FOREST, WILDLIFE AND RANGE EXPERIMENT STATION COLLEGE OF FORESTRY, WILDLIFE AND RANGE SCIENCES UNIVERSITY OF IDAHO

Moscow, Idaho

### SIXTEENTH ANNUAL REPORT

For the Fiscal Year 1963-64

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

December, 1964

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## TABLE OF CONTENTS

# 1963-1964

Page

i.

| Introduction |  | 1 |
|--------------|--|---|
|--------------|--|---|

# Work Accomplishments

Forest Management and Utilization

| Project   | E. | S. | 6   | Idaho Tree Diseases and Defects                   |
|-----------|----|----|-----|---|
| Project   | E. | s. | 20a | The Study of Mycorrhizae of Idaho Conifers 2      |
| Project   | E. | S. | 33  | Robinia Root-Slip Cause and Control 4             |
| Project   | s. | R. | 80  | The "Indian Paint Fungus" in Northern Idaho 4     |
| Project   | E. | s. | 24  | Forest Tree Breeding in Idaho 4                   |
| Project   | S. | R. | 77  | A Progeny Test of Ponderosa Pine 5                |
| Project   | E. | s. | 35  | A Growth Quality Study of Western Redcedar 5      |
| Project   | s. | R. | 63  | Mass Production of Lodgepole and Jack Pine        |
|           |    | 2  |     | Hybrids   |
| Project   | М. | S. | 3   | The Heritability of Important Economic Charac-    |
|           |    |    |     | ters and Population Structure of Ponderosa Pine.6 |
| Project   | E. | S. | 27  | Soil Nutrient - White Pine Site Quality Study7    |
| Project   | E. | s. | 36  | The Drought Resistance of Ponderosa Pine Seed-    |
|           |    |    |     | lings as Affected by Mineral Nutrition 7          |
| Project   | E. | S. | 39  | Growth of Coniferous Seedlings as Affected by     |
|           |    |    |     | Treatment with Plant Growth Substances 8          |
| Project   | s. | R. | 65  | Fertilization of Forest Plantations and Natural   |
|           |    |    |     | Stands  |
| Project   | s. | R. | 70  | Seedling Growth and Survival                      |
| Project   | s. | R. | 94  | Cultural Practices for Improving Quality of       |
|           |    |    |     | Christmas Trees in Idaho 11                       |
| Project   | М. | S. | 2   | Elongation and Activity of Roots of Coniferous    |
|           |    |    |     | Seedlings as Determined by Radioactive Tracers 12 |
| Project   | E. | S. | 38  | Intraregional Competition in Lumber and Ply-      |
|           |    |    |     | wood Marketing in the Western United States . 14  |
| Project   | s. | R. | 54  | Influence of Forest Site on the Wood Properties   |
|           |    |    |     | of Inland-Type Douglas-fir                        |
| Project   | s. | R. | 55  | Identification, Biology, and Ecology of the       |
|           |    |    |     | Cone and Seed Insects of Idaho Conifers 16        |
| Project   | М. | s. | 5   | Effects of Nethyl Demeton on Douglas-fir and      |
|           |    |    |     | its Cone and Seed Insects and Rodent Indicator    |
| A Startes |    |    |     | Species   |
| Project   | M. | S. | 4   | Methods for Estimating Recreational Visits and    |
|           |    |    |     | Use on Unattended Recreation Sites 21             |

# Range Management

| Project | E. | S. | 7  | Evaluation of Salt-Desert Ranges               | 22 |
|---------|----|----|----|--|----|
| Project | E. | s. | 15 | The Ecology and Control of Halogeton           | 22 |
| Project | E. | S. | 8  | (S.R. 27-D) Ecology and Control of Medusahead. | 24 |
| Project | E. | S. | 9  | (R-287) Ecology of Sagebrush-grass Ranges      | 25 |
| Project | E. | S. | 14 | Investigations of Harvester Ants on Southern   |    |
|         |    |    |    | Idaho Rangelands.                              | 30 |

TAME OF CONTLINE

#### 1963-1951

sameridueory stack

Foreat Management and Utilization

| Idaho Trao Discasor ond Balacus  |    | .3      |         |            |
|--|----|---------|---------|------------|
| The Study of Pycorr lase of Idaho Conifere, ?  |    | 3.      | 1       |            |
| Rebining Root-Silo Cause and Control   |    | 32      | 10      | dootor     |
| The "Indian Paint Funguer in Northern Idaho B  |    | 19      | 5.8     |            |
| Forest Tree Freeding in Idaho  |    |         |         | 3- 1 br    |
| A Proveny Yearb of Ponderona Fine  |    | 24      | 22      | tootor     |
| A Growth Couldty Staty of Hestory Heddoday, 5  |    | .8      | 1       | maker      |
| Mass Production of Lodgenois and Jack Pino   |    | a       |         |            |
| de la serie de la  |    |         |         |            |
| the Hard tabi Mty of Important seanords Charnes  |    |         |         |            |
| ters and Population Structure of Fonderons Pines6  |    |         |         | anadina    |
| Soil Muturiant - Mitto Pine Site Daility Study, if   | 80 |         |         |            |
| The Bennets Restatance of Ponderons Fine Sund-   | Ne | 2       | 1       |            |
| The state and the state of interaction of the state of th |    |         | 4.0     |            |
|  | 00 |         |         |            |
| Prestment with Flink Growth Substances, 8  |    | in the  |         |            |
| intuited how suplication & description and test News   |    |         |         |            |
| Phone in the second sec |    | and a   |         |            |
| Of a set of a star town? has druged and han?   |    |         |         | the second |
| To units of the formation of the formation of the  |    | 100     | -       |            |
|  |    | ALC: NO | 1       |            |
| news a start of the start of the start of the start of the   |    |         |         |            |
| or or a set to be been the barbaro of an a set of the  |    |         | and the | 100000     |
|  |    |         |         |            |
| off a part in the fail manner of a salitation of the   |    | 14 G    |         |            |
| the second bank of the still started be second by  |    |         |         |            |
| of the second of the official second of the  |    | and .   | 20      | age cos    |
| and he see had been marked and the second  |    |         |         |            |
| Standard Contract 2 and 2 of the Standard Stand  |    | 8.1     | * *     | ioolor.    |
| MA T - CISTING ONALL IS SUBJECT DVSC ONA SUGS  |    |         |         |            |
| ALL STREAM LEADERED IN LANGE TO LEADER THE   |    |         |         |            |
| the source and second the store of a store of a store of the store of  |    |         |         |            |
| the state of the state state state state state of the sta |    |         |         |            |
| num serera reuchausandan Buravairase dot spoutes   |    |         | -       |            |
| the state of the s |    |         |         |            |

#### inanapanaM ondal

Project E. S. 26 A Ten-Year Evaluation of Range Reseeding in Project S. R. 95 Site Relationships and Productivity of Foothill Project M. S. 1 Woodland Shrub Grazing Lands in Idaho . . . . . 33 Wildlife Management Project W. U. 14 Availability of Deer Browse Under Varying Snow The Ecology and Management of Browse on Elk Project W. U. 37 Winter Range, Selway-Bitterroot Wilderness Occurrence and Significance of Dew on Selected. Project W. U. 45 Project W. U. 48 The Ecology and Use of Mountain Meadows by Elk. 38 Project W. U. 49 Beaver Productivity and Movements in South-Sage Grouse Habitat Study . . . . . . . . . . . . . . . 40 Project W. U. 52 Project W. U. 53 The Development of a Dental Cement Annuli . . . Technique for Aging White-Tailed Deer . . . . 40 Habitats Used by Mountain Quail in Idaho. . . 41 Project W. U. 54 Project W. U. 55 Browse Fertilizing Tests at Hatter Creek. . . 41 Project W. U. 56 Experimental Burning in Deer Winter Range . . . 41 Fisheries Management Project W. U. 47 The Determination and Development of Sperm Toxins for the Control of Undesirable Species Publications by Station Staff: 51 

B. Sources of Research Funds and Other Support

Page

| Evaluation of Manya Respecting  | Project B. S. 25<br>Project S. R. 95 |
|---|--------------------------------------|
| Eito Nolationships and Frednotivity of Foothill<br>Noodland Shruh Grasing Lands in Idaha 33             | Freivet N. S. 1                      |
|   | Inessegnated altibility.             |
| Availability of Deer Browse Under Varying Snow  |                                      |
| The Lools y and Lanagerent of Brouse on Elk<br>Winter Lange, Sciumy- Ltonroot Wilderneou                |                                      |
| Aros, idens<br>Occurrence and Significance of Des en Selected.<br>Format Sites in Jorthern Idaho.       |                                      |
| The Scale 2' and Use of Houstain Headers 5' Alie 38<br>Beaver Fredericity and Frements in South-        | Project M. S. 19                     |
| Care Ground England, Study  | Frequet V. U. S.<br>Project V. V. S. |
| Technique for Aging White-Indiad Dear   | Project V. U. S.                     |
| Ingerinemal summer la Peer Vinter Lange bl  |                                      |
|   |                                      |
| The Determination and Development of Sporm<br>Forder for the Control of Underlyable Spectom<br>of Field | Project V. U. h7                     |
| R   | Publications by Station<br>Tedmicals |

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#### INTRODUCTION

A total of 38 projects were carried on during the year. An additional 11 projects were inactive, but were retained for future work as circumstances and manpower permit.

1.

A major addition was made to the station this year by the formation of a Cooperative Fisheries Research Unit, jointly financed by the U. S. Bureau of Sport Fisheries and Wildlife, Idaho State Fish and Game Department and the University of Idaho. This move added two federal employees and several Research Fellowships to the Station staff and will provide increased manpower and facilities for fisheries research and education.

Four members were added to the permanent Station staff. Dr. Howard Alden filled the position in Forest Recreation which had been held temporarily by James Howland during the previous year. The other three members filled new positions -- Dr. Robert Giles in Wildlife Management; Dr. Donald Chapman and Mr. Robert Thompson as Leader and Assistant Leader respectively in the new Cooperative Fisheries Research Unit. In addition, Richard Ruelle was appointed as Acting Research Associate in Fisheries, working on the fish toxin project.

Support in the form of funds, facilities and other assistance for research was received from many sources. A list of contributors is given in Appendix A of this report. Major additions this year were: 1) the first annual budget under the McIntire-Stennis Act. The funds available to Idaho came to this Station, and were adequate to initiate four projects and a "pilot study" for a fifth study. 2) Funds for the new Cooperative Fisheries Research Unit were provided from the U. S. Bureau of Sport Fisheries and Wildlife, and the Idaho State Fish and Game Department.

Improvements in facilities included renovation and equipping of the Fisheries Research laboratory and development of a new laboratory for certain phases of research in Wood Utilization. Another major acquisition was a walk-in controlled growth chamber.

Ernest Wohletz, Director

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A total of 36 projects were carried on during the year. An aidistonal 12 projects were interior, but were retained for future work as circumstances and componer pordit.

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#### WORK ACCOMPLISHMENTS

I. Forest Management and Utilization

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

New forest fungi and their attendant diseases or defects were described and a paper written for publication in Northwest Science. Nine fungi were included in this list.

Approximately 20 new isolates of decay-causing fungi were made from field specimens for the purposes of confirming or repudiating existing descriptions of decays based on decay in the laboratory and in field associations.

Project E. S. 20a. The Study of Mycorrhizae of Idaho Conifers.

Mycorrhizal work was concentrated on fungi associated with lodgepole pine. The objective is to determine whether ecotypes of either fungi or lodgepole pine or both exist through mycorrhizal formation. In Idaho, lodgepole pine occurs on a wide variety of sites and at least two different habitats involved. In the sprucefir forests of central and southeastern Idaho, lodgepole assumes a disclimax role, typical of vast areas in the Central Rocky Mountains; in the cedar-hemlock climax types of northern Idaho it is a short-lived seral species in an environment related to the Pacific coastal forests. These two habitats are decidedly different floristically. There are also some morphological differences in the lodgepole pines. Most easily seen are bark differences - in the northern stands, the mature bark is thick, black and broken with rectangular plates separated by deep furrows; in the southern stands, mature bark is thin, grey or grey-brown and composed of papery or scaley plates without furrowing.

Two areas were selected for study. In central Idaho the Stanley Basin presented a combination of excellent fungus records with typical habitat, east of the coastal influence represented by grand fir, and relatively easy access. In the northern part of the state, the Rathdrum Prairie and Priest Lake areas were chosen. Both contain pure stands of lodgepole pine in cedar-hemlock climax habitats. Past collectors have left records of fungi which help delimit the study.

Last year fungi in the Boletaceae were tested from central and northern Idaho with the following results:

|                    | Central | Northern |
|--------------------|---------|----------|
| Suillus tomentosus | X       | X        |
| S. sibericus       | X       | -        |
| S. brevipes        | X       | X        |
| S. granulatus      | -       | X        |
| Boletus piperatus  | X       | -        |

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New invest fund and their attenied diseases or infecta verg described and a paper written for publication in buildent Science. Then they were included in this list.

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|           |           | auteliumen            |
|           | 1         | Bolatsus nuperstas    |

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Seeds were collected from the areas where the fungi were collected. All stands were nearly pure lodgepole pine and there was no evidence of other pine species. Ecological descriptions, including stand data, were also made.

