoo, representing the New York Zoological Society, visited the Station.

   The Station had a visit from a National Park Service committee making a study of National Park Service operations.

4. The research personnel of the Station, on many occasions, supplied advice and other help to individuals and agencies in the area on many different biological problems.
As in previous summers, a fine series of seminars was presented. In addition to the seminars presented by the Station investigators, Mr. Peter Hayden, Biologist for Grand Teton National Park, talked to the group. The seminars were very well attended by both Station personnel and other scientists in the area. A capacity crowd attended the seminars.

Following is a list of the seminars presented.


July 8 - Mr. Peter Hayden - Grand Teton National Park. Aquatic research: Jackson Lake and the Snake River.

July 15 - Dr. Howard E. Evans - Harvard University. The incredible continent: An entomological cross-section of Australia.

July 22 - Dr. Michael Parker - University of Wyoming. Plankton ecology.


Mr. K. Dale Engler - Louisiana State University in New Orleans. Ecological, behavioral, and nutritional aspects of the Wyoming pika.

Aug. 5 - Mr. Franz Camenzind - University of Wyoming. Coyote ecology and behavior in Jackson Hole.


Aug. 19 - Dr. Margaret Altmann - University of Colorado. Comparative behavior studies of wild ungulates.

In addition to the above seminars, we showed a film concerning the environment which was produced in cooperation with the American Museum of Natural History. Many evenings at the Station were devoted to informal discussion and showing of slides by Station personnel.
### Financial Report 1970-71

**November 12, 1970-June 30, 1971**

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**July 1, 1971-September 30, 1971**

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$13,038.20 $7,648.72 $5,389.48

In addition to above expenditures, $1,823.99 was expended from a Special Grant fund for electrical rewiring and installations.

Rent received in the amount of $673.00 was placed in the General Fund of the University.

The New York Zoological Society contributed $500.00 toward the Director's salary in the form of an honorarium.

Grants-in-aid in the amount of $2,880.00 were given to investigators by the New York Zoological Society.

Gifts received were: $1,000 - from New York Zoological Society
                      $1,000 - Anonymous donor

*Includes money carried over from previous year, therefore, does not indicate amounts appropriated for one year.
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John, Kenneth R.


Jones, Webster B.

Kennington, Garth S.


Kroger, Richard L.

Laycock, William


Levi, Herbert W. and Lorna R. Levi


Lichtwardt, Robert W.

Lowrie, Donald C.

Lowrie, Donald C. (cont.)

McHugh, Tom

McKnight, Kent H.

Miller, Dwight D.

Nakamura, Mitsuru

Negus, Norman C.


Activity rhythms in Microtus montanus: the role of the pineal gland. (Submitted to Journal of Experimental Zoology.) (With P.J. Berger)


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Noble, Glenn A. (cont.)


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Pinter, Aelita J.


Litter sizes of Microtus montanus in the laboratory. J. Mammal., 46:434-437. (With N. C. Negus)


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