FOREST, WILDLIFE AND RANGE EXPERIMENT STATION

COLLEGE OF FORESTRY

UNIVERSITY OF IDAHO

Moscow, Idaho

F O U R T E E N T H A N N U A L R E P O R T

For the Fiscal Year 1961-1962

Ernest Wohletz, Director E. W. Tisdale, Associate Director

November 1962

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INTRODUCTION

Forty-three projects were active during the year. Six of these were new studies, while four investigations were completed during this period.

No changes in Station staff occurred during the year. The size of staff remained at 18, with one additional position (Forest Management-Recreation) unfilled.

Twelve graduate Research Fellows were on appointment during the year. Two of these completed their work and received their degrees in June, 1962, while two additional theses were presented by Research Fellows whose appointment had been completed in the previous year.

Support for research in the form of funds, facilities and other assistance was received from a number of organization. A list of sixteen major contributors is presented in Appendix B of this report. New contributions received during the year included funds for research on the use of sperm toxins for control of undesirable fish species (U.S. Bureau of Commercial Fisheries); on the significance of dew on forest sites (U.S. Weather Bureau); and on wood quality in western red cedar (U.S. Forest Service).

Research publications for the year included twenty technical publications, seven theses and seven miscellaneous items. This represents a considerable increase over previous years.

Ernest Wohletz

Ernest Wohletz, Director

E. W. Tisdale

E. W. Tisdale, Associate Director

WORK ACCOMPLISHMENTS

I. Forest Management and Utilization

Project E.S. 2. White Pine Blister Rust.

Duplicate records, covering 20 years' work, have been sorted and an analytical program is being prepared.

Project E.S. 6. Idaho Tree Diseases and Defects.

Many inquiries about injuries caused by weather were received. Consequently, two news releases concerning this were published.

In contrast to last year, larch needle cast was rare.

Station Research Note No. 19 concerning the dieback of ponderosa pine caused by a scale insect was written and distributed.

The most frequent diseases reported by individuals and county agents were sycamore anthracnose, hormone and chemical injuries, and Elytroderma needle cast.

Project E.S. 19. Christmas Tree Test Plantings.

Field work on this project has been completed. The results are reported in Station Research Note No. 20. Data summarized in this report are as follows:

1. Well managed Christmas tree plantings in Idaho have good income possibilities, particularly if the trees can be retailed by the grower.

2. A Christmas tree planting cannot be expected to take care of itself. Under cultivation most evergreen species grow too fast after they become established to make good Christmas trees. Careful attention to shearing, cultivation, watering and protection from rodents, insects and livestock is necessary for success.

3. Any evergreen species that produces trees with desirable form, density and color will make merchantable Christmas trees.

4. Scotch pine, Norway spruce and blue spruce were the most promising species in the tests. Douglas-fir, Rocky Mountain juniper and Austrian pine are acceptable. White fir makes a desirable tree but it has a discouragingly slow growth rate.

5. More than 75 percent of the Christmas tree customers wanted trees 5 feet or taller in height. If this percentage of a planting needs to develop into 5- to 7-foot trees, a 5' x 5' spacing is better than 4' x 4'. The closer spacing is satisfactory if the grower can sell 40 percent or more of his trees in size under 5 feet, or if a fast

growing species, such as Scotch pine, is alternated in the row with a slow growing species like blue spruce.

Project E. S. 20. Mortality of Young Western White Pine (Pole Blight).

This project is on a maintenance basis until field plot data are completed. No plot examinations were made during the 1961 field season.

Project E.S. 23 (WM-42). Marketing Practices and Prices for Timber from Small Woodlands.

Log cost and lumber return data were taken from five mills located in the ten northern counties of Idaho. The mills were selected for varied size, stumpage source, method of marketing, and having data available.

A volume of nearly one hundred and fifty million board feet was sampled over the five-year period 1955-1959. The cost of logs delivered to the mill varied by as much as 50 percent from different stumpage sources for ponderosa and white pine. Mixed logs varied less, by as much as 25 percent from different stumpage sources.

Logs coming from the U.S. Forest Service lands were the most expensive for white pine, and were the most expensive for mixed logs along with those from large private stumpage. State land and "large private" ownerships were the source of the most expensive ponderosa pine logs.

The lumber return data and a charting of Western Pine Association Index of prices received for lumber both indicated no correlation between the cost of logs delivered to the sawmill and the price received for the lumber.

A Master's thesis entitled "A Study of the Sawmills of Northern Idaho: Their Facilities, Production, Log Procurement, and Lumber Sales" was prepared on this project and submitted in May of 1962.

Project E.S. 24. Forest Tree Breeding in Idaho.

The forest genetics and tree improvement program of the University of Idaho is conducted in cooperation with private wood-using industries and federal and state forestry agencies, viz.: Southern Idaho Forestry Association, Idaho State Forestry Department, U.S. Bureau of Land Management and U.S. Forest Service, Regions 1 and 4, and the Intermountain Forest and Range Experiment Station.

A genetic study of western red cedar (Thuja plicata) was initiated this year. It is sponsored by the U.S. Forest Service. As a preliminary step, preparation for a general survey of the genetic variation of this species throughout its natural range was made.

For the selection of superior trees of ponderosa pines, primarily for southern Idaho, progenies of individual selected seed trees were test

planted in four plantations (see 13th Annual Report) in collaboration with the State Forestry Department and the Boise National Forest. As of October, 1961, 65 percent to 85 percent survival has been obtained (S.R. #77). Intraspecific hybridization between these progeny-tested trees and other selected trees of distinct morphological characters, including seed, branch, stem and crown form characters were made. Genetic variation in seed size was investigated in relation to its possible influence on seedling root growth. Controlled pollination of selected trees in southern Idaho was made for the development of ponderosa pine of improved tree form and growth. A parallel study was made in northern Idaho by Richard G. Reid, a research fellow, on the inheritance of stem deformities and presented as an M.S. Thesis.

More ponderosa pine seed sources from Idaho and adjacent areas were included in the local genetic variation study. Seedlings are being grown at the Lucky Peak Nursery through the cooperation of the Boise National Forest. In addition, a collection of 127 different ponderosa pine seed sources was made throughout the natural range of this species. A part of the seedlings (2-0) were raised from Dr. Callahan's seeds and obtained from Professor J. W. Wright of the Michigan State University. They are ready to be planted in the breeding material collection at the University Forest.

In the study of genetic differences of wood properties, 21 ponderosa pine seed sources growing for nearly 50 years under apparently uniform conditions at the Priest River Experimental Forest in northern Idaho were investigated. Tracheid lengths were found to be under more rigid genetic control than other characters examined.

Project E.S. 27. Soil Nutrient--White Pine Site Quality Study.

This study, designed to reveal the importance of soil fertility to the growth of white pine, was carried forward on a limited basis during the year. It had been hoped that more intensive work would be accomplished, especially in the laboratory and greenhouse, but new facilities of this nature were not constructed when expected. Some of the planned greenhouse techniques, explained in the 1960-1961 Annual Report, were tested, however, and some modifications devised. It appears certain that the new facilities will be in operation during the 1962-1963 fiscal year and work on nutrient requirements of white pine and the ability of various soils to supply these needs will be carried forward.

Project E.S. 28. Nursery Soil Fertility Studies.

Plans for more soil studies of the nurseries were held in abeyance pending completion of new laboratory and greenhouse facilities. Upon installation of these during the 1962-1963 fiscal year, it is hoped that more intensive research on the effects of native soil fertility and of fertilizers on quality of nursery stock will be undertaken.

Project E.S. 29. Damage Caused by the Engelmann Spruce Weevil in Northern Idaho.

The project was terminated with publication of the results, which will be appearing in the Journal of Forestry, 60(11):34-37, November 1962. A summary of results follows:

The effects of attack by the Engelmann spruce weevil (Pissodes engelmanni Hopk.) in the northern Rockies have been inadequately considered in the published accounts of the silvics and silviculture of Engelmann spruce. Comparison of survey data, collected in stands of this tree species, has shown that the extent and severity of damage by P. engelmanni in Idaho is comparable to that of P. strobi (Peck) and P. sitchensis Hopk. in their respective hosts and ranges.

Quantitative information on the extent of weeviling within five-foot bole length classes was gathered from two spruce plantations differing both as to site quality (height growth) and initial survival of planting stock. The greatest severity of attack per tree occurred on the poor site, where the attacks were concentrated in the 0 to 5 and 10 to 15 foot bole length classes. The relatively more vigorous, closer spaced trees on the better site recovered rather well from weevil attack, with rapid assumption of terminal growth by laterals and a minimum of distortion. Observations and data suggest that cold-pocket stands support much higher Engelmann spruce weevil populations than do stands on sites with good air drainage, regardless of altitude.

Project E.S. 30. A Study of Relationships Between Farm Units, Farm Forests and Off-Farm Employment Opportunities.

A publication by James Esmay and E. L. Williams has been prepared entitled "Trends in Resource Use and Income on Farms in the Cut-Over Area of Northern Idaho." This publication points out the dependence of the rural economy on forest enterprises. Over half the rural people in the area receive less than half their income from their farming activities and over half the off-farm income is from the forest industries in the area.

Another study was made in Boundary County in conjunction with the Farmers Home Administration regarding economic units. This indicates a need for significant increases in size of farming units in the cut-over areas.

Project E.S. ~~30.~~ 33 Robinia Root Slip Cause and Control.

This project was instituted in July, 1961. Its objectives are as follows:

1. To ascertain the primary causal agents and predisposing conditions which incite deterioration of black locust seedlings in cold storage.

2. To develop practical means for preventing or reducing mortality of seedlings.

Standard phytopathological methods, including the use of Koch's postulates, are being used to isolate the biotic agents responsible for deterioration of Robinia roots. Then, the isolated organisms are subjected to in vitro tests to find a suitable counteracting agent. Effective agents are later applied to Robinia seedlings prior to storage. Control groups are simultaneously exposed to external abiotic influences to indicate predisposing factors.

A species of Fusarium has been isolated and found causal. Injury to roots during lifting is apparently predisposing.

Control efforts, utilizing varied pH, chemicals and modified lifting procedures, have been unsuccessful. Potentially promising antibiotics are being studied for use.

Project E.S. 35. A Growth-Quality Study of Western Redcedar.

The cooperative agreement for this study was concluded on May 6, 1962 between the University and the United States Forest Service. The first part of this study is being carried out by James R. Crooks, research fellow in forest genetics, under the direction of Dr. Wang and Professors Howe and Hofstrand.

The overall objective of this project is to study the growth-quality relations of western redcedar; specifically to: measure or evaluate trees in terms of physical, mechanical, and chemical properties as a function of site, location, or other natural growth condition differences; determine optimum physical, mechanical, or chemical wood properties of redcedar in relation to and use as lumber, timber, poles, or fiber.