Seeds were sterilized with bichloride of mercury and germinated on dextrose agar. When the radicles were about 0.5 cm. long, clean seedlings were planted in a sterile spongerock - Terralite complete nutrient medium. At the same time one sq. in. blocks of vigorous inoculum grown on Hagem's agar were introduced next to the seedlings. One to four seedlings were grown per 500 ml. Erlenmeyer flask. Seedlings were grown both in a greenhouse and under fluorescent light.

Results indicate that there is a strong possibility that there are either fungus or tree ecotypes involved as reflected by synthetic mycorrhizal formation. The following results were obtained with from one to four successful syntheses:

#### Success of Mycorrhizal Synthesis

|                          | Northern<br>Seed | Central<br>Seed |
|--------------------------|------------------|-----------------|
| S. tomentosus (northern) | Yes              | No              |
| S. tomentosus (central)  | No               | Yes             |
| S. sibericus (central)   | No               | Yes             |
| S. brevipes (northern)   | Yes              | No              |
| S. brevipes (central)    | No               | No              |
| S. granulatus (northern  | No               | No              |
| B. piperatus (central)   | No               | No              |

S. tomentosus reacted in a pattern expected if ecotypic variation of fungus and/or host affects mycorrhizal formation.

S. sibericus is inconclusive due to lack of northern cultures. This fungus is rare, if present at all, in northern Idaho.

S. brevipes occurs abundantly with lodgepole pine in all parts of the state and should have formed mycorrhizae with central sources of fungus and seed.

S. granulatus is normally on soft pines (Section Diploxylon) and was probably associated with an undetected Pinus monticola.

B. Piperatus was difficult to culture, cultures were low in vigor and eventually the stock cultures died. This failure should not be interpreted as conclusive evidence of non-association with lodgepole pine. This fungus apparently has not been collected in northern Idaho.

Future work will concentrate on S. tomentosus and S. brevipes as test fungi. More replications are needed to substantiate the early indication of ecotypic variation. Scent were articated from the aroun weers the funct were collected. All stands sere averly pure lodgepole pins and there we no evidence of other pine species. Recorded deteriptions, including stand data, were also usic.

Seeds were storilized with cichloride of mecury and stainated an destroke upper. Most the redicies were about 0.5 can look, clean seedlings over planted in a storile sponerool - Invalite complete putrient medium. At the take wire one eq. in, blocks of a story insection grown on Regeria approximation on eq. in, blocks of a story insection grown on Regeria approximate per 20 al. Friendroor finate, Seedlings were room both in a reenvous and under finate. Seedlings were room both in a reenvous and under finate.

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Future Pork Mill concentrate on 8, tementanus and 3, brevines an Last fungi. More replications are needed to substantiate the early fadiration of ecolypic variation. Project E. S. 33. Robinia Root-Slip Cause and Control.

Approximately 240 seedlings were grown aseptically and inoculated with fungi isolated from diseased trees, but no causal relationship was established. The cause, thus far, is uncertain.

The range of the disease was approximately circumscribed as including the Snake River area from Rexburg to Gooding. No new outbreaks were discovered and the disease appears enphytotic at present.

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

Approximately 75 per cent of all townships in northern Idaho have been checked for the presence of and conditions associated with this fungus. Direct relationships exist between decay and age, crown position, or stand density. South slopes with good drainage seem to contain fewer decayed trees. Crown length and stem diameter bear no relationship to decay.

In physiological tests, the fungus grows poorly with single or multiple, simple or combined carbon or nitrogen sources, but is greatly influenced by trace minerals, particularly zinc.

Chemical strength and pulp tests of decayed wood indicate losses of important basic constituents and characteristics which are presently poorly defined. Bioassays of wood extractives indicate only the water-soluble portions to be biologically active.

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

For the genetic improvement of ponderosa pine (Pinus ponderosa) and production of genetically improved seeds in commercial quantities, a one-parent progeny test and seed orchard system was initiated. It includes four separate seed orchard plantations to be established in the Boise and Payette Valleys in 1966.

This project is conducted as a cooperative effort between the University and its cooperators which include Bureau of Land Management, Idaho State Forestry Department, The Southern Idaho Forestry Association and the U. S. Forest Service. The essential features of this project are (1) Phenotypic selection of parent materials from wild populations, (2) Progeny testing of open-pollinated progenies of the above selected parents and the isolation of the best breeding materials through the selection between parents and between individuals of the same parents, and (3) Conversion of the progeny testing plantations through thinning into seeds orchards for quantity production of improved seeds. The original stands were from the best parent trees and will be converted into seed production areas for immediate seed production.

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The range of the discess was appreciately strongeording as including the chake direct area from strongery to Gooding, do now outbrakes wore differented and the discusse apprears approved as creaters.

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Certain interspecific larch hybrids involving Japanese larch (Larix leptolepis) are known to be heterotic. Pollen of local western larch (L. occidentalis) was collected for hybridization purpose upon request of forest geneticists abroad. Reciprocal crosses were made also with eight trees in the Moscow Mountain and St. Maries areas. Seedlings from Schoenike's collection of jack pine (Pinus banksiana) seeds (90 sources) raised at the Nisqually Forest Nursery were ready for field planting. They 1 were out planted in the University Forest this spring in replicates for ecotypic variation and hybridization studies.

#### Project S. R. 77. Progeny test of Ponderosa Pine.

The parent trees to be used in the four progeny test seed orchards (Project E. S. 24) includes selected trees located since 1961 (Project S. R. 77, F.W.R. Report 1961-62, 62-63). A total of 284 trees from 35 natural stands were selected. They represent the following areas in southern Idaho: Adams county - 8 stands/ 66 trees, Boise - 10/80, Elmore - 5/42, Valley - 8/61, and others 4/35.

Seedlings were raised in replicates in a randomized complete block design in nursery beds according to a randomized complete block design in four replicates in the seed beds. They will be raised to 2-O stage for out planting. The weight and size of seeds and their possible effect on juvenile growth of the progenies were investigated.

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

The phase of this project which has been completed involved a study of the geographic variation of tangential tracheid diameter in Idaho western redcedar. This was done as a graduate thesis research program by J. R. Crooks.

Increment cores were collected from five areas in northern Idaho representing different latitudes ranging from 46° 00' to 49° 00, and at each of these areas samples were collected from three different elevations. One core was extracted from each of ten trees at each collection site and tracheids were measured on 45 consecutive annual rings on each core where age would permit.

The average tracheid diameter was found to be 25.8 microns, with a range of 15.6 to 38.4 microns. Analysis of variance of the data indicated highly significant latitudinal and altitudinal effects. The number of cells increased with both latitude and altitude. Average cell size increased with age of the tree. The results indicate the variability of wood quality of western redcedar with geographical location and ecological site and suggest the need for study of other wood qualities such as specific gravity. This The Lasir steel in this long-term project to presented in the

Sertain intervential and the intervention involving anothers into (<u>Larix heriolegie</u>) are have to be buildened. Follow of 1 and written area (<u>L. conideration</u>) are addlected for bubildization purpose upon request of forest pusticities intoid. Recipiedal atomics were made also that their three in the lossew lountain tod St. Suites areas, besinged to the Schoonskets collection of the plan (<u>tible baltaison</u>) seeds (S courses) reined at the disqually corest foresty sure reads for 1 dd planting. They there on planted to the (crystally forest this spring in relifeates for conject waits the intervent planting and the spring in relifeates the conject waits and in relies the station atomics.

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SCHEMATIC DIAGRAM OF A WORK PLAN FOR THE COOPERATIVE TREE IMPROVEMENT PROGRAM

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\*Note: Initially screened materials may be used temporarily for seed orchard purpose, but they are not as intensively selected and from as broad a genetic basis as materials in Phase II. SECTION DIAGRAM OF A HOLK PEAN FOR THE CONSERVENCE THEN THERE THE TOTAL TO MARCATE DIAL



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variability also indicates the need for a provenance orchard of western redcedar from different geographic and ecologic sources.

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

Lodge-pole--jack pine hybrid seeds, to the amount of 2,453, were collected in August, 1963, from the Spirit Lake Lodge pole seed production area. The hybrid seed was obtained from 17 different parent combinations. Open pollinated lodge-pole pine seed was collected from each female parent to serve as controls for future growth studies.

Hybrid seed yields per cone were quite low, ranging from 1 to 17. This low seed production was similar to the previous year which was reported in detail in the 1963 annual report. The hybrid and open pollinated seed was nursery planted June 6, 1964.

Approximately 3,000 two-year old hybrid seedlings and an equal number of lodge-pole and jack pine-seedlings are available at the Forest Nursery for field testing in 1965.

#### Project M. S. 3.- The Heritability of Important Economic Characters and Population Structure of Ponderosa Pine.

At the present stage of tree improvement studies such as the ponderosa pine improvement program of the University of Idaho, two important aspects of basic research need to be undertaken. (1) evaluation of heritability of important characters that are selected for, and (2) determination of the range of genetic variation within the species and between and within local populations. This basic knowledge is of fundamental importance to the operation and success of a tree improvement program.

This project is planned to investigate these basic problems. For the heritability studies, controlled pollination was made on preselected seed trees (S.R. 77 Progeny Test of Ponderosa Pine, and E. S. 24 Tree Breeding in Idaho) with fresh and stored pollen. The trees were selected for their distinct stem, crown and branching characteristics generally used in phenotypic selection. Female flowers were isolated in mid-May and pollinations were made mostly in the first two weeks of June. However, only a portion of the selected trees bore female flowers this year. A total of 529 bags were pollinated on 23 selected trees. The crosses include reciprocals and selfings.

For the study of ponderosa pine population, field surveys were made beginning from the northern edge of the natural range. Samples will be taken from sites in British Columbia and Northern parts of Washington, Idaho and Montana.

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

Organic matter percentage was determined for soil horizons collected from two pits excavated on each of 26 white pine sites of varying quality. Previously, similar analyses of these horizons had been made for nitrogen, phosphorus, potassium, calcium, and magnesium. During the year, all these data have been converted to pounds per acre of organic matter or the particular nutrient as found in each horizon and a total was obtained for each soil profile.

This information has not as yet been completely analyzed, but it is apparent that the better sites are not necessarily superior in all factors investigated. It is possible that the ratio of the level of a certain factor to the level of another may significantly influence tree growth on these sites. In some instances two profiles from the same site show wide variation in nutrient and organic matter contents. This latter fact emphasizes the need for more intensive sampling of mountainous forest land and soil of even a small area.

#### Project E. S. 36 - The Drought Resistance of Ponderosa Pine Seedlings as Affected by Mineral Nutrition.

Observations were continued on the field plots in Island Park, Idaho, throughout the summer of 1963.

Growth and survival were both poor in blocks of 1-0 transplants. Over-all survivals on the two blocks of transplanted seedlings were 34.1 and 29.6 per cent. Survival for individual fertilizer treatments in any one block ranged from 5 to 75 per cent.

Seedling survival was much better in the direct seeding block. Over-all survival was 64.5 per cent, the range in treatments being from 35 to 95 per cent. Differences in survival among the 15 fertilizer treatments have not been analyzed yet.

Because of the scarcity of healthy foliage, no attempt was made to determine the chlorophyll stability index or the foliar nutrient content as was planned. Also, no roots were extracted for comparison of root growth.

Soil samples around the seedlings were taken to determine the extent of downward transport of the fertilizer applied to the soil surface.

A greenhouse experiment will be conducted during the fall and winter of 1964-65. Ponderosa pine seedlings will be grown in eight different nutrient solutions comprising all possible combinations of two levels each of nitrogen, phosphorus, and potassium. Drought resistance will be measured by the time length of survival in a growth chamber under drought conditions.

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The rate of seedling growth, particularly of the roots, is often of critical importance in determining the fate of planted trees. Any stimulation of root activity, proliferation, or elongation should increase chances of survival under adverse environmental conditions. Some notably beneficial results have been obtained in development of deciduous species through a plication of certain plant growth substances. Work with coniferous species has been very limited, and the published results of such studies present conflicting conclusions. The research program outlined below is designed to explore the effects of some growth substances on development and survival of Douglas-fir seedings.

This project was initiated with a greenhouse study in the winter of 1963-54. In one experiment 2-O seedling roots were soaked for two hours in a water solution of either Naphthalene acetic acid, Indole-3-acetic acid or Kinetin. Two concentrations of each growth substance were utilized. A second experiment employed ten hour soaking periods with Gibberelic acid, Indole 3-acetic-acid, 3-Indolebutyric acid, A-Napthalene acetamide and Superthrive (a commercial preparation consisting of Napthyl acetic acid and Vitamin B1). Most of the seedlings were planted in a large sand box, and the remainder were established in glass-fronted root observation boxes. Measurements were made of length of new roots density of new roots, titration value of roots (a technique which gives the absorbing power of roots), dry weight of roots. and top growth characteristics.

The data obtained have not as yet been statistically analyzed, but some preliminary comments on results can be made. The average length of new roots was adversely affected by treatment with any growth substance, the control plants being superior in this respect. However, root absorbing capacity was markedly increased by treatment with 3-Indole-butyric acid (25 ppm), A-Naphthalene acetamide (1 ppm) or Kinetin (0.0001 ppm). The application rate of a particular growth substance was important in determining its effect. For example, seedlings treated with Naphthalene acetic acid applied at the rate of 10 ppm had average titration values of 0.19 and average new root lengths of 5.41 inches. Corresponding figures for plants treated with the same compound at a rate of 100 ppm were 0.12 and 2.05 inches.