In the first phase of this study, trees will be selected from appropriate drainages for sampling with a 10 m.m. increment borer. The extent of natural variation in the texture of the wood will be determined for these sites. Factors associated with this variation will be studied.

Project E.S. 36. The Effect of Mineral Nutrition on the Drought Resistance of Ponderosa Pine.

A greenhouse experiment was designed to measure the effect of varying mineral nutrition on the drought resistance of ponderosa pine seedlings. The specific nutrients studied were nitrogen, phosphorus and potassium.

Seedlings were grown in the greenhouse in two-quart pots of clean silica sand, and were supplied with an artificial nutrient solution. Fifteen different combinations of the three nutrients were used. The treatments and the approximate parts per million of the elements are given in Table 1.

Table 1. Approximate concentration of nitrogen, phosphorus and potassium in fifteen nutrient solutions used in the study of the drought resistance of ponderosa pine seedlings.

Treatment	ppm N	ppm P	ppm K
Control	200	150	150
High N	300	150	150
High P	200	250	150
High K	200	150	250
High N and P	300	250	150
High N and K	300	150	250
High P and K	200	250	250
High N, P, and K	300	250	250
Low N	100	150	150
Low P	200	50	150
Low K	200	150	50
Low N and P	100	50	150
Low N and K	100	150	50
Low P and K	200	50	50
Low N, P, and K	100	50	50

Drought resistance was measured by a modification of a method developed by Kaloyereas (1). In this method, the stability of the chlorophyll to heat is taken as an index of drought resistance.

Samples of the seedlings were taken for drought-resistance analysis when the seedlings were 13 and 28 weeks old. Although the data seems to indicate that the drought resistance of ponderosa pine seedlings is affected by nutrient level, the data has not been analyzed as yet, and no definite conclusions can be reached. Further greenhouse and field studies are planned.

(1). Kaloyereas, S. A. "A New Method of Determining Drought Resistance," Plant Physiology 33:232-233. 1958.

Project S.R. 11-C. Forest Tree Physiology.

Syntheses of ectotrophic mycorrhizae on western white pine were successfully made during the past year. In the past a great number of variables were introduced into flask synthesis work of white pine mycorrhizae. Previous research by other workers on conifer mycorrhizae, chiefly pines, has been very much restricted to young seedlings, usually under 3 months of age. This has also been our program up until last year and our results were never successful. When we switched to older seedlings, successful mycorrhizal syntheses were made for the first time. Now our principal effort may be changed from exploration in synthesis technique to comparisons of the various mycorrhizae, particularly in respect to host species adaption, habitat implications including genotypic and ecotypic variation.

The following Boletes formed ectotrophic mycorrhizae in flask culture:

With western white pine: M707 Suillus subluteus
M703 S. brevipes
M632 and M637 S. americanus
M638 S. granulatus
M707 plus M703 S. subluteus and S. brevipes

With western hemlock: M706 Xerocomus zelleri

Although it is not possible to say that seedling age alone was the variable which made synthesis possible, the fact remains that our first synthetic mycorrhizae were formed with older seedlings.

The technique employed was as follows: White pine seeds were surface sterilized, germinated on agar, and planted in Erlenmeyer flasks (500 ml.) in a medium of sterile 50:50 Vermiculite/Sponge-Rock or in 100 percent screened vermiculite to which Hacskaylo's nutrient solution plus Vitamin B_1 had been added and pH adjusted to 5.3-5.4. Boletes were cultured from sporocarp context material and grown on Hagem's agar plus B_1. One centimeter mats of mycelium (plus about 4 mm of agar) were placed next to the seedling on the vermiculite surface and firmed into place mat side up. Seedlings were grown on a 24 hour photoperiod both before and after inoculation, under daylight florescents at room temperatures. The white pine seedlings were about 22 months old when inoculated, and they were examined for mycorrhizae 6 months after inoculation. Each seedling was preserved in Sass' I and II killing/fixing solution 1:1.

The successful synthesis of western hemlock mycorrhizae was made on seedlings about 1 week old at inoculation and 6 months old at examination. Inoculation was made as the seedling germinated by placing the sterile seed on the mycelial mat on agar: about 1 week later, after the radicle had elongated through the mat and into the agar, a 1 cm. square was transferred to a flask prepared as outlined above. This immediate "take" with western hemlock illustrates the usual reported ease in securing mycorrhizal synthesis. It is also a great stimulus to examination of other species of conifers and other fungi in connection with mycorrhizal work.

The synthesized mycorrhizae were derived from Boletes strongly associated with their host species, with the single exception of S. brevipes. Field observations have shown S. granulatus, S. subluteus and S. americanus never to be found except when western white pine is within rooting distance. Similarly, Xerocomus zelleri is always associated with western hemlock. S. brevipes has been found in the northern Rockies, in association with ponderosa pine or, more commonly, with lodgepole pine. Western white pine is in a different section of the genus Pinus and it has radically different Bolete associates. Much has yet to be learned of the significance of fungus fruiting patterns and of in vivo mycorrhizal synthesis in relation to normal root function. It was interesting to find that the combination of S. subluteus and S. brevipes also formed mycorrhizae. This is the first reported instance

of combinations of known fungi being used in this fashion. Further work may be done in this direction, but final appraisal by microsection examination has not been made and so only one fungus may be involved in this synthesis.

This project is terminated under sponsorship of Special Research Funds. It will, however, be continued with some change in emphasis, under Experiment Station finances.

Project S.R. 54. Influence of Forest Site on the Wood Properties of Inland-Type Douglas-Fir.

Last summer nearly all of the field sampling for this project was completed. Laboratory analysis of these samples was continued with the primary objective of determining the effect of environment on density, proportion of springwood and summerwood, and growth.

Particular attention will be given to samples taken at the Priest River Experimental Forest. These are samples from trees that have been subjected to artificially induced drought conditions.

A progress report of this work was published last year as Station Research Note No. 17 entitled "Factors Affecting the Quality of Inland Douglas-Fir--a Preliminary Report."

Project S.R. 55. The Identification and Biology of the Insects Affecting Cones and Seeds of Commercial Forest Trees in Idaho.

A study, tentatively entitled "The Biology of Dioryctria abietella D. & S. and Eucosma recissoriana Hein. in Northern Idaho" was initiated June, 1961. Collections were made at points established at 22 locations throughout the range of western white pine in the state to determine distribution and abundance. Weekly examinations were conducted of cones collected from an infestation near Moscow to obtain field data on life cycles and seasonal damage. The life cycles of both cone moth species also were studied under laboratory conditions.

E. recissoriana was found to be far more abundant than D. abietella, the latter species comprising only slightly more than one percent of the larvae found in 1050 cones, or only 24 Dioryctria larvae to 2200 Eucosma. E. recissoriana had vacated the cones by August 1, but D. abietella was present in cones collected until late August. Both species were found at all collection points, although their abundance varied relative to each other.

Late fall-collected D. abietella larvae were placed in cages and reared to adults. Oviposition was indiscriminate on all available surfaces of rough texture. Egg hatch occurred in approximately one week and the larvae fed for about five weeks on fresh cone material. The pupal stage required two weeks. The entire cycle from egg to adult required approximately two months. Comparable information has not as yet been obtained under field conditions.

E. recissoriana adults were reared from larvae collected in the field throughout the summer. Diapause occurred in over 99 percent of the resulting pupae, which offers a probable explanation for the absence of this species in field collections after August 1.

Both D. abietella and E. recissoriana attack and damage the cones of white pine in much the same manner. The larvae enter the cone tissue at the juncture of adjacent cone scales and mine inward. Upon reaching the axis, feeding is indescriminant both in direction and cone portion. Increasing amounts of silk accumulate in the mines, and webbed frass becomes evident externally around the entrance hole, as larval development progresses. Under laboratory conditions, pupation occurred in soil and litter placed on the bottom of the rearing cages; however, pupae have not been found of either species in the field in any location. Parasites, predators and associated insects, collected from the rearing cages containing the cone moths, have been sent to specialists for positive determination.

Cone and seed losses attributable to these cone moths varied considerably and ranged from insignificant to total in a given location throughout the sample area--the extent of loss dependent upon insect population and cone production. Accurate damage evaluations will require more intensive sampling and statistical analysis.

Station Research Note #19 by Drs. Partridge and Schenk, entitled "Dieback of Ponderosa Pine in Northern Idaho" was published in 1961.

Project S.R. 63. Mass Production of Lodgepole and Jack Pine Hybrids.

Numerous inspection trips were made to the lodgepole seed production areas No. 1 and 2 near Spirit Lake, Idaho. It was observed that the 2000 plus hybrid cones were developing normally and without damage from outside elements. During the early summer protection bags were put over each of the cones to prevent injury and robbery from insects, squirrels and porcupines. Protection bands were also installed around the trunk of each mother tree as an added precaution to cone damage from rodents.

On May 31, 407 pollination bags were installed in seed production area No. 1, with an average of three lodgepole flowers per bag. The flowers were pollinated June 14th. The bags were removed July 13th and each hybrid conelet marked for positive identification and to facilitate collection in the fall of 1963.

All hybrid cones maturing September, 1962, will be collected along with an equal number of open pollinated cones. Inheritance of cone and seed characters will be studied and seed prepared for nursery planting spring of 1963.

Project S.R. 65. Fertilization of Forest Plantations and Natural Stands.

The effects of fertilization on planted western white pine and natur-

ally propagated grand fir growing under the canopy of an off-site ponderosa pine plantation have been under investigation since plots were established on the St. Joe National Forest in the spring of 1960. Marked uptake of nitrogen, particularly, resulting in greatly increased needle length and deep green color, was noted in both understory species after the first growing season. At the close of the second growing season after fertilization (fall, 1961), height growth measurements were made on all three tree species. Highly significant growth increases were found for treated white pine and grand fir, but response of ponderosa pine was slight. Compared with elongation prior to fertilization, increases averaged 286 percent for grand fir and 187 percent for white pine on plots receiving nitrogen, phosphorus and potassium. Trees fertilized with nitrogen alone also responded well, although growth increases were not quite as large.

Fertilizer influence on total tree height is already apparent. For example, after the 1961 growing season trees on grand fir control plots were 35 percent taller than in 1959. In contrast, a similar comparison shows that trees receiving complete fertilizer or nitrogen alone were 56 to 68 percent taller. Should fertilizer stimulation continue in future years, differences in height of control and treated trees will become more and more marked.

A naturally propagated 25-30 year old stand of white pine near the plantation, fertilized with nitrogen before the 1960 growing season, produced essentially the same response pattern as the planted stock.

New fertilization research plots were established on two areas in the College Forest during the spring of 1962. A 25-year old white pine plantation in the Meadow Creek unit served as one site. Plots 1/10 acre in size were treated with 300 pounds of nitrogen as ammonium sulfate, 150 pounds of potassium as muriate of potash, and 66 pounds/A phosphorus as treble super phosphate. Young naturally propagated grand fir growing on the Flat Creek unit of the forest were similarly treated. Studies on these new plots will include fertilization effects on seed production as well as on growth and wood quality.

Project S.R. 66. Effects of Tree Seedling Fertilization.

The use of fertilizer pellets in the planting hole does not seem to have significantly affected survival of tree seedlings planted in 1960 and 1961. During the spring of 1962, seedlings planted on certain survival plots were furnished with a granular type fertilizer, Golden Vigaro, rather than pellets. It was felt that under our climatic conditions the nutrients contained in this product may become more quickly available to the seedlings than those contained in the pellets. Test plots with pellets were installed in connection with a study of Scotch pine strains in an area on the Clearwater River near Orofino. These plots will be irrigated and in this circumstance, the pellets may dissolve sufficiently to supply nutrients to the seedlings effectively.

As of July 1, 1962, this project will be absorbed into S.R. 65, Ferti-

lization of Forest Plantations and Natural Stands, also concerned with fertilization potentials.

Project S.R. 70. Seedling Growth and Survival as Conditioned by Variation in Climate, Soil, Competing Vegetation, Site Preparation and Planting Stock.

During the year covered by this report, experiments with planted seedlings were conducted on four sites and a direct seeding investigation was initiated on two others. Studies on one of the sites (Athol) were carried through their second year, and the three other areas involving planted seedlings furnished information for the first year. The direct seeding experiments started after the 1961 growing season and thus results will be reported in the next fiscal year.

A. Abandoned farmland sites.

Comparisons tested this year utilizing 2-1 Douglas-fir seedlings included the following:

1. Fallow vs. no fallow the summer before planting.
2. Cultivation vs. no cultivation during growing season.
3. Irrigation several times during growing season vs. no irrigation.
4. Fertilization at time of planting vs. no fertilization.
5. Mulching vs. no mulching.
6. Evaporation retardant on foliage vs. no evaporation retardant.
7. Nine inch vs. 12 inch root systems at planting time.
8. Interactions of the above treatments.

The analysis of variance for each of the two sites utilized is presented below.

Athol

Source of Variation	df	ss	ms	F
Main plots:				
Fallow vs. no fallow	1	6,570	6,570	46.8**
Cult. vs. no cult.	1	87,583	87,583	624.3**
Cult., NC x Fallow, NF	1	6,560	6,560	46.8**
Main plot error (A)	12	1,684	140.3	
Sub plots:				
Treatments	4	8,354	2,088	9.05**
Treat. x Fallow, NF	4	1,018	254.5	1.10
Treat. x Cult., NC	4	5,954	1,488	6.45**
Treat. x Cult. x Fallow	4	1,862	465.5	2.02
Sub plot error (B)	48	10,073	230.7	
Total	79	130,658		

Orofino

Source of Variation	df	ss	ms	F
Main Plots:				
Fallow vs. no fallow	1	59	59	5.18*
Cult. vs. no cult.	1	177,075	177,075	15,533**
Cult., NC x Fallow, NF	1	9	9	0.79
Main plot error (A)	12	137	11.4	
Sub Plots:				
Treatments	5	218	43.6	
Treat. x Fallow, NF	5	58	11.6	
Treat. x Cult., NC	5	47	9.4	
Treat. x Cult. x Fallow	5	176	35.2	
Sub plot error (B)	60	3,456	57.6	
Total	95	181,235		

** Highly significant difference, exceeding the 1 percent point.

At Athol further analysis of the data revealed that significantly better survival occurred on the irrigated or mulched treatments than on those fertilized, treated with evaporation retardants, or the controls. Cultivated treatments, whether fallowed or non-fallowed, were significantly better than those fallowed only, and these in turn were more favorable for survival than those receiving neither cultivation or summer fallowing. In general, it can be said of these plots that even though other significant interactions took place, the overriding effect was that of cultivation for weed control. The average survival on all cultivated plots was 97.6 percent, that on non-cultivated plots, regardless of other superimposed treatment, was 31.4 percent.

At Orofino the dominant effect of cultivation was even more striking. All cultivated plots produced an average of 87 percent survival, the non-cultivated plots showed 1.1 percent survival at the end of the growing season. Length of root system had no apparent effect on survival. Although the statistical analysis indicates that fallowing significantly improved survival at Orofino, this is misleading as the actual difference between the two was only about 1.5 percent.

A significant interaction occurred at Athol where uncultivated, summer fallowed areas produced better survival than uncultivated non-summer fallowed plots. This interaction did not occur at Orofino where the soil produced a heavy weed growth even on the plots fallowed the summer before planting. At this latter site, weed competition with the tree seedlings was marked on all plots not cultivated during the growing season.

B. Forest land plantings

Comparisons on these plots, established near Spirit Lake and on the University Forest, included hand vs. machine planting, 2-0 stock vs. 2-1 stock, 9 inch roots vs. 12 inch roots, and use or non-use of a foliage evaporation retardant prior to planting.

Machine planting produced somewhat better results than did hand planting; little effect was noted from use of evaporation retardants. Nine inch root and 12 inch root comparisons indicate that no large differences in survival occurred as a result of this factor.

Trees on north facing slopes had a better moisture regime than those on south slopes, those in bottoms were situated better than those on ridges. It appears that survival on these areas is probably conditioned more by the topography than by individual treatments.

Project S.R. 80. The "Indian-Paint Fungus" in Idaho.

This project, under the direction of Dr. Partridge, was begun in July, 1961. The objectives are as follows:

1. To delimit the optimal, maximal, and minimal requirements of the "Indian-paint fungus" (Echinodontium tinctorium), and relate these to the destruction of standing timber in Idaho.

2. To interrelate site-associated factors with the occurrence and destructivity of E. tinctorium.

3. To find possible means for controlling wood-decay losses caused by E. tinctorium.

The fungus is grown on artificial media under controlled temperature, light, moisture, nutrient and pH levels. Limiting and optimal levels of these factors are ascertained and the findings are applied to field studies. Concurrent studies of variants are also pursued.

Naturally infested and artificially infested wood is tested for pulping and strength qualities to provide information concerning the utilization of invaded wood.

Conditionally randomized plots are established as temporary entities throughout the ranges of susceptible species in Idaho. Physical, ecological, and individual tree characteristics are measured on each plot along with external and internal evidences of decay. All such data are recorded on punch cards and interpretations regarding interrelationships, distributions, cull, loss forecasts and potential controls are made directly from the cards.

Results obtained to date indicate 25 degrees centigrade is optimal for growth of the fungus in culture although 10 degrees centigrade to 30

degrees centigrade are tolerated. At 26.5 degrees centigrade growth is markedly curtailed. Carbon dioxide up to 75 percent and oil immersion do not noticeably affect growth. None of 30 carbon sources is significantly better than others for growth. Carbon/nitrogen ratios are apparently important growth factors. Decay has proceeded at less than 8 cubic inches of grand fir wood in two years. Abortive sporophores form on wood in 2.5 years.

A marked decrease in pulp yield has been discovered in laboratory tests of partly and wholly decayed wood.

Static bending tests of sound and decayed grand fir are reported in Ralph B. Maloney's thesis (spring, 1962). The modulus of elasticity, modulus of rupture, and work to proportional limit decrease significantly in incipiently decayed wood. In advance-decayed wood these values are often immeasureably small.

Fifteen hundred trees on 182 townships have been examined and measured. Ninety of these were completely dissected. A direct correlation between rapid growth and freedom from decay is indicated, although other factors, e.g. slope, aspect, tree age, soil type, etc., are not obviously related to decay or its absence. Cull, indicated by increment borings and dissections, is more extensive in trees and stands than previously estimated. Individual rot columns more than 60 feet long are common. External indicators, e.g. conks, branch stubs, and knots, are not good indicators of heartrot in individuals or stands, although conks may show that the fungus is present in the latter. Site and external indicators probably will have to be used simultaneously in cull prediction.

II. Range Management

Project E.S. 7. Evaluation of Salt-Desert Ranges.
Project E.S. 15. The Ecology and Control of Halogeton.

The year 1961 was the fourth in a sequence of drier than normal years. In general, the communities of salt-desert ranges suffered from lack of moisture and higher than normal temperatures during June, July and August. Poor growth, minimum seed production and a decline in number of perennial plants occurred during the year.

The Meadow Creek exclosure, which was constructed in 1951 on a depleted saltsage area was remapped in 1961. The original count of perennial plants in 1952 and the count obtained in 1961 are shown in Table 1.

Table 1. Number of plants found on 100,000 square feet of the Meadow Creek exclosure in 1952 and 1961.

Species	Number of Plants		Number of time the 1961 count increased over the 1952 count
	1952	1961	
Saltsage	43	297	6.9
Sagebrush	11	296	26.9
Greasewood	4	85	21.2
Squirreltail	8	199	24.9
Indian ricegrass	1	79	79.0
Total	67	956	14.3

Protection from grazing by livestock and rabbits has caused a material increase in the number of perennial plants over a nine-year period. The exclosure was also mapped in 1955, 1956, 1958 and 1959. The largest increase of Indian ricegrass occurred in 1959 at which time 53 new plants were recorded. The main increase in saltsage occurred between 1952 and 1955 although a general increase has been noted in each year of mapping. Squirreltail showed greatest increases at the time of the 1958 and 1959 mapping. Sagebrush showed the largest count in 1955 and has generally declined since that time except for one section of the exclosure where a substantial increase was recorded in 1959.

Five plants each of six salt-desert species were marked in 1958 to follow yearly growth development. Table 2 shows the maximum average yearly height attained by each species for four years. Individual plants with the half-shrub growth habit (kochia, saltsage, winterfat) showed a tendency to gain in stature through 1959 and then generally declined in height through 1961. Shadscale (a true shrub) increased in size each of the four years as would be expected. Indian ricegrass reacted the same as the half-shrubs but squirreltail tended to increase in size in each succeeding year.