Field studies commenced in April, 1964, with plots established on two sites in northern Idaho. Approximately 1,000 2-0 Douglas-fir seedlings are involved in this phase of the investigation, and six growth substances are being examined. Seedling survival will be recorded at intervals through the growing season, and measurements will be made of top growth and needle elongation. Root systems of certain seedlings will be excavated and their characteristics noted.

#### Wegest B. 3. 39 - Growth of Guilferoun Seedings as Aflacted by Transact, with Flowt Growth Substances.

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The Flat Creek and Meadow Creek experimental areas on the College Forest were reexamined early in December, 1963. Fertilizer study plots (1/10 acre in size) were established on these sites in the spring of 1962, with treatments consisting of 300 pounds per acre of nitrogen as ammonium sulfate, 150 pounds per acre of potassium as muriate of potash, and 66 pounds per acre of phosphorus as treble super phosphate. Foliar analyses of both treated and control trees were made after the first growing season in the fall of 1962 (see Annual Report 1962-63). As growth pattern changes become apparent only after the second season no measurements were made in 1962. The 1963 determinations at Flat Creek, where the species involved were young grand fir and Douglas-fir, included height growth appraisal as well as nutrient analyses of the newly produced needles. At Meadow Creek, the major species of concern was Western white pine. These trees are almost 30 years old, and many of them exceeding 50 foot in height. It proved impossible to accurately determine height growth increases occurring since fertilization, and in this instance diameter growth as revealed by increment borings was used as an indicator of fertilizer response. Foliar analyses were also made for the Meadow Creek trees in 1963.

Substantial responses to fertilization were obtained at Flat Creek. Leader elongation of treated grand fir in 1963 averaged 211 per cent of that recorded for 1962; the corresponding figure for control trees was 121 per cent. Fertilized Douglas-fir growth was 154 per cent and untreated tree growth was 108 per cent of that found for 1962. In both species, the small increase in growth of controls in 1963 as compared to the previous year may be attributed to climatic differences.

Foliar analyses revealed that nitrogen concentrations of needles developed in 1963 were appreciably higher in fertilized trees of both species. The levels of nitrogen in these fertilized tree needles did not approach those found in 1962. Little difference was found in comparisons of potassium and phosphorus concentrations of treated and untreated tree needles.

Results with white pine at Meadow Creek have been rather disappointing, with no clear evidence of increased diameter growth through fertilization. The performance of trees within the fertilized plot varied widely, as did the nutrient content. An explanation of these findings can probably be found in factors having to do with the density of this unthinned plantation and distribution of volunteer specimens of other species within the stand. Competition for light and soil moisture is undoubtedly intense, and the favorable or unfavorable situation of a particular white pine in regard to these will affect both its uptake of nutrients and its growth response. This plantation will apparently have to be thinned before favorable results through fertilization can be obtained. Research with white pine conducted at Ramskull Creek and reported earlier indicates that under proper conditions a strong fertilizer response, particularly with nitrogen, can be expected.

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Fertilization may also benefit seed production. Such a benefit would be of particular value in seed orchards, where the greatest possible yield of seed of superior tree strains is desired. An attempt to increase the seed yield from an experimental lodgepole pine seed orchard near Spirit Lake by means of fertilization is now in progress. Treatments in this thinned stand were made in May, 1964, on an individual tree basis, the area of coverage being a circle 14' in diameter around each stem. Each treatment was replicated four times. In one instance, 13-13-13 fertilizer at a rate approximating 300 pounds of nitrogen per acre was added together with chelated iron. In second and third treatments four pounds per acre Dowpon for grass control were added with the basic fertilizer ingredients mentioned above. A fourth treatment consisted of Dowpon alone. Results of this experiment will not become discernable until after the 1965 growing season, however analysis of foliage produced in 1964 should indicate the magnitude of fertilizer uptake.

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

For the second year in a row the climatic pattern during the growing season was very favorable for seedling survival in northern Idaho. As a consequence, treatment differences which might have developed in a drier summer were obscured, and no definitive information was forthcoming as to the relative merits of chemical versus mechanical weed control at the Athol and Orofino sites. The magnitude of the climatic effect may be noted by citing the data for one treatment which has been repeated during the four study years. Plots of 2-1 Douglas-fir seedlings, receiving no summer fallow, cultivation, herbicide, or other manipulation, produced 15 per cent survival in 1960, 1 per cent in 1961, 60 per cent in 1962, and 99 per cent in the 1963 growing season. Obviously, in 1963 as good a stand resulted when nothing was done to reduce competition as when intensive measures were utilized.

Visual observation of the plots indicated that Simazine was quite efficient as a weed eradicant. It was most effective as a preemergence herbicide, and apparently produced a cleaner site on Experiments with prederors bins who can bind at home containt. In 1963 trends in this plantation were fartilized with 197 be 300 pounds per sore mitrogen, either is an anise salished of accents mitrate. At the time of the billestion, the companies rate on the site was treated with the origination. The companies rate on efforts on while site were horizored by large uptate of the horizant's by preset. Free follars was analyted at the end of the 1963 growing season with some indication of increased mitrogen one cantrations in targets from fartilized trees as compared to controls that exertine were installed in the full of 1960. Deplicates of this exertine were installed in the full of 1960. Deplicates of this exertine were installed in the south of 1960.

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Experiments were replicated again at Athol in 1964 with planting taking place on April 29; herbicide applications were made two weeks later. It was decided to discontinue plantings at the Orofino site, but annual observations of survival and growth of the older seedlings will be made.

Forest-land type planting experiments were continued on the Spirit Lake site for the third year. Undulating topography characterizes the area, and planting slope as well as plot treatment strongly affects survival. Tests in 1963 included comparisons of three fertilizers, Ammonium nitrate, 8-40-0 and Vigaro, as applied in the planting hole. Douglas fir 2-0 and 2-1 planting stock was used. Use of fertilizers failed to increase survival over controls, although growth may be benefited in the first few seasons. Slope strongly influenced survival. About 33 per cent of the seedlings planted on south facing aspects died, for example, compared to some 4 per cent in bottoms.

Piche type evaporimeters were placed on each slope type and were examined weekly, but because of calibration problems were not too useful. Enough data were obtained to indicate that this kind of instrument could prove of value in future work.

The site of Spirit Lake was prepared by bulldozing strips about twelve feet wide, and planting was done along the center of these. Because of the difficult terrain and the large quantity of brush to be moved, soil disturbance by the dozer blade was markedly variable. In some places the topsoil was barely touched, in others a foot or more of soil was pushed to the side. The diversity of edaphic environment does not seem to have affected seedling survival, but the possibility of diminished growth where all the topsoil has been relocated a distance from the immediate area of the seedling cannot be discounted. In 1963 soil samples were collected from lightly and heavily disturbed locations on each topographic type. These were subjected to nutrient and organic matter analysis. Almost without exception, the areas of heavily disturbed soils were relatively low in all factors tested. Growth measurements of trees planted in 1961 are now planned, and these measurements should reveal whether the varying condition of soil nutrients and organic matter have had an effect on seedling development.

Project S. R. 94 - Cultural Practices for Improving Quality of Christmas Trees in Idaho.

Recently the demand for Christmas trees from Idaho has risen sharply. Many Idaho woodland owners are attempting to secure part of this summer failowed land. On nor failoged money, many of the peromini mostees seemed relatively uneffected by the breakfant. In a fry very most planes could a concentrate to compate vicorously diff is seedilings for relative. Thus failowing the yeat prior to planting it orobably esegnical even if this beridable is a ployed the frist growing reason.

Experientes vero replicated opin at a cont in 1966 with planting baking place on April 201 estimates applications were made two rescalinter. It as dealed to discontinue clastings at the Orotheo alte, but amount contractions to survival and growth of the older readities will be made.

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Piche two ovanorimators were placed on each slope type and ware exacted weakly, but produce of calibration providents were not too useful. Enough ists were obtained to trainess that this kind of the truncts could prove of value in future work.

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Project 5. R. St. - Caltural Freditors for Deproving quality of Christman Trotes in Idaha.

Recently the demand for Charletons trees from Idaho has itera sharply. Hany Idaho woodlend owners are all coping to require part of this

expanded market. Whether the product marketed is plantation grown or harvested from wildland, the quality of the tree will importantly influence the return to the owners. Many investigators have shown the beneficial effects on Christmas tree quality obtained through various cultural techniques. These techniques, however, vary in their effectiveness with tree species and environmental conditions. Little or no published information is available concerning methods of improvement most satisfactory in northern Idaho. Results of the study described below should delineate the techniques necessary to develop a high proportion of premium Christmas trees on sites in north Idaho counties.

During 1963 and 1964 cultural investigations were begun with three species: grand fir, Douglas-fir, and Scotch pine. The first two occur on the three wildland sites, whereas the Scotch pine have been grown in a plantation. Techniques employed, either singly or in combination, include basal pruning, partial basal pruning, fan trimming, trimming, scarring, tip pruning, reverse tip pruning, and fertilization. For comparison, no cultural treatment has been carried out on a number of trees on each site.

Each tree involved has been numbered, and yearly examinations will be made of each specimen until harvest. Observations recorded include leader growth, angle of leader (if tip has been pruned), number of laterals on each false whorl developed, foliage density, foliage color, and quality grade. A photographic record of representative trees is being maintained. When the trees are cut, a quality grade for each will be independently determined by a professional Christmas tree marketer.

#### Project M. S. 2 - Elongation and Activity of Roots of Coniferous Seedlings as Determined by Radioactive Tracers.

Efforts to increase survival of out-planted seedlings are greatly hindered by the surprisingly meager information concerning root development and activity in the critical first as well as succeeding growing seasons. Root systems have been studied by laborious excavation of surrounding soil, but this is a difficult and timeconsuming task. In addition, use of this method requires sacrifice of the seedling. Roots have also been investigated as they grow in glass fronted observation boxes. The glass front box, however, introduces a highly modified environment and development may differ appreciably from more normal growing conditions. Recently, a radioisotope technique has been used to study roots of several agricultural plants. A modification of this approach forms the basis of root investigations planned for this newly initiated project concerning coniferous seedlings.

The new technique may be briefly summarized as follows. After the seedlings are planted, radioactive phosphorus is injected in the soil around each, the pattern to be described below. At weekly intervals needles from the seedlings are analyzed for the presence and level of the tracer. Using the data obtained, it is possible expended offet. Mandi ar the frostet sateted to plandthe nave or stread from all hand, the quality of the tree will importantly infibuate the return to the orders, a any investigation have then the bonelister effects on 000 down on the sector of the very in various contural test these. These techniques, however vary in their effectiveness with the area addientiron at a conditions wittle or a published information to available concerning returns of inprovement nont satisfactory in northern likes. Necestry of the study described below the freedom of the techniques of the develop a hip propertion of predent for the techniques and the port of the second of the second of the techniques of the study described below the of predent for the techniques and the study described the second for the techniques and the study described the second of the techniques and the study described to a predent for the techniques and the south ident constitues.

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Harn thes involved had beau numbered, and restly an introduces will be made of elob Precimer until berveet, Observations reported include leader from h, angle of leader (if the has been prined), mumber of laterals to each false whore developed, faiture donainy folders rolor, and quality grade. A photographic record of representative trees is being ministed. When the trees are out, a quality grade for each will be independently determined by a potentianal (arisemus inte marketer.

> Project M. S. 1 - Elemention and Activity of Acets of Coniference 1. Seedlings as percented by Indicative Tracetor

Efforts to induced convival of one-planted acadimes are printy hindered by the sorringingly convision firms as well as inconding asycloptest and activity in the contribution firms as well as inconding extracts scapeds. Noot systeme have been stadled to ishocious construits task. The addition will not only is a difficult end time of the modifier. Konis have also term investigated as they are in difference and they are also term investigated as they are in the firm and the reaction of a state of this well, and a signal of the modifier. Konis have also term investigated as they are in difference as a state of this well, and the state of a firm of the modifier. Konis have also term investigated as they are in the state fronted many state is a signal to be to be and the operand ably from more normal proving contributions. However, interact blants, a configuration of this approach form the prove of the state of the state of the state of the state interaction of the state of the state of the state operand ably from more normal proving contributions and interactions is a configuration of this approach form to prove of root investigation of an addition of the state of the proving interact be investigation of the state of the state of the operand able investigation of the state of the state of the interaction of the state of the state of the state of the interaction of the state of the state of the state of the operand able investigation of the state of the state of the operand state of the state of the state of the state of the operand state of the state of the state of the state of the operand state of the state of the state of the state of the operand state of the state of the state of the state of the operand state of the state of the state of the state of the operand state of the state of root investigation of the state of t

the new treations say to infolly summitted as follows. Alter the specifings are planted, redreative chordbords is interied in the soll sround radia, the outland to be fractibed below. We washly intervals needed from the seedimily are analyzed for the presence and level at the tracers, Using the data oftenned, it is possible to record both root location and activity. Information is gained with minimum disturbance to the plant, and none at all to the root systems themselves.

Injection probes for placing the radio-isotope in the soil had been developed for use in the agricultural experiments. These were deemed too inefficient for this seedling study, in which a very large number of injections were required. Thus a new device was designed which fully meets the triple requirements of safety, accuracy, and rapidity.