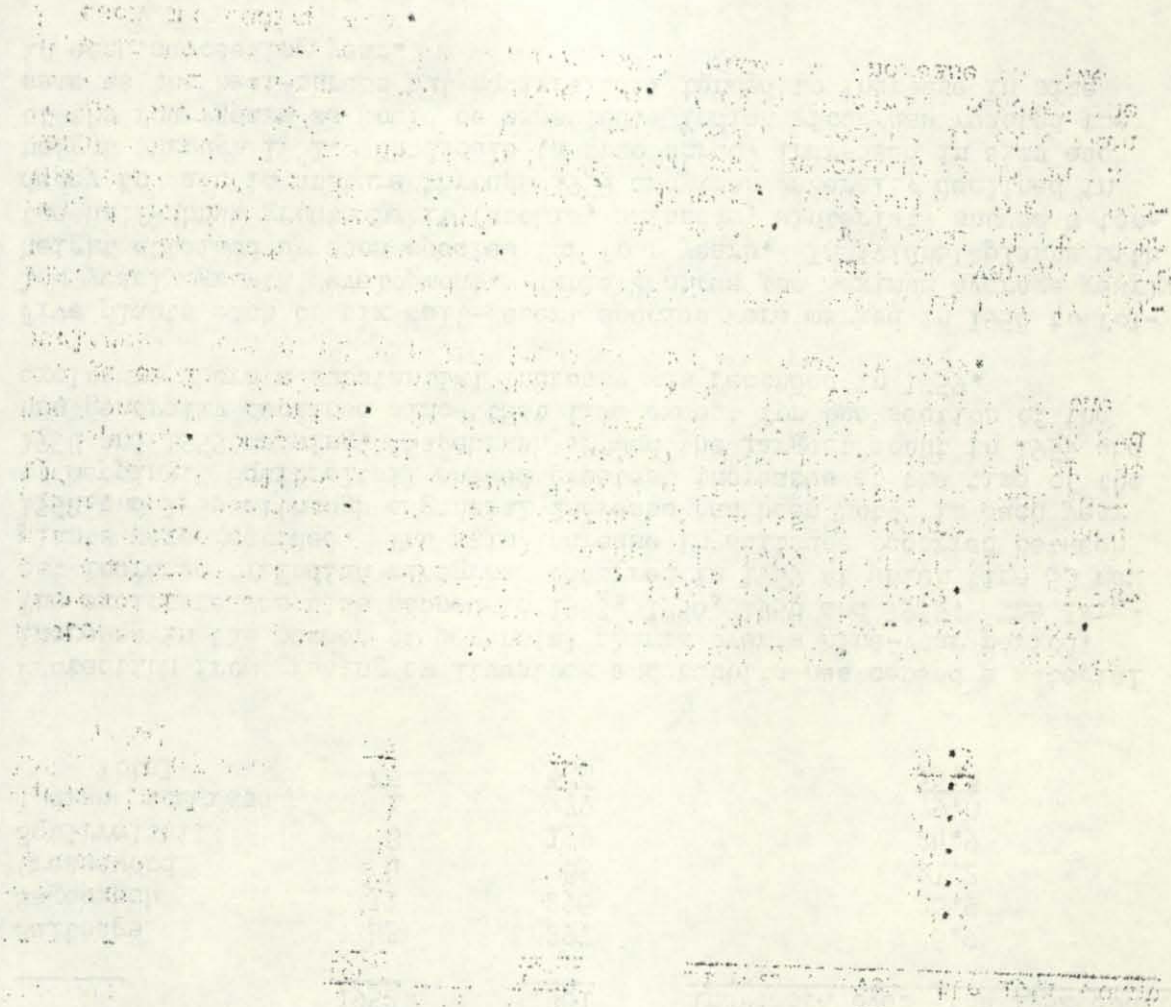


Table 2. Average maximum height growth in inches for five plants of each of three half-shrubs, one shrub and two grasses for the four years 1958-1961.

Date of Measurement	Salt-sage	Winter-fat	Kochia	Shad-scale	Indian rice-grass	Squirrel-tail
9/9/58	10.0	7.2	4.2	5.4	12.6	3.6
9/7/59	10.4	---	5.2	6.0	18.2	4.0
8/17/60	9.1	7.8	4.5	5.9	16.6	4.2
9/9/61	5.7	6.8	2.2	6.0	14.5	5.3

A study involving the transplanting of four salt-desert shrub species (shadscale, saltsage, winterfat, kochia) to other habitats was started in 1958 and continued in 1959. Late winter transplanting proved to be more successful for all species than did fall transplanting. With one-half of the fall transplants of each species, a gallon of water was placed in the hole before transplanting while the remaining one-half were not watered. Watering at this time proved to be beneficial for transplanting.

Saltsage and winterfat were successfully transplanted, as judged by their presence in 1961, to shadscale and greasewood-kochia habitat types. Shadscale survived in greasewood-kochia, saltsage and winterfat habitat types. Kochia was transplanted in shadscale and saltsage habitat types but was successfully established in the shadscale habitat type.

Rabbits were abundant during the period that the transplants were made and are thought to be largely responsible for the poor success obtained with saltsage in the winterfat habitat type and the kochia in the saltsage habitat type.

Halogeton seed buried for a period of eight years in the Raft River Valley was germinated in the laboratory during the winter of 1961. The black seed had completely broken down and no viable seeds were found. Slight observable deterioration of the brown seed had taken place during the eight years of burial; however, three of the approximately 800 seeds recovered germinated in the laboratory.

The life history investigations of saltsage (Atriplex nuttallii S. Wats.) were intensified in 1961. Emphasis has been placed on determining viability and germination characteristics of the species, using selected seed lots collected in 1960 and 1961. Forty-five lots of seed were collected in southern Idaho and received from contributors in other western states and Canadian provinces for this work. In addition, phenological development, seedling establishment and survival, and clipping studies have been initiated near Malta, Idaho.

Under favorable conditions saltsage is a prolific seeder. Evidence to date, however, indicates only moderate viability (generally less than 40 percent). A strong positive correlation exists between fruit size and seed viability, and it is possible through screening methods to

raise the viability of a seed lot 10-15 percent.

Efforts to determine the factors affecting saltsage viability have been made. Fertilization failure of the ovary accounted for more than 85 percent of non-viability in 5,631 utricles in 14 seed lots. Insect damage occurred in less than 14 percent. Factors affecting fertilization are currently being investigated.

At least two types of dormancy are involved in saltsage germination. Acid scarification and leaching of the fruits (utricles) with distilled water have both proved effective in increasing germination. A second type of dormancy is inherent in the seed itself and has been partially overcome through stratification and plant hormones. Considerable variation in dormancy characteristics exists between seed lots which is believed to be largely due to ecotypic and age differences.

The subscpeies of saltsage occur in the Raft River Valley. Subspecies gardneri is found generally on the river terraces, while ssp. falcata occurs principally on the alluvial fans near the base of the sagebrush zone.

Salt-desert soils as germination media have been found to be superior in respect to mold control than the conventional blotter methods. Four factors affecting saltsage germination were compared in the preliminary testing of the soil media method; viz., 2 subspecies, 7 soil types, soil leaching, and soil moisture level. Leached soils were saturated with distilled water, and $\frac{1}{4}$ to $\frac{1}{2}$ inch of water was allowed to drain through them. Soil moisture levels were closely controlled at 35, 40 and 45 percent. The seed lots used were stratified in a refrigerator for one month before testing. The results, given in percent germination of total (both viable and non-viable seeds) are presented below:

	Ssp. falcata						Spp. gardneri					
	Leached			Unleached			Leached			Unleached		
Moisture Level	35	40	45	35	40	45	35	40	45	35	40	45
Soil Source:												
Sagebrush	21	6	5	31	16	20	6	3	2	12	7	2
Winterfat	14	20	12	27	16	4	4	1	0	6	1	0
Saltsage	15	12	1	20	20	2	3	2	4	0	1	0
Bottomland greasewood	9	1	1	23	3	0	2	0	0	2	3	0
Kochia	10	1	1	21	8	1	0	0	0	1	0	0
Shadscale	11	4	1	14	0	0	0	0	2	2	0	0
Upland greasewood	1	1	1	2	0	0	0	0	0	0	0	0

Analysis of Variance

Source of Variation	df	M.S.
soil source (So)	6	161.71**
leaching (L)	1	92.19**
subspecies (Su)	1	1,144.05**
soil moisture (Sm)	2	362.22**
SoL	6	22.97*
SoSu	6	58.38**
SoSm	12	19.21
LSu	1	61.71*
LSm	2	39.66*
SuSm	2	184.80**
SoLSu	6	11.22
SoLSm	12	5.72
SoSuSm	12	17.76
LSuSm	2	16.75
Error	12	7.62

* Significant at the 5 percent probability level.
** Significant at the 1 percent probability level.

Soil source, subspecies, and soil moisture were significant, as expected. Leaching caused a breakdown in soil structure, reducing aeration and germination. Interactions between subspecies and soil source, leaching and soil moisture strongly indicate physiological, as well as morphological, differences in the subspecies. Germination rates of ssp. gardneri were not as severely affected by excess soil moisture and reduced aeration. Additional experimentation will be conducted along these lines with greater representation of these subspecies and their suspected ecotypes.

Project E.S. 8 (S.R. 27-D). Ecology and Control of Medusahead.

Due to lack of a graduate student on this project from September 1961 through June, 1962, the volume of work on this project was much reduced. The principal accomplishment for the year included sampling of a new study area on range infested with medusahead, establishment and initial sampling of a medusahead/cheatgrass competition study, and recovery and germination of the first year samples from a long-term seed burial study.

The new study area is a 9-acre area fenced to exclude livestock and located in Gem County about 20 miles northwest of Emmett, Idaho. The area was selected primarily because it contained a small remnant population of perennial grasses and forbs in a vegetation dominated by medusahead. The current plant cover is typical of large areas in southwestern Idaho. The main use for this exclosure will be to study the changes in plant cover which occur when the factor of grazing by livestock is removed. It will also be used for various other studies of the life history and competitive relationships of medusahead and associated species.

The area within the exclosure is varied in both topography and vegetation. Ten vegetation subtypes were recognized for sampling and 336 permanent plots established for this purpose. The basic plot size is 1.1 by 0.5 meters. Basal area and density of all perennials were obtained on this major plot and density of all species in 1/25 and $1/100^2$ subplots was recorded also. The initial sampling showed Sitanion hystrix to be the principal perennial, with an average basal area of 1.02 percent, while Agropyron spicatum ranked next with 0.54 percent followed by Poa secunda with 0.37 percent.

This nucleus of perennial grasses is both small and highly variable in distribution. Sitanion basal area, for example, varied from 0 to 3.73 percent among the subtypes. Sampling by subtypes should aid in following changes in this sparse population.

A field study of competition between medusahead and cheatgrass was set up with artificially seeded populations. A series of 4 x 5 foot plots were kept fallow during the summer of 1961 and then seeded in different groups--one with medusahead only, one with cheatgrass, and the third with 50-50 mixture of these two species. In each case, the seeding rate was 3000 seeds per plot.

Sampling in 1962 revealed the following population densities:

Pure cheatgrass - 20.4 plants per square foot
Pure medusahead - 23.3 plants per square foot
Mixture - 19 plants per square foot
(cheatgrass 9.2 and medusahead 9.8)

These low densities were attributed to the lack of litter and amount of frost heaving on the fallow plots. Most individuals produced several culms and a good seed crop resulted. The plots will be resampled next year to follow changes in the population density when an ample seed source of both species is available.

Longevity of medusahead seed buried in the soil is under study at two locations in Gem County, southwestern Idaho. At each site, quadruplicate samples of 100 seeds each were buried at depths of $\frac{1}{2}$, $1\frac{1}{2}$, 3 and 6 inches respectively below the ground surface.

The first series of these samples was recovered in October, 1961 and the germination was tested in Petri dishes at normal room temperature. The results of these tests showed some germination from seed recovered from each of the 4 depths at each site. The germination for the two sites averaged 8.4, 11.1, 12.3 and 3.4 percent for the $\frac{1}{2}$, $1\frac{1}{2}$, 3 and 6-inch depths respectively.

Informal coordination of research on medusahead was continued by direct contacts with the other workers involved. A two-day work conference held at Davis, California in March was attended by Mr. Hironaka as the University of Idaho representative.

Project E.S. 9 (R-287). Ecology of Sagebrush-Grass Ranges.

Fourteen new sites were sampled, bringing to 97 the total studied to date. Most of these represent major types of sagebrush-grass vegetation relatively free from disturbance by heavy grazing or other factors. The 1962 sampling was designed primarily to fill in gaps in existing data on sagebrush range types in the drier portions of the region. Included were 3 kipukas, areas protected from livestock grazing by relatively recent lava flows. One of these areas, located near Carey, Idaho, is of particular importance due to its isolation and size (180 acres). Intensive sampling was done on this area to determine the modifications produced in vegetation and soils by local differences in relief and parent material.

A start was made at the second phase of this project, dealing with the nature and causes of change in the sagebrush-grass communities of the state. Modifications of the basic sampling methods for vegetation were made to fit the objectives of this phase of the study, and these were given preliminary field tests. Modifications in the soil sampling procedures are also under test. The overall objective is to modify the basic methods to the minimum extent necessary to cope with such special features of disturbed sites as sparseness of herbaceous perennials, abundance of annuals and soil surface disturbance. The data obtained will be kept as comparable as possible to those taken on undisturbed sites.

A special study of the relation of environmental factors to the distribution and abundance of major species in the sagebrush-grass region of Idaho was continued by Mr. Hironaka. This work is now near completion and the results will be submitted as a doctoral thesis at the University of Wisconsin. A feature of this work during 1962 was the use of discriminant analysis to determine the relative effect of the environmental factors controlling distribution and dominance of two species of sagebrush, Artemisia tridentata and A. arbuscula, and one grass, Festuca idahoensis.

Annual yield studies were continued on two representative areas of sagebrush-grass vegetation. Data obtained from the drier of the two sites during the past four years indicate the productivity from a typical site in the Artemisia tridentata/Agropyron spicatum/ Poa secunda type occurring on soils in the Sierozem group in an area with average annual precipitation of approximately 9 inches.

Table 1. Air-dry yields in pounds per acre from the Jordan Valley study area, 1959-1962.

Species	1959	1960	1961	1962	Average
Agropyron spicatum	193	388	360	416	339
Sitanion hystrix	12	7	13	9	10
Poa secunda	5	46	32	81	41
Bromus tectorum	22	83	38	38	45
Total	232	524	443	554	435

The variations in total annual production show the influence of an especially dry year (1959), also marked fluctuation in yields of the annual Bromus tectorum, and even greater variability for Poa secunda, an early-developing, dwarf perennial.

The second clipping site is located in the Artemisia tridentata/Agropyron/Festuca type in the Chernozem soils group with an annual precipitation of about 15 inches. Results have been affected by the effects of wild fire which swept the area in 1960. Average total production for 1959, 1960 and 1962 was 1,997 pounds per acre, with forbs contributing about 900 pounds of this amount.

All treatments of the sagebrush thinning study begun in 1960 were resampled to determine basal area and plant density (numbers per unit area) and frequency. The distance measure method previously used for this purpose was dropped because of the excessive time required to reach a reasonable level of accuracy. The new sampling method involves a set of 32 permanent plots, each 1 x 0.5 meters in size, randomly located along 4 transects in each treatment. This type of sampling appears to provide the intensity needed to measure change in the vegetation and is fairly rapid.

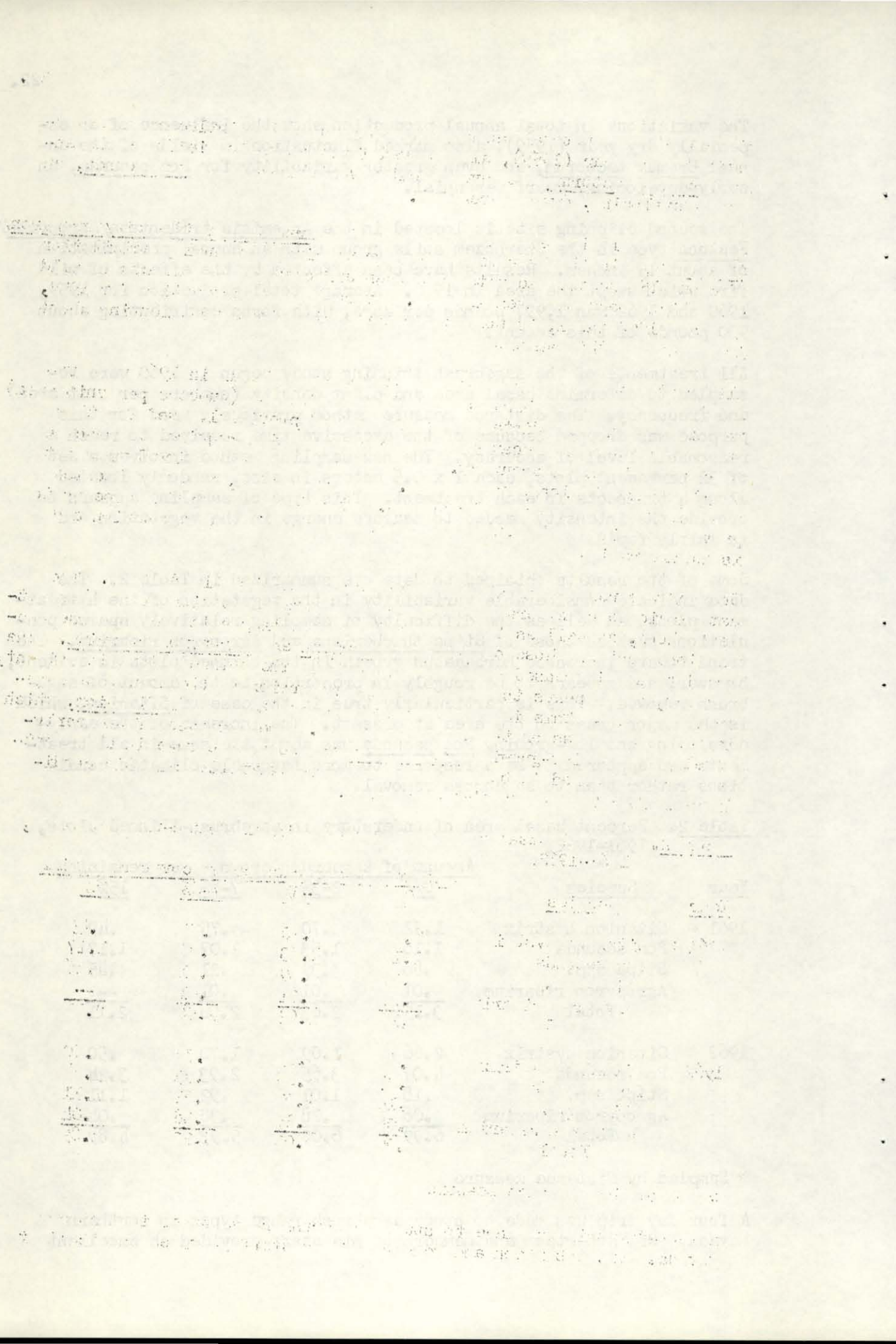
Some of the results obtained to date are summarized in Table 2. The data indicate considerable variability in the vegetation of the 4 treatment plots, as well as the difficulty of sampling relatively sparse populations such as those of Stipa thurberiana and Agropyron riparium. The trend toward increased herbaceous growth in the thinned plots is evident, however, and appears to be roughly in proportion to the amount of sagebrush removed. This is particularly true in the case of Sitanion, which is the major grass on the area at present. The increase of the early-developing and low-growing Poa secunda was about the same in all treatments and appeared to be a response to more favorable climatic conditions rather than to sagebrush removal.

Table 2. Percent basal area of understory in sagebrush-thinned plots, 1961-1962.

Year	Species	Amount of sagebrush crown cover remaining 0%	2-3%	7-8%	15%
1961 *	Sitanion hystrix	1.52	.70	.75	.49
	Poa secunda	1.16	1.53	1.07	1.17
	Stipa spp.	.46	.39	.21	.45
	Agropyron riparium	.01	.01	.01	--
	Total	3.15	2.63	2.04	2.11
1962	Sitanion hystrix	2.66	1.09	1.70	.50
	Poa secunda	4.07	3.65	2.93	3.24
	Stipa spp.	.18	1.01	.92	1.11
	Agropyron riparium	.08	.28	.38	.04
	Total	6.99	6.03	5.93	4.89

* Sampled by distance measure

A four-day trip was made to study sagebrush range types in northern Nevada. Dr. Robertson and members of his staff provided an excellent



review of this area for the group which included representatives from Oregon, Washington and Idaho.

The areas visited showed close relationships with sagebrush vegetation in much of the tri-state area, and particularly to types in southern Idaho. Apparent differences included the relative status of Agropyron spicatum and Stipa thurberiana in the drier areas and that of Elymus cinereus (giant wildrye) in more mesic situations. The latter species appears to have been a major constituent of sagebrush-grass vegetation in many areas. An overall feature of the area seen in Nevada was the scarcity of sites with relatively undisturbed vegetation.

This trip was in line with the policy of the tri-state group, which is to meet annually, in the field, to further the progress of research on sagebrush-grass ranges. Trips have now been made to Montana, Nevada and Utah as well as to the three states concerned.

Project E.S. 13. Ecotypic Variation in Idaho Range Species.

Field notes were continued on the Moscow nursery material only. Vouchers were taken of 5 plants each from each of the 4 lots of Festuca scabrella which were missed in the 1961 voucher collections.

A few observations were made on the distribution of F. idahoensis, F. scabrella and F. occidentalis in northern Idaho and in the south Okanagon and Similkameen areas of British Columbia. The collections of F. idahoensis and F. occidentalis in the herbarium of the University of British Columbia were examined briefly, and a few critical specimens obtained on loan.

Detailed measurements were made on morphological characters of vouchers from the original field collections and from material of the same lots grown in the Moscow and Stanford nurseries. The materials studied in this manner included 7 lots of F. idahoensis, 1 lot of F. occidentalis and one (U. I. No. 12) currently referred to F. rubra. Characters studied included length of panicle, length of the first panicle branch, length of spikelet, and of first and second empty glumes and of the lemma, also length of awns. Other characters recorded included the percentage of viviparous spikelets.