Recent studies at the University of Idaho (Forest, Wildlife and Range Experiment Station Annual Reports 1961-62, 1962-63) indicate that there is little difference in field survival of 2-0 and 2-1 Douglas fir planting stock. This finding is contrary to commonly held assumptions, but the similarity in survival could come about if the 2-0 stock develops root systems of the same magnitude and activity as the 2-1 stock during the first growing season on the planting site. The initial experiment utilizing the new radioisotope tracer technique was designed to provide information on root system development of the two age classes of seedlings. In addition, it should allow method refinement in preparation for future tracer studies of roots.

Seedlings utilized in the experiment was selected from single known seed sources, graded for uniformity and planted in rows at a three foot spacing on a homogeneous area of the University Nursery. Eight rows were involved in the study, each two rows being considered one block. Within each block twenty 2-0 and twenty 2-1 seedlings were planted at random on April 15, 1964. Fourteen different treatments were involved, and these were assigned at random to fourteen trees of each age class per block. Each treatment was thus replicated four times in this randomized block design.

Each treatment involved placement of the radio-isotope in the soil at a certain lateral distance from the plant and at a particular depth. An outline of the treatment pattern follows.

| Depth<br>(inches) | Lateral Distance from plant (inches) |
|-------------------|--------------------------------------|
| 3                 | 1<br>6                               |
| 8                 | 1<br>6<br>12<br>18                   |
| 16                | 1<br>6<br>12<br>18                   |
| 24                |                                      |

to record toth root location and are view. Information is passed with moninum disturbance to the plant, and node at All to the root writtens theread way.

Introductor proces for fiscing the collocitous in the soil had been download (structs in the evidentical organizate. There were decred to institution for this wouldness the which your large number of injections the instituted. Thus a new divious we decrement and fully means the tructs rechtrocomes of safety.

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Sach breathant involved place and if the rodes-lastope in the mail at a contain lateral distance from the plant and at a paraioulary depit, as outline of the areabient restarm follows. Injections were made in a circular pattern around each plant, with a steel ring of the proper radius placed on the soil to serve as a guide. Five ml. injections were to be used, the number to be used for each treatment being determined by the lateral distance from the plant. Thus two equally spaced injections were made at the one-inch radius, ten at the six inch, twenty at the twelve inch, and thirty at the eighteen inch. It was calculated that about 20 per cent of a one-inch diameter circular "tube" of soil of the particular radius absorbed the isotope in each treatment.

The soil around the untreated trees in each block was used in weekly determinations of soil moisture and other factors. In addition, equipment for recording climatic factors was installed on the site.

Injections were made on May 6, 1964. Each consisted of five ml. of three uc/ml carrier-free  $H_3P^{320}\mu$ . Using three probes, approximately 1600 injections were made in an eight hour period.

The half-life of  $P^{32}$  is about fourteen days and the amount which may be concentrated in the seedling needles will not be detectable after seventy or eighty days. In order to trace root development for the entire growing season a new series of injections will have to be made in mid-summer. These will be exact duplicates of the first series, with the original seedlings being retreated in the same manner as before.

Needle tissue will be collected weekly from each seedling. These samples will be asked and assayed quantitatively for  $P^{32}$  content. Detection of the tracer in a treatment sample will furnish conclusive evidence that plant roots have reached the particular lateral distance-depth injection site concerned. For example, early in the growing season radioactivity may be found only in samples at greater lateral distances and greater depths. Thus, root extension will be followed through the growing period. The relative activity (ratio of  $P^{32}$  activity in sample to the total  $P^{32}$  activity of all treatments) will give information on the zone of maximum root activity as the season proceeds.

#### Project E. S. 38 - Intraregional Competition in Lumber and Plywood Marketing in the Western United States.

The purpose of this project is to determine production, consumption and distribution of lumber and plywood from the western states by species. It is a cooperative project involving Washington, Oregon, Montana, California, Utah, New Mexico, Colorado and Idaho. After the needed data are collected, an economic model will be developed to determine how transportation costs might be minimized.

By utilizing this information the lumber and plywood industry might minimize transportation costs, make their products more competitive in price with substitutes, and thus strengthen the industry and local economies. injections very made in a character pat are include each blink, with a sheel wine of the rearr reduce blaced on the toll to serve as a pilde. Five all injections rore to be used, the dather to be used for each treat she blink non-trained by the lateral distance from the plims. Thus two shalls served in the lateral distance from one-inch redies, the stability served in techture when and at the one-inch redies, the stability served in the interface that accessed and thirty at the elithesen inches interim trabel of the accessed particular redies the internet the inches in reduction to the particular redies the internet the interiment of the training

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Project L. S. 36 - Intraregional Computation in Le er and Linuori Martetray in the Vesterry Dation Creise.

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By utilizing this information the limit r and divised industry argin withinks (massionbelling control data their products mars compatibility) in price with eventibules, uni take strongthen the limit ry and local eremovies.

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The state has been divided into two regions with northern Idaho's ten counties in one region and the balance of the state designated as southern Idaho. Up-to-date sawmill lists were compiled for the two regions.

In southern Idaho the following information has been compiled to date:

TABLE 1. Mill Size and Lumber Shipments.

Intra-State

## First Destination of Lumber in Per Cent

| Mill Size<br>Class in<br>"M"/Day | No. of<br>Mills | West | Mountain<br>States | Midwest | South<br>& East | Local | Total<br>Volume (M) |
|----------------------------------|-----------------|------|--------------------|---------|-----------------|-------|---------------------|
| 0-9                              | 28              | -    | 1.8                | -       | -               | 98.2  | 5,026               |
| 10-19                            | 4               | .2   | .8                 | .1      | •2'             | 98.7  | 7,741               |
| 20-39                            | 11              | **   | 21.8               | 9.1     | 6.4             | 62.7  | 40,147              |
| 40-59                            | 2               | 5.0  | 2.5                | 62.5    | 20.0            | 2.5   | 23,500              |
| 60-100                           | 6               | 12.5 | 8.3                | 35.8    | 22.5            | 15.8  | 118,000             |
| 100+                             | 2               | 15.0 | 25.0               | 30.0    | 20.0            | 5.0   | 125,000             |

TABLE 2. Method of Lumber Transportation for 53 Southern Idaho Mills.

Inter-State

|                   | Rail  | For Hire<br>Truck | Company<br>Truck | Rail    | For Hire<br>Truck | Company<br>Truck | Total   |
|-------------------|-------|-------------------|------------------|---------|-------------------|------------------|---------|
| Volume<br>(in"M") | 3,200 | 54,719            | 12,504           | 237,813 | 14,983            | 1,195            | 324,414 |
| Per Cent          | •99   | 16.87             | 3.85             | 73.30   | 4.62              | •37              | 100.00  |

I In northern Idaho nineteen mills are being visited and data is being secured from invoices. This collection of data is not yet completed.

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

In this study, paired Douglas-fir plots have been selected in different parts of the northern Rocky Mountain area. Field sampling has consisted of removing increment cores at breast height from ten trees on each plot. The ecological conditions of the plots were evaluated at the time of sampling and at later dates when necessary. Sampling has been completed for plot pairs which consist of a Douglasfir and a spruce-fir type site.

Laboratory analysis of the cores from the Douglas-fir and spruce-fir plots has also been completed. This consisted of the determination of growth rate, specific gravity and percent summerwood. Tabulation of The state has been divided into two request with northern (decore ten counties in one region and the vitroe of the state deviation as conthern "sake. Sp-to-date deviil light were compiled for the two regions.

In conthern light the following is providen has been complied to contact

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| Total<br>Volume (M)                                      | Loool                                      | . Gdrod<br>daed A | derub25   | ntetaari<br>Station | ABAN | lo .of<br>MALLS                          | Class in   |
|--|--|-------------------|---|---------------------|------|--|--|
| 5,036<br>7,741<br>10,417<br>23,500<br>118,000<br>118,000 | 5.02<br>5.02<br>5.03<br>5.03<br>5.0<br>5.0 |                   | 2<br>2<br>2<br>3<br>5<br>4<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5 |                     |      | 20<br>2 6 2 1 1 - 2 0<br>2 6 2 1 1 - 2 0 | 049<br>10-19<br>20+39<br>1.0-59<br>60-100<br>1.004 |

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|-------------------------|---------------|---|-------------------------|----------------------------------|-------------------|----------------------|---------|
| 100,00                  | 12            |   | 25.30                   | $\partial P_{i} \mathcal{L}_{i}$ | 19.87             | Sea.                 | ino con |

I To northern light himshean alls are being visited and fate is being secured iron interfere. Tais solloction of data is not reb completed.

Project 2. R. St - influence of Forest five on the load Frepenties of

is this study, paired Douelas-fir plots have been releated in differ to parts of the northern doer nouseds area. Field sampling has possibled of reacting incompare cores at integal both from ten treas on each plot. The explosival cores at integrate when message, evaluated at the time of of plust and at hitser dreas then message. Sampling has been completed for plot pairs which consists of a loughasily and t oproce-fir type size.

Laboratory analysis of the cores from the Howflag-fir and spruse-fir plots has also been completed. This consisted of the delerministion of erowth cate, creative and percent sum twood. Tabulation of

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this information is being done in a manner that will permit use of the university computer in making a statistical analysis of the data.

This study, in cooperation with Washington State University, and the Washington Water Power Company has also been concerned with the effect of irrigation on the wood properties of living trees. Increment cores have been taken on three adjacent plots at Kettle Falls, Washington. One plot receives one watering per year; a second plot receives two waterings per year; a third no watering. The field work of removing the cores at breast height and at a height of 40 feet (at crown base) has been completed.

Laboratory analysis consists of determination of growth rate, specific gravity, percent summerwood, cell count per year and fiber length. This laboratory work is about 40 per cent complete.

# Project S. R. 55 - Identification, Biology, and Ecology of the Cone and Seed Insects of Idaho Conifers.

Since its inception in 1957, several phases of this prospect have been developed, and some have been completed. The latter include two studies dealing with insects affecting cones and seeds of western white pine; namely, (1) the biology of <u>Conophthorus</u> <u>monticolae</u> and (2) the biology of <u>Eucosma rescissoria</u>. A third study is that of <u>Barbara colfaxiana</u>, a cone-infesting moth on Douglas-fir.

New or continuing studies under way are as follows:

I. Cone and seed insects of western white pine in northern Idaho, Phase 3 - Distribution, general biologies, and seed losses in relation to stand density.

# Objectives - To determine:

(1) Relative abundance of the cone and seed insect species present, their general life cycles, and the extent of seed losses attributable to each species or species group.

(2) Whether stand density affects the intensity of insect-caused seed losses.

### Procedures

Bi-weekly collections were made from white pine in the Cathedral Peak Seed Production Areas of the Coeur d'Alene National Forest between July 7 and August 23, 1963. Four cones, taken from each of five trees from each tree spacing (8 x 8, 20 x 20, 30 x 30 feet and mixed, natural check) were sliced longitudinally along the axis. The number of larvae, and the number of insect-damaged and normal seed, were recorded for each section face. The cones were then examined, scale by scale, and the total number of larvae, this information is being done in a summer that will permit you of the university computer in cabing a storystical analysis of the data.

This story, in unoperation with anhieron itsta University, and the Washington Water Forer Coronar has also been concerned with the effect of intringtion on the wood production of 1 ving trong. Increment coron have been taken on three adjacent. Note at lettle Falls, Washington. The plot receives one starting per yours a second plot receives two materings per yours a fidering per yours a second plot work of removing the cores of preset being and at adjainst of ho feet (at grown base) has include completed.

inhorstory analysis consists of detormination of provin vate, meeting in proving percent summerwood, coll count per year and fiber longth. This inhorstory work as about 40 per text complete.

Fraject S. R. 57 - Rentilication, Biology, and Reslaw of the Cone and Seed Insects of Idaho Confers.

Since its inteption in 1957, soveral phases of this prospect have iere seveloped, and some nave been completed. The libter induces the similar dealing with intests alfeoting cones and seeds of education units since mately, (1) the biology of <u>Conscitients</u> mostacolar and (2) the biology of <u>Aucourn resciscories</u>. A main study is that of <u>Deravia collection</u>, a constituting conbourds-tire.

And an an Linking studies under vor are as follows -

 Cone and seed interview of vestors while pine in northern idato.
 Pistribuice, gateral biologies, and sual losses is relation to stand density.

Obdectites - To determine:

(1) Noistive abundance of the cone and seal insect rector promets, their reneral life cycles, and the extent of sead losses attributed of to each species or seador roup.

(2) Mether stand densit silvets the intensity of linarob-caused bood losing.

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"-workly collections were made from white pine in the Orthodral roads Send Fredretion irgan of the Coeur d'Alene Mathemai Forest baceeen Ally 7 and Aucust 23, 1963. From comps. taits from orch of five trees from each tree specing (6 ± 8, 20 ± 30, 30 ± 30 feet and mixed, natural sheet) mere eldeed for stadically along the axis. The number of farvas, and big region of insect-damaged and normal acad, were recorded for each period for total fine cones were then existing a reacted for each period for total fine cones were then existing a real by scale, and the total formate, in cones

and damaged and undamaged seeds were recorded. All larvae were preserved in alcohol for subsequent positive identification and dissection for parasitism. One additional cone from each tree and density was placed in a rearing container and a daily record of adult host and parasite emergence was maintained. These adult specimens were shipped to specialists for identification.