The data from this study are now being analyzed in preparation for publication.

A paper entitled "The Ecotype Concept in Range Management" by E. W. Tisdale was prepared for and published in the Scottish Plant Breeding Station Record for 1962. This paper was based in part on research done on this Festuca project.

Project E.S. 14. Investigations of Harvester Ants on Southern Idaho Rangelands.

The size and number of harvester ant clearings on southern Idaho range lands remained about the same as in the previous year. The average per

acre values obtained at three locations are given below:

	1960			1961		
		Area Cleared per Acre			Area Cleared per Acre	
	Number	Sq. Ft.	Percent	Number	Sq. Ft.	Percent
Good Condition						
SALTSAGE	9.3	1465.3	3.36	9.0	1468.6	3.37
Depleted						
SALTSAGE	47.3	3830.3	8.79	47.3	3394.4	7.79
SHADSCALE	14.3	--	--	14.3	--	--

Although the average size and number of clearings remained approximately the same in the depleted saltsage, fourteen of the 1960 clearings were abandoned and fourteen new colonies were established.

Project E.S. 26. Evaluation of Range Reseeding.

Continued dry conditions prevailed during the spring of the seventh year of the crested wheatgrass grazing studies at the Point Springs experimental area near Malta, Idaho. Precipitation during May of this year was 0.51 inches as measured at the study site.

The weather conditions for the fall period, however, were more favorable for plant growth than in any of the seven years of the trials. Precipitation during the period from August 1st to November 1st was 5.18 inches with 2.07 falling in August, 1.66 in September and 1.45 in October.

Spring Trials

Forage production and utilization for each spring use pasture is shown in Table 1. In all but the heavy used spring pasture, utilization values were greater than desired. The small amount of growth from the beginning to the end of the trial is largely responsible for the excess use. Some reduction in animal numbers was made at the time of the intermediate weighing but this was not sufficiently large to prevent the higher than desired utilization levels.

Table 1. Air dry forage production and utilization for the spring grazing trials of 1961.

Pasture	Intensity of Use	Initial Production lbs./acre	Initial Produc. Plus Growth lbs./acre	Utilization Percent
02	Light	242	384	79
05	Moderate	110	275	72
03	Heavy	104	248	87
10	Moderate	172	349	79
20	Light	185	328	73
30	Moderate	114	265	69
40	Light	91	225	79
50	Moderate	112	253	81
60	Light	77	216	68

The animal gains by pasture obtained in 1961 are shown in Table 2. Gains for the first 28 days of the spring trial averaged in excess of two pounds per day per animal. The light use pasture was the only one maintaining animal gains above two pounds a day during the last sixteen days of the trial and animals in the heavy use pasture lost weight during this period.

Table 2. Average livestock weights and gains by pasture and season during 1961.

Past. No.	Season	Intensity	Initial Weight	Total Gain/ Animal	Daily Gain/ Animal	Gain/ Acre	Acres/ Animal Month
02	Spring	Light	521	107	2.4	40.1	1.8
05	Spring	Moderate	520	99	2.2	26.4	2.5
03	Spring	Heavy	501	70	1.6	29.0	1.6
01	Fall	Light	617	54	1.2	12.4	2.9
06	Fall	Moderate	638	36	0.8	8.0	3.0
04	Fall	Heavy	603	25	0.6	7.7	1.9
10	Spring	Moderate	518	95	2.2	37.0	1.8
	Fall	Heavy	512	54*	1.9*	5.4	10.7
				149		42.4	1.5
20	Spring	Light	541	102	2.3	31.9	2.2
	Fall	Light	526	41*	1.4*	4.6	9.5
				143		36.5	1.8
30	Spring	Moderate	551	82	1.8	24.4	2.4
	Fall	Moderate	---	--	---	----	---
40	Spring	Light	530	91	2.1	23.6	2.9
	Fall	Heavy	647	26*	0.9*	1.6	17.0
				117		25.2	2.1
50	Spring	Moderate	528	100	2.3	27.4	2.5
	Fall	Light	---	---	---	----	---
60	Spring	Light	527	95	2.2	19.6	3.2
	Fall	Moderate	---	---	---	----	---

* These gains are for a 28 day period after which time the animals were removed.

Fall Trials

Production and utilization for the fall use pastures are given in Table 3. Substantial green growth developed during August and September and this persisted through the time of the grazing trial.

Livestock gains made during the fall period were more than in any previous year (Table 2). These gains were primarily a result of the extra green growth that developed during this fall period.

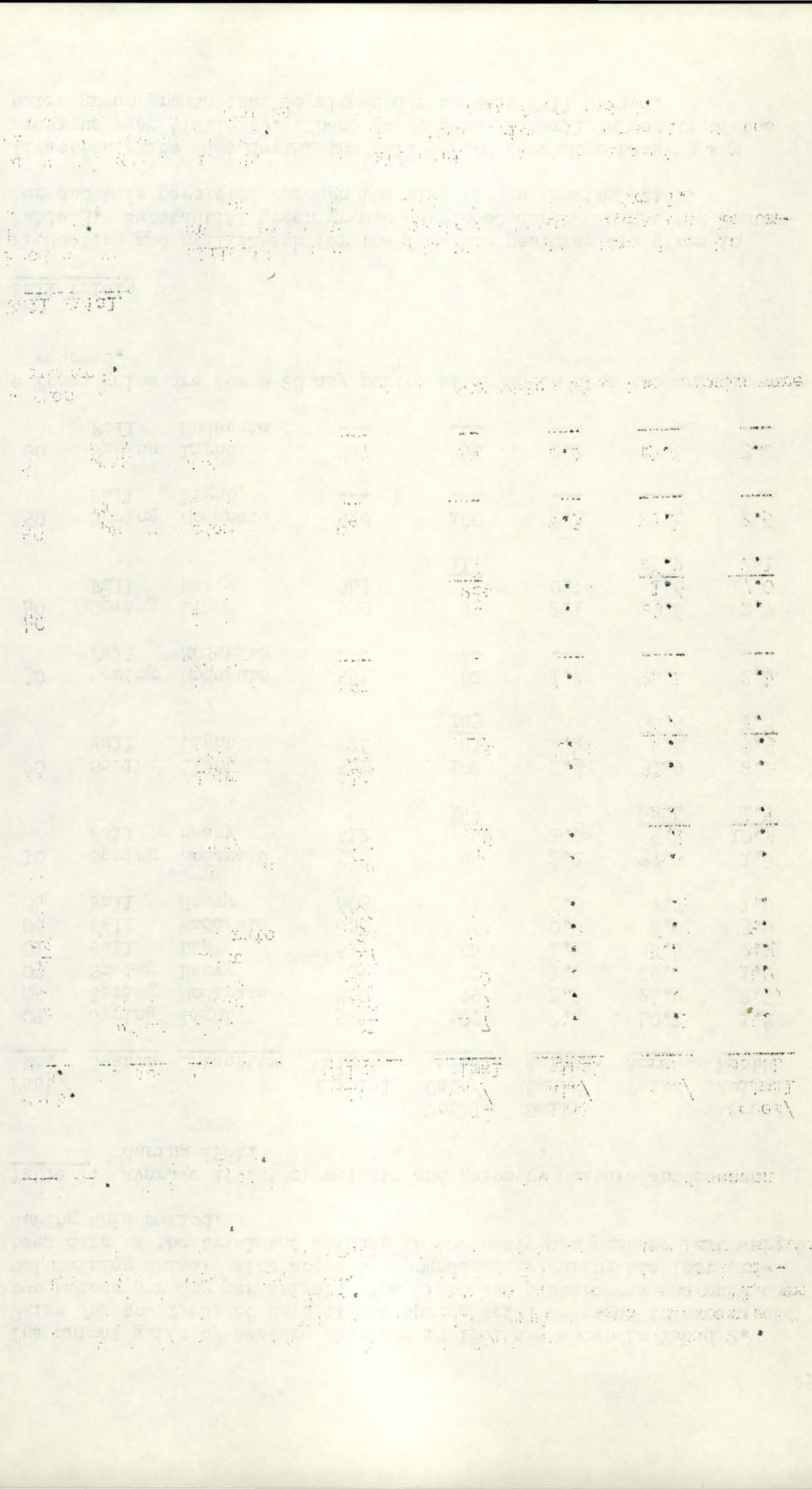


Table 3. Air dry forage production and utilization for the fall grazing trials of 1961.

Pasture	Intensity of Use	Initial Production 1/	Utilization Percent
01	Light	412	52
06	Moderate	240	43
04	Heavy	311	87
10	Heavy	100	47
20	Light	125	42
40	Heavy	82	29

1/ These values include the additional green growth that developed during August and September.

Project E.S. 32. Ecology and Control of Goatweed (Hypericum perforatum).

Work was confined to re-sampling 5 sites on which the effect of Chrysolina beetles on Hypericum stands has been studied for the past 9 to 10 years. General observations were made on several other sites.

The data for sites in the Clearwater River drainage showed a considerable reduction from the moderate upsurge recorded in 1959 and 1960. Counts on mature plants (1 year or older) indicated that none of the fair-sized seedling crop observed at 2 sites in 1961 had survived.

The infestation of medusahead (Elymus caput-medusae) on all 4 sites in the Clearwater continued to increase, and this species now dominates on 2 of the study areas.

As in previous years, the population of Hypericum remained at a higher level in that portion of the state north of Coeur d'Alene. The one site (Kaniksu) studied in detail showed a reduction in numbers of Hypericum plants since the plots were last sampled in 1958, but a thin stand of mature plants and seedlings was found. Vigor of the mature plants appeared low, with no culms present by the end of June. A moderate population of Chrysolina beetles was observed throughout the Hypericum patches in this region.

Project E.S. 34. Ecology of the Grasslands of Northern Idaho.

This project is under the leadership of E. W. Tisdale. A graduate student, John Campbell, was assigned to the study for the 1961-1962 fiscal year.

Preliminary observations were begun as early as 1950, but the project was not set up formally until April, 1961.

Objectives:

1. To determine the nature and productivity of the grassland ecosystems existing prior to disturbance by white settlement with par-

ticular emphasis on the effects of slope and exposure.

2. To determine the effects of disturbance due to grazing, fire or other cause on these grassland ecosystems.

Procedures:

The first phase of the project involves reconnaissance of the grassland area, with location of relict areas for detailed study. The vegetation of representative, relatively undisturbed areas is sampled to determine species composition, foliage cover and/or basal area, frequency and herbage production on permanently marked sites. Soil studies include profile description and classification as well as analysis for bulk density, texture, pH, nitrogen, C/N ratio and other physical and chemical characteristics.

During the past year detailed study was confined to a limited area in Nez Perce and Idaho Counties, Idaho and adjacent portions of Whitman and Asotin Counties, Washington. Due to scarcity of relict areas at lower elevations, the study was conducted on the upper valley slopes only, and was confined to an area in which the parent material is basalt overlain with loess.

The results of this study are presented in a thesis submitted by John Campbell. Briefly, the area was found to support two major climax plant communities, designated as the Festuca/Agropyron and Festuca/Koeleria associations. Both are characterized by dominance of Festuca idahoensis and Agropyron spicatum, by the rhizomatic habit of the Agropyron, common occurrence of perennial forbs, and lack of the semi-desert shrubs associated with drier grasslands of the region. Differences between the two communities involve both soil and vegetational characteristics. The Festuca/Agropyron association occurs on Chernozem soils showing a strong influence of loess in the upper horizons and possessing a definite layer of lime accumulation. The vegetation is characterized by strong dominance of grasses, absence or sparse occurrence of Koeleria cristata, a total perennial forb cover of about 9 percent, and a well-developed cryptogam cover of 31 percent. The soil of the Festuca/Koeleria association belongs in the Prairie group. It shows little influence of loess, and has no layer of lime accumulation. The vegetation is less strongly grass-dominated; Koeleria is the third ranking grass with 100 percent presence, the perennial forb cover averages 15 percent, and the cryptogam cover averages only 7 percent.

Further studies of this type are needed to determine the extent to which these two ecosystems are represented on soils of different parent material, and to describe the vegetation of the drier portions of the region.

III. Wildlife and Fisheries Management

Project W.U. 18. Productivity of Ruffed Grouse in Northern Idaho.

This project has been inactive except for continued effort to recover banded grouse from the Flat Creek population. One banded grouse was recovered from the 1960 banding work.

Further grouse banding was done during a short period of fall trapping in the spring on drumming logs. Only three grouse were banded and marked during the year. This data will be added to that already accumulated to better understand grouse movements and cover use in forest areas.

Project W.U. 23b. Census, Habitat Use, and Productivity of White-Tailed Deer in the Hatter Creek Enclosure.

Field work on this project was completed in July and a thesis written by Mr. Shaw was accepted in September. Objectives of this study have been to investigate the intensity and the form of habitat use by white-tailed deer in six major cover types in the Hatter Creek enclosure and to relate the effects of climatic factors and food availability to movements of white-tailed deer. Both objectives have been pursued with the object of relating deer management to forest land management. All cover types available at Hatter Creek are various stages of a forest succession and represent natural clearings, clear-cut blocks, mature forest, and the edges between. The pellet-group count technique was used to evaluate the relative use by deer on twelve selected study sites. Since validity of this technique as an indicator of use is currently in doubt, conclusions reached in this study must remain tentative until further information on deer defecation behavior becomes available.

The detailed study sites represented the shrub stage, the intolerant tree stage and the mid-tolerant tree stages of the Thuya plicata/Pachistima myrsinites and the Pseudotsuga menziesii/Physocarpus malvaceus habitat types. Each site was characterized by measurement of aerial frequency of important browse and tree species and a measurement of the concealment value of plant cover. Concealment value was measured through a modification of the coverboard technique.

Distribution of pellet-groups during the periods covered in the study was tested for statistical relationship to the distribution of red stem ceanothus, willow, snowberry, ocean spray and total crown cover by use of contingency tables. They were also tested for relationship to the two associations studied and the seral stages of these associations. Deer were distributed in a constantly varying mosaic. Cover use changed in response to phenology and availability of food plants rather than climate during most of the year. Fall distribution was strongly correlated with available browse species such as red stem ceanothus. Use was high in the shrub stages of both habitat types. As the animals used available browse in the stands of shrubs, and as

snow began to accumulate in the open areas, the deer moved to open stands of timber. Only when snow accumulated to depths greater than 18 inches did the animals seek cover of dense conifer stands. At such times, the stands of mid-tolerant trees in the Pseudotsuga/Physocarpus association near the north end of the enclosure held most of the deer population.

During the spring, animals dispersed widely as soon as green forbs and grasses became available. By mid-summer, they began to move to north and east facing slopes where green grasses and forbs had not yet begun to cure. By late August, the animals were again dispersed in relation to preferred browse species as they had been during the fall.

One of the most significant findings relates the cover use of deer to the relative snow accumulation in the forest habitat. A rapid shift was noted when heavy snows came, usually in late November. As snow depths reached approximately 18 inches, the animals concentrated in dense stands of Douglas-fir and lodgepole pine in the mid-tolerant tree stages of the Pseudotsuga/Physocarpus association. These concentrations continued through the periods of heavy snowfall in November and December and often dispersed rapidly when cold temperatures of January resulted in a snow crust.

At this time concealment value of the habitat apparently played a role in cover choice. As long as snow remained deep, at least 18 inches, the shrub stages of both associations were veritable snow fields. The shrubs were bent until cover was near zero. Even though considerable quantities of unused browse at the tops of the plants were made available at this time, deer did not move into the open areas. The combination of low cover and deep snow was apparently the worst possible condition for deer to avoid predators. Low temperatures did not appear to influence choice of cover types over extended periods. As long as the animals could move relatively easily over the snow in an area and as long as a degree of concealment and food were present, the cover type was used.

Most of the use on western red cedar occurred in late winter when the animals could find access to the creek bottom habitats. It should be noted that Hatter Creek itself is deficient in tree cover along the creek bottoms because of past logging practices. Since there are no dense timber stands where cedar might normally be available, this may be the major factor in the use picture on the western red cedar type.

Project W.U. 26. Salt in the Management of Elk in the Lower Selway River Area, Idaho County, Idaho.

The fourth and last of four master's theses on this project was submitted by Thomas R. Williams. It was entitled "The Significance of Salt and Natural Licks in Elk Management." A manuscript covering the 5 years of this project is being prepared.

The summary of the last phase of the study follows:

A pronounced appetite for salt by elk succeeded the advent of new vegetation and increased concurrently with its development to maturity in early summer. The affinity for salt was the greatest during May and June. Salt use during previous and subsequent seasons of the year was small.

The degree of use of artificial salt grounds depended upon the location in respect to desired vegetation, elevational location, number of migrant animals in the area, the existence of salt, and the amount of disturbance by livestock.

Strategically placed salt in areas commonly used by migrant and sedentary elk adjacent to natural licks gave favorable results the first year; the second year of salting was not conclusive.

Statistical analysis of the pellet-group data for April and May over a four-year period indicated that the major influence on elk behavior was weather and that differences between the unsalted and the salted areas were not significant. Movements were relatively the same for the two years that both areas were salted but differed among the drainages sampled by the pellet-group transects. It was common for elk to be at lower elevations in the eastern half of the study area than in the western half, irrespective of salt.

If salt is effective, the big difference in movement should show up after the first year of salting; such was not the case. Aerial survey showed the elk throughout the wilderness portion to be at approximately the same elevation during late March and early April both years the area was salted. Elk remained as high as weather permitted during late winter.

This study demonstrated that salting the various vegetative types equally did not induce elk to use them equally.

The attractant at natural licks is associated with the water issuing from the licks. Since about an equal number of well-used licks issue warm and cold waters, the physical characteristic of the water appeared to have no relationship to its use. In the chemical analysis of water and soil samples from nineteen natural licks sodium carried in the spring and seep waters seems to be the element attracting elk to these areas. The only element appearing in abnormal amounts in some of the licks was fluorine. It exceeded 6 ppm in five lick waters.

The social behavior of elk at natural licks was on the basis of a patriarchy. The patriarch or a larger and often an older bull was never belligerent at the lick except during the mating season. The harem bull at this season is extremely belligerent, even to chasing and goring large bull moose.

Project W.U. 28a. Influence of Logging on Trout Streams in Northern Idaho.

This study began in 1955 to determine the effect, if any, of specialized logging practices on stream environments and associated resident

trout populations. The research consists of three phases, namely a pre-logging, logging and post-logging phase. The project is now in the post-logging phase of development in one area and in the logging phase of operations in a second study area.

Physical, chemical and biological samples were taken during the summer of 1961 from each of the study areas. These samples were analyzed at the University laboratory and the findings tabulated.

Project W.U. 36b. Plant Succession and Utilization by Livestock and Big Game in a Sand Dune Area in Fremont County, Idaho.

Fall sheep use on bitterbrush over 11,000 acres of big game winter range averaged 14.1 percent where bitterbrush had an average density of 23 percent.

The following table shows the degree of use by 6 inch height classes of bitterbrush:

Height Class	% Total Use	% Total Sample
½'-1'	13.7	9.6
1'-1.5'	39.2	32.7
1.5'-2.0'	29.2	27.9
2.0'-2.5'	14.6	20.6
2.5'-3.0'	3.1	7.6
3.0'-3.5'	0.4	1.1
3.5'-4.0'	0.0	0.6

As availability of grasses and forbs decreased, bitterbrush use increased especially as snow became more than six inches deep. Sheep were removed when snow exceeded ten inches. The use of low growing chokecherry reproduction and rabbitbrush also increased noticeably after snow was six inches deep. The area sustained 130,000 sheep days of use during the three-month fall grazing period, and the southern end of the area received 6,000 cow days of use.

Big game use of bitterbrush over two feet in height varied from 83 percent to 25 percent with an average of 55.5 percent. This compares with 76.8 percent to 9.6 percent with an average of 34.2 percent for all heights.

Pellet group densites were determined for deer, elk and moose on nineteen utilization sample units with 132 to 144 plots per unit. Elk pellet group densities varied from 1 to 396 per acre with an average of 7.7 per acre. Field observations indicated that animals tended to deposit greater densities of pellets on and adjacent to their bed grounds. For this reason it is important to include in each pellet-group density sample both bedding and feeding grounds in approximately the proportions occurring on the range.

The main elk herd in and near the study area increased to over 580 animals by mid-January. Ninety-two moose were counted. Mule deer

were found in small groups of 5 to 30 animals but no total figure was obtained.

Bitterbrush was the principal food of all three of the big game species. Both elk and deer readily ate big sagebrush, rabbitbrush and chokecherry. Elk sought out and ate cured grasses wherever they were available.

Project W.U. 41. Productivity of Mule Deer on an Over-Used Low Grade Range.

Twenty deer live traps furnished by the Fish and Game Department were placed on the winter range. Success of winter trapping is dependent upon a normal or excess of snow. Neither condition occurred during the winter of 1961-1962 and only 16 deer were trapped, weighed and tagged with plastic streamers in each ear. By the end of June, four deer had been observed, one 38 airline-miles west of the study area, and 3 about 50 airline miles west of the tagging point. This is an exceptionally long spring migration movement in such rugged country. During the time deer occupy the winter range, the area of use by individual deer is small. The marked deer were rarely more than a quarter to half mile from the trapping site.

A fairly heavy infestation of internal parasites is evident. All 35 collected specimens had nose bots, slender-necked bladder worms. Ninety-two percent (32) had leg worms, 28 percent carried an additional species of bladder worm and 11 percent contained both lung worms and intestinal worms. Ticks were abundant on all specimens, three-fourths carried louse flies while lice were present on a fifth of the collected deer. The nose bots appear to bother the deer since they breathe through their mouths after only a small amount of exertion.