## Seasonal Progression of Attack

Four insect species were found infesting cones of western white pine in the study area: Eucosma rescissoriana Hein., Dioryctria abietella (D.&S.), Conophthorus monticolae Hopk., and a cecidomyiid. E. rescissoriana was found to be far more abundant than D. abietella, the latter species comprising only slightly more than five per cent of the larvae found in 640 cones, or 70 Dioryctria to 1148 Eucosma. These findings are in agreement with those obtained from more extensive collections during a previous study (Univ. Idaho F.W.R. Expt. Sta. Ann. Rept., 1962-63). Eucosma had vacated most cones by August 8, but Dioryctria larvae were present in cones collected in late August. C. monticolae larvae were found in cones until July, after which time the infested cones had dropped from the trees. These aborted cones were not collected because it was impossible to accurately ascertain from which tree they had fallen. The cecidomyiid was first recorded in early August, and was present in all subsequent collections. It is believed that this midge was present from early spring, but overlooked while in its initial instars. Positive identification has not been obtained, and one specialist reported that it does not "fit" any of the available descriptions of known species.

Dioryctria and Eucosma pupae, taken from rearing containers in October, were subjected to cold treatment of 40°F. for 1 to 2 months to break diapause. Very few moth adults (primarily D. abietella) emerged from rearing containers without exposure to cold treatment. A large majority (over 90 per cent) of <u>C. monticolae</u> emerged as adults without cold treatment.

# Seed Losses in Relation to Stand Density and Time of Collection

The average damage to the 1963 cone and seed crop in two replicates and two checks is summarized in Table 1. "Sample" losses were obtained from seed counts on longitudinal sections; "total" percent seed losses were calculated from 100 per cent seed counts from scale by scale examination of the cones. The data have not been statistically analyzed, but it is apparent that <u>E. rescissoriana</u> was responsible for the major portion of the seed losses; however, the contribution of <u>C. monticolae</u> cannot be accurately calculated due to the lack of data from aborted cones. and damaged the orthomored sector with recorded. All invite white pressived in alcohol for an equivative identification and startetion for paresition. One additional costs from and the density has claced in a reacting container and a daily record of addit host and parasite explored on additional from addit spectaces your satoped to opecialize for firstification.

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| Date | Average         | % seed<br>8x8 | loss by<br>20x20 | tree spa<br>30x30 | cing (ft.)<br>Check | Average %<br>loss; all<br>spacings | Percent<br>cones<br>damaged |
|------|-----------------|---------------|------------------|-------------------|---------------------|------------------------------------|-----------------------------|
| 7-9  | Sample<br>Total | 3.7           | 25.7<br>24.1     | 52.1<br>46.6      | 4.1<br>4.2          | 18.2                               | 52.5                        |
| 7-23 | Sample<br>Total | 5.6           | 39.4<br>34.9     | 25.4<br>21.9      | 1.4<br>1.1          | 12.4                               | 28.8                        |
| 8-6  | Sample<br>Total | 10.4          | 23.7<br>23.3     | 30.4<br>28.0      | 1.7<br>1.1          | 15.2                               | 39.4                        |
| 8-20 | Sample<br>Total | 3.9<br>3.9    | 17.7<br>18.3     | 35.9<br>35.6      | 1.0<br>0.8          | 13.2                               | 35.0                        |

Table 1. Insect-caused seed losses in western white pine in northern Idaho, 1963.

These data apparently support the hypothesis that there is an increase in insect-caused seed loss as tree spacing increases, and that a greater percent loss occurred earlier and remained at a higher level throughout the season in the less dense stands. Although not yet statistically proven, it appears that there was a close correlation in western white pine between seed loss estimates made from single longitudinal cuts through the cone axis and the actual seed loss obtained from a total count.

II. Cone and seed insects of western white pine in northern Idaho, Phase 4 - The parasites of Eucosma rescissoriana Hein., with emphasis on the biology and effectiveness of <u>Apanteles</u> starki Mason and <u>Chelonus</u> n.sp.

### Objectives - To ascertain:

(1) The progressive rates of parasitism and relative abundance of each parasite species or species group.

(2) The biology of the most important parasite species.

## Procedures

Ten insect-damaged cones of each of three trees will be bagged each week in each of several locations (including the Cathedral Peak Seed Production Areas). Five cones will be removed from each tree at weekly intervals and dissected scale by scale to determine the number and identification of the host larvae. One-half of these larvae will then be dissected to obtain progressive rates of parasitism and identification of the parasites to the nearest possible taxon. The remainder of the host larvae will be individually reared on suitable cone portions. The emerging adult parasites will be maintained on a sugar-honey-water diet and introduced into cages

| <br>14001-01<br>50.307<br>50.307 | Nversio 3<br>10st, all<br>specings | orion (17.)<br>Disole | ge nord<br>Nexct | ud seel<br>Gazes | boas 4       | ajstati          | - e*-5 |
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| 52.5                             | 5.81                               | 1.1<br>5.1            | 1.52<br>5.04     | 1.32<br>1.15     | 5+C<br>- 645 | tangla<br>Tatal  |        |
|                                  | 1.22                               | 4.1.*.<br>1.1.*.      | 1129             | 1.0.2            | 5.6          | signst<br>Tötel  | 85-5   |
| Tet.                             | 15,21                              | 1.7                   | 30.4<br>24.02    | L.ES             | 12.1         | Sample<br>Court  | 3.48   |
| 2.31                             | 3.61                               | 0, 5<br>8, 6          | 35.6             | 17.7<br>18.3     | 9.8<br>9.9   | fierplo<br>Indei | 6420   |

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The five cones left on each tree each week will be tagged as to date of treatment and allowed to develop normally. This procedure will provide a field check on emergence dates and relative abundance of the parasite species reared in the laboratory.

### Progress

Due to the late date (July) of initiation of this project phase, the major portion of the first field season was utilized in planning and testing procedures, and making collections for Phase 3. Four, bi-weekly collections have, however, established the identity and tentative relative abundance of the parasites of E. rescissoriana. This information is presented in Table 2, where "abundant" represents 20 or more parasite specimens in (at least) two collections; "numerous", 10 to 20 specimens in two collections; "common", 5 to 10 specimens in two collections; and "rare", less than 5 specimens in only one collection.

Table 2. Relative abundance of the parasites of <u>Eucosma</u> rescissoriana Hein. in northern Idaho, 1963.

| Parasite species by Family                                      | Relative Abundance |
|---|--------------------|
| Braconidae:   |                    |
| Apanteles starki Mason  | Abundant           |
| Chelonus n. sp.   | Common             |
| Eubadizon n. sp.  | Rare               |
| Eulophidae:   |                    |
| Tetrastichus coerulescens Ashm. (hyperparasite of) (A. starki.) | Rare               |
| Ichneumonidae:  |                    |
| Campoplex sp.   | Rare               |
| Pimplopterus n. sp.   | Numerous           |
| Sinophorus mutibilis (Holgren)                                  | Rare               |
| Pteromalidae:   |                    |
| Habrocytus sp.  | Rare               |
| Zacalochlora milleri Crawford                                   | Rare               |

The information in Table 2 indicates that <u>Apanteles starki</u> is the predominant species, with <u>Pimplopterus</u> n. sp. and <u>Chelonus</u> n. sp. following in that order. <u>Consequently</u>, research efforts during 1964-1965 will be directed toward acquiring information and data on the biology and effectiveness of these three species, with emphasis on A. starki. contrainty supervisits to be that a conce. Sample annual data on procreasive rates of parasitism will be obtained from timesoldy collocations and for the stary learnised portousiv (These ). Fait I)

The five cores left on each tree ends not that la targed as to date of trattment and allowed to devolop ideally. This predates will provide a field pheak of chargers dates and relative similance of the parasite species reared in the laboratory.

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One objective of this project, started in the spring of 1964, is to conduct a pilot study whose primary objective is to develop methodology for evaluating the effects of a systemic insecticide. Other objectives include: a. To ascertain the effectiveness of a systemic insecticide against the insect species attacking the cones and seeds of Rocky Mountain Douglas-fir (Pseudotsuga menziesii var. glauca (Beissn.) Franco.); b. To ascertain the effects of the insecticide on rodents feeding on the seeds, cones, or other parts of treated trees; c. To determine the concentration of the chemical within the cones and foliage, and to investigate its phytotoxic effects and its influence on seed production, viability, and seedling development.

Introduction of a systemic insecticide, methyl demeton, into coniferous trees by means of "Mauget Tree Injector Units" was proved feasible. An average of 8.75 minutes (8 to 13 minutes) per tree was required to position 8 injector units, for a total time lapse of 1.75 hours for 12 test trees. This method has the advantage of reducing hazard to operators. Each tree assimilated the systemic within 2 to 3 hours after injection.

Two cone moths, a gall midge, and a seed chalcid accounted for the greater proportion of the 21 phytophagous and entomophagous species recovered from the collected cones. Representative specimens of all species have been sent to specialists for identification.

The systemic treatment of only 24 grams per tree substantially reduced both the <u>Barbara colfaxiana</u> and gall midge populations, but had no apparent effect on the later attacking (second generation) <u>Dioryctria</u> species. Gall formation by the midges in treated trees was not entirely prevented due to the lateness of treatment (June 22); however, all larvae within these initiated galls were killed and no further gall formation occurred.

There was no evidence of phytotoxicity in any of the treated trees. Cones from treated and check trees were collected in early September and seed are being cold-treated prior to testing.

A colony of deer mice was established. Deer mice, fed cones of treated and untreated Douglas-fir seed showed no difference in responses or weight change. Seeds in cones are readily eaten by the test animals, but must be supplemented with other foods. Dermal toxicity of 50 per cent technical methyl demeton on white mice varies widely with the condition of the animal.

It is planned to repeat the same procedures in 1964-65, but using a higher dosage of methyl demeton per tree so as to produce detectable levels of phytotoxicity and mammalian toxicity for investigative purposes. Further effort will be directed to obtaining quantitative determinations of insecticide levels within treated cones and foliage. Project 12 5. 5 - Elfects of Motogl Jameton on Douglet-Fir and its - Come and Jeed Insects and Motors Indépater ofecial.

• One conjective of this project, atamted in the spring of 1904, 13 to conduct a pilot state there erran; objective is to develop insthodology for evaluating the effects of errandor intertitute. Utier objectives include: a. To accertain the effective at a systemic insecticide against the intert species attactive at a and code of Rocky fourning for lastic (<u>Epsection encoded</u>) with <u>Elanon</u> (Beisen,) France,); b. To accertain Min ericets of the <u>elanon</u> (treated treas: c. To determine the conception of the distribution on rodoms isoching on the second conce, or other parts of treated treas: c. To determine the interticute of the distribuvithin the concepted of second roduction, is blicked; elacte and the interest of the second roduction, is blicked;

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Project M. S. 4 - Methods for Estimating Recreational Visits and Use on Unattended Recreation Sites.

The primary objective of the study is to develop and evaluate methods for estimating recreational visits and use on unattended wildland recreation sites. The secondary objectives are to develop several counting devices for placement at unattended recreation sites and to evaluate these counting devices to determine their suitability for estimating recreation visits and use on these sites.

Duration of the study is estimated to be three years. The first year, the 1964 recreation season was allocated to the development of counting instruments and adapting these instruments to recreation sites. Preliminary interviewing of recreation users was also to be conducted.

The second year will be allocated to the evaluation of counter instruments and the development of recreation visit and use prediction curves. This is to be done with instrument and interview data.

The third year will be devoted to evaluation -- testing of preliminary visit and use prediction methods developed in the second year.

# Projects Inactive During the Year

Project E. S. 2 - White Pine Blister Rust Project E. S. 20 - Mortality of Young Western White Pine (Pole Blight). Project E. S. 28 - Nursery Soil Fertility Studies.

Project E. S. 37 - Direct Seeding of Coniferous Species.

# Project K. 2. 4 - Notheds for Latinating Regrational Vielts and Name on Valified Representation States.

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Project E. S. 20 - Fortulity of Young Contervite Fine (Fole Blight).

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Project L. G. 37 - Birect Section of Continuous Species.

## II. Range Management

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

Life history investigations of saltsage (<u>Atriplex nuttallii</u> S. Wats.) were continued during 1963-1964, with major emphasis on the (1) soil-plant relations, (2) taxonomy, and (3) genecology of the species.

# Soil Plant Relations

It was determined in 1962 that two distinct subspecies of saltsage occurred in the Raft River Valley, Idaho; <u>viz.</u>, <u>Atriplex</u> <u>nuttallii</u> ssp. falcata and <u>A. n. gardneri</u>. Preliminary investigation indicated that ssp. falcata occurred in nearly pure stands primarily on upland alluvial fans, while ssp. gardneri was found in nearly pure stands and mixtures with various salt-desert species on both upland and floodplain soils. A soil study was initiated during the summer of 1963 in an effort to determine if these two subspecies possessed different habitat preferences.

Samples were obtained with a soil auger at 3-inch intervals to 24 inches and at 12-inch intervals to a depth of 60 inches. Textural, salinity, pH, and soluble lime salts analyses were conducted. Salinity (E.C. x10-3) of the surface 12 inches of soil appears to be the most influential soil factor affecting site preference by the two saltsages studied. The relationship between saltsage subspecies and salinity of the surface 12 inches of soil is presented in Figure 1.





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## Taxonomy

Saltsage is a polymorphic species, comprised of at least five subspecies, and occurs throughout most of western United States and southwestern Canada. Existing taxonomic keys are inadequate for identifying saltsage subspecies, particularly in the central portion of its range.