The number of embryos in the 35 collected does averaged 1.43 which is 6.5 percent lower than the Cassia mule deer herd on the Sawtooth National Forest.

Project W.U. 42. The Life History and Seasonal Movement of a Fluvial Cutthroat Trout in the Salmon River, Idaho.

Field work on this project was done in the summers of 1959 and 1960 as part of a larger Federal Aid in Fish Restoration project. Some of the data have been used for a Master's thesis, the rough draft of which now has been completed.

Project W.U. 43. A Limnological Survey of the Backwater of the Lower St. Joe River, Idaho.

This project has been finished except for publication in a journal, which is planned for the near future.

Project W.U. 44. Ecology of Mule Deer Winter Range, Middle Fork Salmon River, Idaho.

The lower 35 miles of the Middle Fork of the Salmon River accommodates a large winter herd of mule deer. Sample units of this winter range on Sheep, Brushy and Warm Springs Creeks were established for determination of plant density, soil movement and utilization of the key species. The continual over-utilization of bitterbrush has resulted in large stands in poor vigor with dead and decadent plants common. A square rod exclosure constructed in 1931 on Sheep Creek Ridge showed no seedlings of bitterbrush. Remeasurement in 1962 revealed no seedlings while the number of mature plants remained the same. Outside the exclosure there was likewise no seedlings either in 1931 or 1962. Three plots established in a two-acre exclosure built in 1950 show no change in the number of bitterbrush plants, but an increase in numbers of Agropyron spicatum plants from 100 to 300 percent.

Some idea of the age of the bitterbrush stand was determined from 90 samples. The average age is 40 years with extremes of 14 to 118 years old.

A plot 35 feet square containing seven bitterbrush plants was cleared of all other vegetation in an attempt to secure bitterbrush reproduction. The seed crop was good but no seedlings resulted from this cultural treatment.

Forty-five transects were established, fifteen in each drainage, and 10,821 twigs measured and remeasured.

Project W.U. 45. Occurrence and Significance of Dew on Selected Forest Sites in Northern Idaho.

The project was initiated under formal agreement with the U.S. Weather Bureau on July 1, 1961. Investigators are K. E. Hungerford and P. J. Edgerton. Field work had actually begun in June of 1961 with the preparation of field sites and establishment of the field camp which was used during the summer.

Objectives are as follows:

1. To perfect a dew measurement procedure that would give values approximating amounts of dew deposited on the vegetation of the study area.

2. To determine the amounts and pattern of distribution of dew on these selected sites.

3. To study the influence of microclimatic factors, specifically temperature, wind movements, air drainage, rainfall, humidity, and solar radiation upon dew deposition.

4. To study the effects of forest cover and forest clearings upon

these microclimatic variables during the summer season of dew deposition.

5. To investigate possible functions of dew in the moisture relations of certain herbaceous plants.

6. To investigate possible correlations between the microclimatic variables, including dew, and the food preferences and habitat preferences of Idaho ruffed grouse and white-tailed deer on the study area.

Field study was concentrated at the Hatter Creek Enclosure, an 800-acre fenced area in the University Experimental Forest. A nine-foot fence with locked gates surrounds this area to control an experimental deer population. This also gives a measure of protection to instruments both from livestock and from human vandalism. The area is about 30 miles from Moscow, Idaho.

Dew gauges were established at a number of selected sites during the early part of the summer. A limited number of thermographs and three hygrothermographs were set up in small instrument shelters to operate adjacent to the dew gauges. Maximum-minimum thermometers were set up at most of the other dew gauge stations to obtain data on temperature fluctuation. The original plan of operation included the establishment of a series of microclimatic stations each equipped with a hygrothermograph, a recording wind gauge and a dew gauge at each station. Since the ten hygrothermographs on loan from the Weather Bureau did not arrive until early September, this plan was not possible. Procedures were modified to attempt some correlations with the few recording instruments available and the maximum-minimum thermometers.

Dew Gauge Development

Development of an effective dew gauge, following objective number 1, began with the matted acetate gauge developed by Hungerford (1951) in earlier research. This is simply a square of the acetate material, buffed on the upper side, weighed in the early morning to measure dew accumulation. The four-inch square of this material formed the basic gauge in our experiments.

A number of the materials tested for the collector gauges were also tried by the weight method, in the four-inch size and in other sizes and shapes. Among those tested were plastic plates and funnels, polyethylene plates and funnels of various thicknesses, plasticized nylon, foam plastics and expanded styrofoam. The painted wood Duvdevani dew gauge was also weighed to determine the amount of dew accumulated.

Of the materials tested, the acetate plates seem to yield the best results. We believe this is due to several reasons:

a. The gauges are thin and translucent, rapidly radiating the heat energy accumulated during the daytime and transmitting the radiant energy from the earth. They follow air temperature changes quickly.

b. These gauges are thin and flat, presenting little barrier to air drainage, and minor air currents.

c. The gauges quickly dry out and maintain a constant dry weight.

d. The material can be easily and quickly cleaned of dust and dirt with a small paint brush.

e. The material is cheap and the gauge is easily constructed.

The biggest disadvantage is the problem of weighing to determine the amount of dew deposited. Work during this next field season will continue the search for an accurate and reliable method of measuring dew accumulated without the time-consuming process of weighing each plate. We plan a series of experiments to convert the dew deposition to a varying electrical resistance which can be recorded, read directly, or telemetered by radio.

Tests will be continued on the collector type of gauge using plasticized nylon and also the epoxy resins and detergents as used by Scott (1962) in New Zealand.

Project W.U. 46. Life History of the North Idaho Cutthroat Trout.

This project was begun in July, 1961. The objective of this study is to investigate the life history and distribution of an adfluvial race of cutthroat trout that lives in the complex of lakes at the south end of Lake Coeur d'Alene and Lake Coeur d'Alene, and that migrates up the St. Joe River system to spawn.

Collections of fish were made on tributary streams varying distances from the mouth of the St. Joe River and scale samples were obtained from fish caught in the St. Joe River proper.

Distribution limits of the adfluvial cutthroat trout will be ascertained on the basis of growth studies, scale patterns and meristic counts.

Project W.U. 47. The Determination and Development of Sperm Toxins for the Control of Undesirable Species of Fish.

The research is the result of a contract between the Bureau of Commercial Fisheries, U.S. Fish and Wildlife Service, and the University of Idaho, and is under the direction of Dr. MacPhee.

The project objectives are as follows:

1. To determine the minimum effective concentrations lethal to fish sperm of various toxins which are sublethal to young salmonids at the concentrations tested.

2. To test the effectiveness of sperm toxin in suppressing a natural squawfish population.

3. To explore and develop any toxins which, during the course of this investigation, are noted accidentally to have detrimental effects on the eggs or larvae of the coarse fish utilized.

The greater part of May was involved with ordering supplies and equipment anticipated for the project. A temporary field research laboratory was constructed during the month of June at Rochat Creek, nine miles upstream from St. Maries on the St. Joe River, Idaho.

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APPENDIX A. F. W. R. EXPERIMENT STATION STAFF 1961-1962

I. Regular Staff Members

Ernest Wohletz, Director and Professor (Forest Management)
E. W. Tisdale, Associate Director and Professor (Range Management)
P. D. Dalke, Leader, Cooperative Wildlife Research Unit and Professor (Wildlife Management)
M. E. Deters, Professor (Forest Management)
Minoru Hironaka, Assistant Range Ecologist
A. D. Hofstrand, Instructor (Wood Utilization)
J. P. Howe, Assistant Professor (Wood Utilization)
K. E. Hungerford, Professor (Wildlife Management)
F. D. Johnson, Assistant Professor (Forest Management)
Howard Loewenstein, Assistant Professor (Forest Management--Soils)
Craig MacPhee, Associate Professor (Fisheries Management)
A. D. Partridge, Assistant Professor (Forest Management--Pathology)
F. H. Pitkin, Assistant Professor and Nurseryman
R. H. Seale, Associate Professor (Forest Management)
J. E. Schenk, Assistant Professor (Forest Entomology)
L. A. Sharp, Associate Professor (Range Management)
Chi-Wu Wang, Associate Professor (Forest Genetics)
E. L. Williams, Assistant Forest Economist, Jr.

II. Research Fellows

R. C. Averett--Fisheries Management
J. R. Crooks--Forest Genetics
B. G. McIlvain--Range Management
R. B. Maloney, Jr.--Wood Utilization
J. R. Nelson--Range Management
M. M. Ollieu--Forest Entomology
R. C. Presby--Wildlife Management
R. G. Reid--Forest Genetics
H. G. Shaw--Wildlife Management
S. W. Stroup--Forest Management
L. D. Wing--Wildlife Management
R. E. Wood--Wildlife Management

APPENDIX B. SOURCES OF RESEARCH FUNDS AND OTHER SUPPORT 1961-1962

1. University of Idaho, Forest, Wildlife and Range Experiment Station, projects in Forest Management, Range Management, Wildlife Management and Wood Utilization.

2. University of Idaho Special Research Funds for Projects S.R. 11-C, 27-D, 54, 55, 63, 65, 66, 70 and 80.

3. Boise-Cascade Company. Assistance in forest genetics research.

4. Idaho State Department of Forestry. Support for forest genetics research.

5. Idaho State Fish and Game Department. Regular support for the Wildlife Research Unit.

6. Inland Paper Company. Labor, equipment and field accommodations for work on tree hybridization, seedling survival and forest fertilization.

7. National Science Foundation. Matching funds for laboratory renovation under the Graduate Research Laboratory Modernization Program.

8. Potlatch Forest, Inc. Potlatch Research Fellowship and a special grant for work on forest site influences on wood properties of inland Douglas-fir and for research on bark-base fertilizers.

9. Southern Idaho Forestry Association. Financial support for forest genetics research.

10. United States Bureau of Commercial Fisheries. Funds for research on determination and development of sperm toxins for control of undesirable species of fish.

11. United States Bureau of Land Management. Funds for research on salt-desert shrub ranges, facilities and assistance for Point Springs grazing project, medusahead research and forest genetics studies.

12. United States Bureau of Sport Fisheries and Wildlife. Funds for the Wildlife Research Unit.

13. United States Department of Agriculture. Funds from Regional Research Projects WM-42, W-25 and W-71, through cooperation of Agricultural Experiment Station, University of Idaho.

14. United States Forest Service. Funds for a growth-quality study of western red cedar, office space at the Boise office of the Intermountain Forest and Range Experiment Station, field living accommodations and assistance in collection of research material for several projects.

15. United States Weather Bureau. Funds for research on distribution and significance of dew on selected forest sites.

16. Wildlife Management Institute. Funds for wildlife research.