Saltsage specimens, borrowed from the major herbaria of the West, were examined, and qualitative and quantitative taxonomic data were obtained. Petiole and pedicel length and the basic form of the fruit were found to have the greatest geographic affinities of all morphological attributes compared. Habit, leaf shape, and fruit appendagement, previously emphasized as major taxonomic criteria, were found to be too variable for critical use over much of the species' range.

# Genecology

Nine uniform saltsage nurseries were established in the fall of 1962 with 56 seed lots. These seed lots were collected from throughout the range of the species and represented five recognized subspecies. Germination, survival, growth, and phenology data were gathered on 7 of these nurseries during the summer of 1963, an exceptionally favorable year for saltsage germination and survival.

The results indicate that ecotypic variation exists at two levels within the species; viz., (1) subspecific level and (2) below the subspecific level. By and large local populations out-performed imported collections. The subspecies falcata exhibited higher survival on gravelly soils than subspecies gardneri, possibly because of the former's capacity to germinate 1-2 weeks earlier than the latter. Subspecies cuneata had the lowest survival rate. A saltsage from Manyberries, Alberta, a normally erect form of subspecies nuttallii, assumed a prostrate habit in the Raft River Valley. Other strains of the same subspecies from North Dakota and Montana retained their erect habit.

## Halogeton Seed Longevity

Brown halogeton seed buried in the Raft River Valley in 1953 was removed in the fall of 1963 and germinated at room temperature during the spring of 1964. These seeds had been buried at one and three inches with 400 seeds placed at each depth. All but 54 seeds were recovered at the end of 10 years. Two of the 800 seeds, one from each burial depth, germinated at the end of thirty days at which time the test was terminated. The seed was retained, however, since results with a comparable lot tested in 1962 indicates that dormancy may be strong in this buried seed, and not always broken in a thirty-day germination trial.

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#### Malogeton Seal Longevity

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Studies of the ecology of medusahead were continued with emphasis on seed longevity and dormancy and the influence of site characteristics upon the dominance of this species.

Field germination trials were conducted on an area in Nez Perce county dominated by a mixture of medusahead and several species of annual brome. Of the seeds available in the fall of 1963, survival by June of 1964 either as plants or as ungerminated seed was 45 per cent for medusahead compared to 3 per cent for cheatgrass (Bromus tectorum) and 42 per cent for other annual bromes. Comparable figures for 1962-63 were 45, 31 and 26 per cent respectively. While the causes of this difference in survival rate are not fully understood, it seems evident that the consistently greater survival of medusahead must give it an advantage in competition with the annual bromes.

Studies made in 1962 indicated that there may be a field-induced dormancy in medusahead and cheatgrass seed which begins as early as November. This phenomenon was tested by collecting medusahead seed in October, 1963, and dividing it into five lots placed into fiberglass packets. One of these packets was brought into the laboratory at the time of collection while the others were left in the field and brought into the lab at intervals during the winter. Material brought into the laboratory on October 3 and November 16 germinated readily, although the November lot required 60 days for maximum germination compared to 45 days for the October lot. Seed brought into the laboratory on February 17 had a germination rate of only 46 per cent in 45 days and only 74 per cent in 101 days. These data indicate that there is winterinduced dormancy in medusahead which is not completely overcome until late in the spring. Thus many of the seeds that do not germinate in the fall may remain dormant during the following spring also and be available for germination in the following autumn.

Due to the undesirable nature of medusahead, there is interest in the possibilities of disease organisms which might have some effect in controlling it. The species of annual brome growing in Idaho are susceptible to head smut and heavy infestations of this disease occurred in 1963 and 1964. An intensive search revealed no head smut on medusahead during either of these two years. During germination trials in 1963, a black horny-appearing organism was noticed on both medusahead and annual brome seeds collected from Nez Perce county. Medusahead seed appeared more resistant than the bromes, but the degree of infestation became more pronounced as the winter advanced. By January, six per cent of the remaining medusahead seeds, 46 per cent of the cheatgrass and 33 per cent of the other annual brome seeds were affected. The organism responsible was identified in the summer of 1964 as Podosporiella verticellata, a soil borne fungus which affects cereal grains and some range grasses. Species known to

# rotart E. S. 8 (L.M. 27-D) - Louis vielent an Control of Federationd,

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Studies - to in 1962 instanted that it of any as a flatd-induced dormany, is reducated as choseness and which begins in each as forement. This phonement realization is obligating an each stand in detect, 1963, and limiting is itso he lots phonen into liber less backtas. One of there wackers was brough into the liber less backtas. One of there wackers was brough into the dim the field and intertion of the liber limiting in the starts. Storiel from the into the liber will be store by and the inte field and intertion of the liber will be been used being the field and intertion of the liber will be been used in the dimension of the liber of a store the liber will be been used in the biddress of a store of the liber of the liber will be been as the liber when it is the store of the liber of the between the term of the Oscober lot. Seed brought into the termster of the store of the detect of the store of the liber of the best and to be the intertion. In 101 days, finder of the termster of the store of induced to the term of the period to the store of the induced to the termster. These and to be the termster induced to the termster in the period to be the store of induced to the termster. The period is the second will be induced to the termster in the period to be the termster induced to the termster in the period to be the termster of the induced to the termster. The period to be the termster of the second termster in the second be and the termster of the termster is string.

One to the undestrable mature of on a shead, there is interest in the nearly different of discrete of parties which wight have some effect in evolveding it. The measure of annual order growing the iddae are super tisks to head from the evolve heavy universities of this intrine accurred in 1961 and 1962, as internative rearch revealed no head soul on exchanges which wither of these to years. Northly established to both multiple of these to originate was noticed on both multiple of the static spearing collected from be for each and to be a solution of these to a collected from be for each multiple of the both appearing areas and the forces, but an an each of all and a point reads and the torest, but are an each of a multiple of the sector protocored as the visitor evolution of all and a point reads and the torest, but are an each of a multiple of the reads of the torest, but are an each of a multiple of the sector. The the state of the other and the sector is an areas and the torest, the state and the state of the chart of the torest, and the other and the state of the chart grade and the organism responsible was investigated for an each of the torest, and of the state and the state of 1901 as fodesponentials vertical lates are bound of a state of the torest and and and the states of the states and at the state of the states and and the states of the states and the torest and the states and and the states of the states and at the states and and an and the states of the states of the states and at the states and and and the states of the states of the states and at the states and and and the states of the states of the states and at the to areas states and and a states of the states of the states and the at the states and the states and and the states of the states and the be susceptible to this fungus include the crested wheatgrass group, intermediate wheatgrass, smoth brome, mountain brome and cheatgrass. No reference to medusahead as a host for this organism has been found.

Material from the seed burial experiment initiated in 1960 was evaluated again this year. The number of seeds germinating is shown below:

| Site Depth | Original  | Plump Seeds    | Seeds       | Germination |         |
|------------|-----------|----------------|-------------|-------------|---------|
| (ins.)     | No. Seeds | Remaining 1963 | Germinating | 1963        | Percent |
| 12         | 700       | 8              | 8           |             | 1,1     |
| 112        | 800       | 6              | 4           |             | 0.5     |
| 3          | 800       | 6              | 3           |             | 0.4     |
| 6          | 800       | 0              | 0           |             | 0       |

The data indicate the longevity possible for at least a small percentage of the seed of this species.

An attempt to determine the relative tolerance of medusahead and cheatgrass to poor soil aeration was made under laboratory methods. The results indicated that both species can survive considerable soil flooding, although adverse effects were indicated by the high proportion of dead leaves. Under severe conditions of flooding, the percentage mortality for cheatgrass plants was greater than for medusahead.

A major effort was made to determine the site characteristics responsible for domination by cheatgrass or medusahead on particular stands. Twenty-five site characteristics were measured on 43 sites in the course of this study. These included soil and topographic characteristics as well as associated vegetation. The data from this study are currently being analyzed by I. B. M. methods.

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

A major step toward automatic data processing of our sagebrush-grass data was taken this year. Vegetation data collected during the nine previous years on 94 relatively undisturbed stands were transscribed and key punched on to more than 4000 I.B.M. cards. Each card represents the summarized transect data of individual species. Essentially a card contains the site identification, transect number, species, basal area and frequency for each species found in a series of ten plots. In addition, data on crown cover, density by height class and average height of shrub species per transect are recorded.

The principal credit for the design of the card layout for ADP goes to Dr. Charles E. Poulton of Oregon State University. Collaborating with the range management personnel of the F.W.R. Experiment Station, he undertook the burden of designing the be supportively to which there the back the orestation reaction of the support of the second state of the

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Frederic R. S. 9 (2-289) - Sealery of Strabult constants

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To permit wide usage of machine processing of data collected in vegetation studies throughout the Pacific Northwest, the names of more than 3500 plant species that are now expressed in alpha code (the four-letter symbol for plant species) are being converted to a numerical code. This is necessary because most computers are not designed to process alpha code entries directly. The conversion of alpha to numeric code for plant species is in the final stages of editing.

The vegetation and soils of five relatively undisturbed sagebrushgrass stands were sampled. The stands were located in selected plant associations with the hope that their study would provide greater understanding of communities dominated by Artemisia tripartita and A. longiloba. The dominance and geographic distribution of these two species are poorly understood. An objective separation between A. tripartita and some A. tridentata sites based on interpretation of climate and soils has not been successful. The segregation between A. longiloba and A. arbuscula sites has been equally frustrating.

In addition to the study of undisturbed sites, four seral stands were intensively sampled with a modified method. A more rapid method of sampling is sought to study seral vegetation. In the stands sampled, basal area estimates were omitted and only frequency of occurrence data for understory species were recorded. Frequency percentage was determined from nested plots containing five different sizes, ranging from 1 to 288 square inches. This method is more rapid and less subject to bias by the observer than basal estimates because only one decision needs to be made is the plant rooted within or without the plot boundary? It is hoped that seral stages can be more easily differentiated by this nest plot frequency method than placing reliance on frequency percentage based on a single plot size. Evaluation of the merits of the nested plot is being investigated with artificial populations having known parameters.

An attempt to establish a second sagebrush thinning study near Idaho Falls was thwarted because of unsatisfactory kill of sagebrush. To minimize disturbance and leave the dead sagebrush in an upright position, the basal portion of individual shrubs was hand sprayed with a recommended mixture of 2-4-5-T and diesel oil in June. More than 2300 individuals were treated but kill was less than 30 per cent. Insufficient penetration of the chemical solution through the absorbent shreddy bark of old sagebrush was probably the primary reason for the poor showing. This experiment will be initiated again next year with careful foliar application of 2-4-D to minimize injury to forbs in the understory.

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Annual yield studies were continued in two sagebrush-grass associations for the sixth consecutive year. Yields from the two areas will probably be discontinued after next year and moved to another area to compare yields in a dwarf sagebrush (<u>A. arbuscula</u>) and an adjacent big sagebrush (<u>A. tridentata</u>) community.

A tentative classification of major sagebrush-grass associations in southern Idaho is in Table 1. Only those communities with a clear shrub dominance of the genus Artemisia (or Eriogonum) are included. It is recognized that other shrub and even small tree species (e.g. Purshia tridentata, Cercocarpus ledifolius and Juniperus spp.) may be co-dominant with sagebrush in some communities. These situations are not included in the presented classification scheme. The nomenclature of the association is based on the dominant member of the shrub layer and the dominant understory species of relatively undisturbed sagebrush-grass communities.

The classification scheme attempts to show that sagebrush-grass vegetation is influenced by both climate (represented by soil zones) and soils. Associations controlled by climate are indicated under the category, "Zonal Series". These associations occur on "normal" soils. Within a given climatic range, edaphic features may exert sufficient influence to develop a vegetation different from those in the Zonal Series, and these are grouped under "Edaphic Series".

There remain gaps in the classification. Part of this cannot be resolved because a particular edaphic feature may not exist across the entire climatic range encompassed in the study. Other gaps occur because some communities on a particular edaphic condition (e.g. parent material) may not have been examined. The climatic range of an association is arbitrarily delimited. With further study, the boundaries of some associations may be revised.

The relation between sagebrush-grass vegetation and the influence of climate and soils is grossly simplified in this presentation. Except for moisture, the major components of "climate", particularly temperature and seasonal distributional pattern of precipitation, are ignored. Some edaphic features are obscured because they are lumped into broad categories. With refinement of major environmental features, the classification scheme would be improved. This would not alter the classification of plant associations, but would better indicate under what conditions a particular association is likely to occur.

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Table 1. Tentative classification scheme of major sagebrush-grass associations as related to precipitation (soil zones) and major breakdown of parent material.

| * | ARTR-AGSP   | Artemisia | tridentata-Agropyron spicatum          |
|---|-------------|-----------|--|
|   | ARTR-FEID   | Artemisia | tridentata-Festuca idahoensis          |
|   | ARTR-STCO2  | Artemisia | tridentataStipa comata                 |
|   | ARTR-STTH   | Artemisia | tridentataStipa thurberiana            |
|   | ARTRV-STCO  | Artemisia | tridentata vaseyana-Stipa columbiana   |
|   | ARTRV-FEID  | Artemisia | tridentata vaseyana-Festuca idahoensis |
|   | ARTR2-AGSP  | Artemisia | tripartita-Agropyron spicatum          |
|   | ARTR2-FEID  | Artemisia | tripartita-Festuca idahoensis          |
|   | ARAR-AGSP   | Artemisia | arbuscula-Agropyron spicatum           |
|   | ARAR-FEID   | Artemisia | arbuscula-Festuca idahoensis           |
|   | ARLO2-FEID  | Artemisia | longiloba-Festuca idahoensis           |
|   | ARNO-AGSP   | Artemisia | nova-Agropyron spicatum                |
|   | ARRI-POSE   | Artemisia | rigida-Poa secunda                     |
|   | ERTH-POSE   | Eriogonum | thymoides-Poa secunda                  |
|   | ARCAV-CAREX | Artemisia | cana viscidula - Carex complex         |
|   |             |           |  |

# MAJOR SAGEBRUSH-GRASS ASSOCIATIONS\* IN SOUTHERN IDAHO (TENTATIVE CLASSIFICATION)



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

The average number of ant clearings in the good condition saltsage plots remained the same as 1962. The average number per acre in the depleted saltsage increased from 47.3 in 1962 to 51.0 in 1963 and from 13.5 to 19.7 in the depleted shadscale area. The favorable growing conditions in the spring of 1963 gave rise to an abundance of annual plant species in the two depleted areas and thus may have had some influence on the increased number of clearings in the depleted areas.

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

Growing conditions at the Point Springs pasture area were the most favorable in 1963 of any year during the time of the study. Precipitation from December 1, 1962, to December 6, 1963, was 20.4 inches with 7.79 inches falling from April 5, 1963, to June 10, 1963.

Precipitation in August and September was adequate to start green growth on the crested wheatgrass in the fall of 1963. Cold temperatures during the last part of September and through October, however, prevented any sizeable increase in production from this source.

### Spring Trial

The air dry forage production and utilization for the spring are shown in table 1. The normal 45 day grazing period was extended to 84 days so that a more desirable utilization level could be achieved. Production was roughly 200 to 500 pounds greater in 1963 than 1962.

Livestock gains for the spring and fall periods are given in table 2. Total gain per animal and gain per acre increased in 1963 over 1962 during the spring period while average daily gain and acres per animal month decreased as a result of the greater forage production and extended grazing period.

#### Fall Trial

Dry forage yields were roughly 400 to 650 pounds more in the fall of 1963 than in 1962, table 3.

Livestock weight and gains are shown in table 2. Average daily gain as well as gain per animal was higher in 1962 than in 1963. Gain per acre, however, was less in 1962 than in 1963.

Combined spring and fall gains per acre were generally greater than those pastures used only in a single season, table 2. Project E. S. II. - Livertightons of Harvester Ants on Southern Idaho

The everys indices of any clearings in the good pondition saturage plots repaired the same as 1962. The svers a marker per vers in the depleted soltsage increased from 17.3 is 1962 to 51.0 is 1963 and from 15.5 to 10.7 is the depleted shadeche area. The favorable growin, conditions in the spring of 1963 yave rise to an abundance of montal plant spaces in the two depleted areas and thus may have bad here influence on the increased number of clarings in the depleted areas.

Project E. S. 26 - Evaluation of Range Reseatings

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Presidentiation in Adgust and September has dequate to start grean growth on the errated wheat great in the full of 1963. Cold togen during the last part of September and through October, nowever, provented any closelies increase in production from this squares.

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Cochtinal apring and fall rains per are sure superally greater

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| Pasture No. | Intensity<br>of Use | 1963<br>Initial<br>Initial Production<br>Production Plus Growth Utiliz<br>lbs./acre lbs./acre Perc |      |    |  |  |
|-------------|---------------------|--|------|----|--|--|
| 02          | Light               | 418  | 881  | 58 |  |  |
| 05          | Moderate            | 324  | 988  | 55 |  |  |
| 03          | Heavy               | 181  | 660  | 87 |  |  |
| 10          | Moderate            | 247  | 990  | 56 |  |  |
| 20          | Light               | 266  | 858  | 63 |  |  |
| 30          | Moderate            | 192  | 822  | 54 |  |  |
| 40          | Light               | 209  | 970  | 46 |  |  |
| 50          | Moderate            | 222  | 911  | 50 |  |  |
| 60          | Light               | 272  | 1036 | 46 |  |  |

# Table 1. AVERAGE AIR DRY FORAGE PRODUCTION AND UTILIZATION FOR THE SPRING GRAZING TRIALS, 1963.

Table 3. AIR DRY FORAGE PRODUCTION AND UTILIZATION FOR THE FALL GRAZING TRIALS OF 1962 AND 1963.

|             | 1963                |                                    |                        |  |  |  |  |
|-------------|---------------------|------------------------------------|------------------------|--|--|--|--|
| Pasture No. | Intensity<br>of Use | Initial<br>Production<br>Ibs./acre | Utilization<br>Percent |  |  |  |  |
| 01          | Light               | 1110                               | 38                     |  |  |  |  |
| 06          | Moderate            | 1177                               | 56                     |  |  |  |  |
| 04          | Heavy               | 810                                | 75                     |  |  |  |  |
| 10          | Heavy               | 31/4                               | 49                     |  |  |  |  |
| 20          | Light               | 258                                | 33                     |  |  |  |  |
| 30          | Moderate            | 299                                | 49                     |  |  |  |  |
| 40          | Heavy               | 417                                | 47                     |  |  |  |  |
| 50          | Light               | 408                                | ?                      |  |  |  |  |
| 60          | Moderate            | 429                                | 48                     |  |  |  |  |
|             |                     |                                    |                        |  |  |  |  |

| 1 | and the second second  | and the second second BARLES.                         |                                    |                             |             |  |  |  |
|---|------------------------|---|------------------------------------|-----------------------------|-------------|--|--|--|
|   | notisatiitu<br>Parocat | Productici<br>Productici<br>Pline Growth<br>Low, Jack | Initial<br>Production<br>Ibs./acre | ya kanada I<br>nga kanada I | Partura So. |  |  |  |
|   |                        | **288   | 418                                | đajki                       |             |  |  |  |
|   | 55                     | 998   |                                    | Nederate                    | 05'         |  |  |  |
|   |                        | 660   | 181                                | liowy                       | . 80        |  |  |  |
|   | 56                     | 099   | 247                                | Modérate                    |             |  |  |  |
|   | 63                     | 858   |                                    | Light                       | 05          |  |  |  |
|   | · Le                   | 822   |                                    | Moderate                    |             |  |  |  |
|   | àń                     | 970   | 209                                |                             |             |  |  |  |
|   | 62                     |   |                                    | Moderate                    | 50          |  |  |  |
|   | 16.                    | 1036  | 272                                | Mght                        |             |  |  |  |

Table 1. APURAS AIR DRI DRI PORAIS PRODUCTION LAD UTILIZATION FOR THE SENT'S GRAZING THANS, 1953.

TABLE 3. AIR DRY FORAGE FRODITION AND UTILIZATION FOR THE FALL ORAZING THIALS OF 1962 AND 1953.

| 34- |                        | 1963                                 |                     |             |
|-----|------------------------|--------------------------------------|---------------------|-------------|
|     | Utilization<br>Percent | Initial<br>Production<br>Ibs. (acre- | Inbearity<br>of 510 | Pathie flor |
|     |                        | 1110                                 | Light               | 1. 10       |
|     | 56                     | 1177                                 | Hoderate            |             |
|     | 75                     |                                      | Heavy               |             |
|     |                        | atte                                 | VyasH               |             |
|     | 33                     | 250 "                                | . dityEI            | 20          |
|     | e.d                    | 299                                  | Noderato            | 30          |
|     | 67                     | 117                                  |                     | · 01        |
|     |                        | Boil                                 | Light .             | ·* 02       |
|     | <u>4</u> 8             | 129                                  | Moderate            | at 00       |

31. .

|                | 1963   |   |   |  |   |  |  |
|----------------|--|---|---|--|---|--|--|
|                |  | an Arres/   |   |  |   |  |  |
| Season         | Intensity  | Weight  | Animal  | Animal   | Acre.   | Animal Month   |  |
| Spring         | Light  | 460   | 160   | 1.9  | 68.7  | 0.85   |  |
| Spring         | Moderate   | 463   | 169   | 2.0  | 71.4  | 0.85   |  |
| Spring         | Heavy  | 463   | 147   | 1.8  | 76.8  | 0.76   |  |
| Fall           | Light  | 592   | 37.2  | 0.8  | 28.0  | 0.9  |  |
| Fall           | Moderate   | 593   | 27.0  | 0.6  | 25.0  | 0.7  |  |
| Fall           | Heavy  | 591   | 37.4  | 0.8  | 38.0  | 0.7  |  |
| Spring<br>Fall | Moderate<br>Heavy  | 491<br>614  | 171.8<br>38.9   | 2.0<br>0.9   | 73.4<br>18.2<br>91.6  | 0.8<br><u>1.5</u><br>0.5   |  |
| Spring<br>Fall | Light<br>Light   | 436<br>580  | 171.9<br>44.8   | 2.0<br>1.0   | 72.2<br>11.2<br>83.4  | 0.8<br>2.7<br>0.6  |  |
| Spring<br>Fall | Moderate<br>Moderate   | 490<br>588  | 183.0<br>45.2   | 2.2<br>1.0   | 59.7<br><u>13.6</u><br>73.3   | 1.0<br>2.0<br>0.7  |  |
| Spring<br>Fall | Light<br>Heavy   | 453<br>577  | 180.9<br>54.1   | 2.2<br>1.2   | 59.1<br>28.4<br>87.5  | 1.1<br>1.3<br>0.6  |  |
| Spring<br>Fall | Moderate<br>Light  | 481<br>590  | 171.3<br>80.8   | 2.0<br>1.8   | 61.1<br>20.8<br>81.9  | 1.0<br>2.5<br>0.7  |  |
| Spring<br>Fall | Light<br>Moderate  | 442°<br>596   | 178.9<br>53.4   | 211<br>1.2   | 63.8<br>22.7<br>86.5  | 1.0<br><u>1.5</u><br>0.6   |  |
|                | Season<br>Spring<br>Spring<br>Fall<br>Fall<br>Spring<br>Fall<br>Spring<br>Fall<br>Spring<br>Fall<br>Spring<br>Fall<br>Spring<br>Fall<br>Spring<br>Fall<br>Spring<br>Fall | SeasonIntensitySpringLightSpringModerateSpringHeavyFallLightFallModerateFallHeavySpringModerateFallLightSpringModerateFallLightSpringLightSpringModerateFallLightSpringLightSpringLightSpringLightFallLightSpringLightFallLightSpringLightFallModerateSpringLightFallLightSpringLightFallLightSpringLightSpringLightFallLight | SeasonIntensityAvg.<br>InitialSpringLight460SpringModerate463SpringHeavy463FallLight592FallModerate593FallHeavy591SpringModerate491FallLight436SpringLight436SpringLight436SpringLight436SpringLight436SpringLight436SpringLight436SpringLight436SpringLight436SpringLight453FallLight453SpringLight453FallLight453SpringLight453FallLight590SpringLight481FallLight590SpringLight426SpringLight590 | 19Avg.Avg.InitialTotal Gain/<br>AnimalSpringLight460SpringModerate463SpringMeavy463SpringHeavy463SpringHeavy463FallLight592FallModerate593FallModerate593SpringModerate491SpringModerate491SpringModerate491FallHeavy511SpringModerate490SpringModerate490FallModerate588SpringModerate588SpringModerate588SpringLight453SpringLight453SpringModerate481SpringModerate481SpringModerate481SpringLight590SpringLight596SpringLight442SpringLight596SpringLight596SpringLight596SpringLight596SpringLight596SpringLight596SpringSo.8SpringLight596So.4596SpringLight596SpringLight596So.4596So.4596So.4596So | 1963Avg. Avg. Avg. Dai<br>Initial Total Gain/ Gain/<br>Spring Light 460 160 1.9Spring Light 460 160 1.9Spring Moderate 463 169 2.0Spring Heavy 463 147 1.8Fall Light 592 37.2 0.8Fall Moderate 593 27.0 0.6Fall Heavy 591 37.4 0.8Spring Moderate 491 171.8 2.0Spring Light 436 171.9 2.0Fall Light 580 44.8 1.0Spring Light 436 171.9 2.0Spring Moderate 490 183.0 2.2Fall Moderate 588 45.2 1.0Spring Moderate 490 183.0 2.2Fall Heavy 577 54.1 1.2Spring Light 481 171.3 2.0Spring 1.1 191 192 178.9 2.1Spring 1.1 193 102 178.9 2.1Spring 1.1 193 102 178.9 1.2 | 1963           Avg.<br>Initial         Avg.<br>Total Gain/<br>Animal         Avg.<br>Gain/<br>Animal         Animal<br>Acra.           Spring         Light         460         160         1.9         68.7           Spring         Light         463         169         2.0         71.4           Spring         Moderate         463         169         2.0         71.4           Spring         Heavy         463         147         1.8         76.8           Fall         Light         592         37.2         0.8         28.0           Fall         Moderate         593         27.0         0.6         25.0           Fall         Moderate         593         27.0         0.6         25.0           Fall         Heavy         591         37.4         0.8         38.0           Spring         Moderate         491         171.8         2.0         73.4           Fall         Heavy         614         38.9         0.9         18.2           Spring         Light         436         171.9         2.0         72.2           Fall         Heavy         577         54.1         1.0         13.6 |  |

Table 2. LIVESTOCK WEIGHTS, GAINS, AND STOCKING RATE BY PASTURE AND SEASON DURING 1963.

| E & 194                  |                       |                              | 5                            |                            |                            |                 |                    |
|--------------------------|-----------------------|------------------------------|------------------------------|----------------------------|----------------------------|-----------------|--------------------|
| Leres/                   | ly<br>Galay<br>Aore   | Avic Data<br>Gata/<br>Animal | Avg.<br>Total Gain<br>Animal | Avga<br>Initial<br>Mei yht | Thismoth                   | 1008898         | Prestore<br>Number |
|                          | F.30                  | 2.9                          |                              | 034                        | driptd                     | gabage          |                    |
| 0.85                     | 72.44                 | 0,5                          | 269                          | 684                        | Moderate                   | Spring          |                    |
| 67.0                     | 6.37                  | S.L                          |                              | 263                        |                            |                 |                    |
| 0.0                      | 26.07                 | 6,8                          | 37.8                         |                            | - \$10.1.1                 |                 |                    |
| 1.0                      | 25.0                  | 3.0                          | 27,0                         |                            | Hoderata                   | F831            |                    |
| 0.7                      | 0,85                  | 8.9                          | 3Vela                        | 591.                       |                            |                 |                    |
| 0.6<br>1.5<br>0.5        | 73.1<br>18.2<br>91.6  | 0.5<br>Re0                   | 8.171<br>9.85                | h91<br>61L                 | iloderatie<br>Heevy        | Spring<br>Pall  | 10!                |
| 8.0<br>3.3<br>0.0        | 72.2                  | 2.0                          | 172.9<br>9.44                | 436<br>580                 | tin 11<br>tin 11<br>tin 11 | Spring<br>Fall  |                    |
| 1.0<br>240<br>0.7        | 1.8<br>3.0<br>6.0     | 2.2<br>1.0                   | 18349 \<br>1548              |                            | Moderate<br>Hoderate       | Spring<br>Fall  |                    |
| 1+1<br><u>1+3</u><br>0+6 | 5911<br>2611<br>87.5  | 2+2<br>1-2                   | 180,9<br>91                  | 62.1<br>577                | Light .<br>Hoavy           | Spring:<br>Pall |                    |
| 2.5<br>2.5<br>0.7        | 61.1.<br>50.6<br>81.9 | 042<br>841                   | 171+3 ·<br>80+8              |                            | Medarate<br>Light          | Spring<br>Full  |                    |
| 1.0<br>1.5<br>0.6        | 8.88<br>7.55<br>2.88  | 2.1<br>1.2                   | 178,99<br>53,6               | 596-<br>596-               | 14ght)<br>Noderate .       |                 |                    |

Table 2. LIVETCOM MIGHTS, MINS, AND STOCKED HATS AT PASTORS AND SEASON DURING 1963.
Project S. R. 95 - A Ten-Year Evaluation of Range Reseeding in Idaho.

This project was started July 1, 1963. Its objectives are to evaluate the benefits accruing from range improvement through reseeding of depleted or low-producing range lands.

Stand density of crested wheatgrass seedings at five locations in southern Idaho have been followed over a ten-year period. The density of a seeded species would be expected to fluctua'e until the population acquired a level somewhat adjusted to the particular environment of the reseeded area. Crested wheatgrass is known to be able to adapt to the habitat of Idaho sagebrushgrass ranges. The density changes (Figure 1) for the first four years (1954-1957) illustrate the population fluctuation as the stands become adjusted to their separate environments.

The precipitation in 1957 was favorable for the establishment of seedlings; and a general increase in the crested wheatgrass density was noticed the following year. Several dry years followed the 1958 season. During this dry period the stands generally declined in density. Other factors, such as grazing influence the stand density of crested wheatgrass, however, precipitation during the early spring growing period appears to be extremely important in determining population variations.

# Project M. S. 1 - Site Relationships and Productivity of Foothill Woodland Shrub Grazing Lands in Idaho.

This project was begun in June, 1964, with the support from the newly passed McIntire-Stennis Bill. The objective is to ascertain the habitat factors associated with the distribution of vegetation in the foothill zones, and to characterize the major vegetationsoil complexes.

The initial phase of the study will be largely confined to the Juniper zone. While this zone is not a large one in Idaho (approximate area 1.5 million acres), it is of considerable importance for spring-fall grazing.by livestock and big game. Other factors favoring its study include its close relationship to the sagebrush-grass region and the fact that in places the Juniper appears to have been spreading into sagebrush-grass vegetation.

Active field work on the project was not begun until July 1, 1964, when Wayne Burkhardt, a graduate assistant was assigned to the project. Plans for the field season of 1964 include a reconnaissance of the entire Juniper Zone in Idaho, and development of methods for sampling the vegetation.

# Projects Inactive During the Year

Project E. S. 13 - Ecotypic Variation in Idaho Range Species. Project E. S. 32 - Ecology and Control of Goatweed (Hypericum Perforatum). Project E. S. 34 - Ecology of the Grasslands of Northern Idaho. Project S. R. 95 - A Ten-lear Systuction of Range Researing in Idaho,

This project was started July 1, 1963. Its objectives are to evaluate the benefits accounty from range imprevenent through receding of debleted or low-producing range lands.

Stand denuity of created wheaterass soudings at five locations in southern light have been followed over a ten-year period. The density of a sended speakes would be expected to fluctuate until the portistics acquired a level somethat adjusted to the particular environment of the rescoded area. Greated wheatgrass is habin to be dole to adapt to the half at of light angebraic grass ranges. The density changes (rights 1) for the first four years (1950-1957) filestrate the population fluctuation as its stands become adjusted to their separate environments.

The procipitation in 1957 was favorable for the entablichtunt of scedings; and a general increase in the created wheatgrass density was noticed the following year, Several duy years followed the 1958 season. During this duy period the stands generally decided in density. Other factors, such is graving influence the stand density of created wheatgrass, however, precipitation during the early spring growing period appears to be extremely important in determining requiration variations.

# Project N. S. I - Site Relationships and Productivity of Posthill Woodland Shrub Grazing Lands in Idaho.

This project was begun in June, 1966, with the appart from the newly passed holntire-Steamin 2411. The objective is to encertain the hebitat factors associated with the distribution of vegetation in the foothill somes, and to characterize the major wagetationsoil complexes.

The initial phase of the study will be largely confined to the Juniper zone. While this zone is not a large and in Idaho (approximate area 1.5 militon cares), it is an of considerable importance for spring-fall grasingly livestock and big game. Other factors favoring its study include its close reictionship to the sagebruch-grass region and the fact that in places the Juniper appends to have been byreading into sagebruch-grass vegetation.

Active field work on the project was not begin until July 1, 1964, when bayne Durkhardt, a graduate ansistant was analyzed to the project. Flams for the field season of 1962 include a regonnalesance of the entire Juniper Zone in Julio, and development of methods for sampling the wigetation.

# Projects Inastive Buring the Keer

Project E. S. 13 - Ecology and Control Cabbo Hange Specied. Project E. S. 32 - Ecology and Control of Contanted (Hypericum Parforatum). Project E. S. 31 - Ecology of the Oracelands of Acthem. Idaho.



Figure 1. Variation of Crested Wheatgrass Density Over a Nine-Year Period for Five Reseeded Southern Idaho Ranges.





### III. Wildlife Management

# Project WU-14 - Availability of Deer Browse Under Varying Snow Conditions.

This project was reactivated this last year when favorable snow conditions developed. Originally begun in 1954, this project has been inactive because of lack of snow in suitable amounts.

The study aims at correlating the depth and density of snow with the availability of big game browse plants. Four key species were chosen; willow, serviceberry, redstemmed ceanothus and Western red cedar.

Ceanothus was most subject to bending by snow of the species studied. Density of the snow is of major importance in determining how much of the current annual growth will be exposed above the snow pack. Light fluffy snow of low water content has little effect. Heavy wet snow will bend the branches nearly to the ground and if freezing follows and the snow pack builds on this base, the maximum impact of the snow is noted. However, a light snow of low moisture content will gradually settle, become more dense and gradually force down the ceanothus branches and make more of them unavailable. By early February a sample of 11 ceanothus shrubs in an open site showed only 23 per cent of the total current annual growth above the snow pack. At that time the snow was 29.4 inches in depth with a water content of 6.4 inches. These samples were within an exclosure where deer use could not affect measurements of available browse. Another sample of nine ceanothus shrubs indicated 29 per cent of the current growth available during the same week in early February. These shrubs were browsed by deer but were in a different site with less snow.

During the past winter serviceberry and willow were not measurably effected by the snow. Stands of these shrubs in the sample are five feet or more in height and generally above the snow pack.

Western red cedar is measurably effected by snow. In one sample of 10 cedar trees ranging from 7 to 10 feet in height, 46 per cent of the total branch length up to  $6\frac{1}{2}$  feet above the ground was available on January 30. Snow depths on the site averaged 26.6 inches with a moisture content of 6.9 inches. Another sample of 10 cedar trees measured on the same basis was 42 per cent available on February 6. On this site snow depth was 26.2 inches with a moisture content of 7.8 inches. The relation of cedar availability to snow depth is more complicated than that of ceanothus. While lower limbs are covered by the snow the upper limbs are bent lower and along with small tree tops are bent down placing more branches within the zone of utilization. In extreme cases of bending, small trees may have one side exposed while the top is under the snow. Only the upper half of the recumbent tree may be browsed.

# "II. Wildlife Managament

Frofest MU-11 - Availability of Deer Norwoo Under Varying Srow Couditions.

This project was reactivated this last year when favorable and . conditions leveloped. Orightally of an in 1951, this project has . been inactive because of lack of in 19 in the subtable converse.

The study aims at correlating the level and density of snow with the availability of big gave browse plonis. Four way speales were chosen willow, serviceberry, rediterned cosmothus and Western red cedar.

Coanothus was most subject to bending by snow of the spacing studied. Censity of the anow is of major importance in determining how much of the current annual grouts will be expered above the anow pack. itcht flaffy show of low water content has little effect. Seavy wet grow will bend the branches namely to the ground and if freezing to inadel manixed bit also and to ablive road bas would be maximum impact of the anow is noted. However, a light anow of low monsture content will gradually settle, become more dense and gradually force down the connervations branches and make here of them unavailable. By early February a sample of 11 ceanothus survice in an open sits showed only 23 per out of the total current around growth above the snow pack. At that they the snow was 29.4 inches in Lapthwith a water cratent of 5.4 inches. These scories were within an exclosure where deen use could not affort measurements of available browse. Another sample of nine cosmothus chrubs indicated 29 per cent of the current growth available during the same week in carly February. These shruls mare browsed by fact but were in a

During the past whiter serviceborry and while were not seasurably will at a standard of those should be the sample are fixed by the show a back and generally there the snew mark.

Western and cedar is ressurably affected by snow. In one sample of 10 redar three ranging from 7 to 10 foot in neight, hd per cent of the total braich length up to (A fect above the ground was available on landary 30. Show depths on the site averaged 26.6 thetas with a solutions content of (A fect above the averaged 26.6 thetas with a solutions content of (A fect above the averaged 26.6 thetas with a solutions content of (A fect above the averaged 26.6 thetas with a solutions content of (A fect above the set averaged 26.6 thetas with a solutions content of (A fect above the set averaged 26.6 the set these measured on the same busis was 12 our cent available on february 6. In this site anow depth was 20.2 increas with a to show tepth is more complicated than that of contrine. While to anow tepth is more complicated than that of contrine. While lower limbs are covered to the same best depth was contained while the start the total time tops are best depth while that of starts are covered to the same best depth of contains while the start has a lower one side expanded while the top is under the show. The trees may have one side expanded while the top is under the show. Project WU-37 - The Ecology and Management of Browse on Elk Winter Range, Selway-Bitterroot Wilderness Area, Idaho.

Chemical analysis was made of red stem ceanothus, <u>Ceanothus</u> <u>sanguineus</u>, mountain maple, <u>Acer glabrum</u>, and willow, <u>Salix</u> spp. in mid-November and mid-April. Two to three inches of the annual growth of unbrowsed twigs were clipped from shrubs selected randomly for about a mile along the lower slopes of Gedney Creek until approximately two pounds of browse were clipped from each species.

|           | Fat             | Crude<br>Fiber | Ash          | H20          | Protein      | NFE            | F.W.      | Ca   | P            |
|-----------|-----------------|----------------|--------------|--------------|--------------|----------------|-----------|------|--------------|
| Red Stem  | 1.36*<br>1.58** | 31.48<br>40.86 | 2.45         | 2.92<br>3.21 | 6.63<br>9.06 | 55.16<br>42.09 | 33%<br>33 | 1.00 | 0.10         |
| Mt. Maple | 1.58*<br>2.46** | 39.01<br>46.78 | 2.68<br>2.98 | 2.65         | 5.88<br>5.31 | 48.20<br>29.38 | 34<br>36  | 2.40 | 0.14         |
| Willow    | 2.81*<br>4.57** | 32.67<br>36.98 | 3.80<br>4.32 | 2.35<br>2.71 | 6.81<br>8.25 | 51.56<br>43.17 | 35<br>33  | 1.40 | 0.18<br>0.14 |

Table 1. Comparative Values in the November and April Samples.

\* November sample

\*\* April sample

On the basis of the preliminary figures, red stem and willow seem to provide forage of a more nutritious nature than mountain maple during the winter.

# Project WU-45 - Occurrence and Significance of Dew on Selected Forest Sites in Northern Idaho.

The project was essentially completed by June, 1964, and a final report was submitted to the U. S. Weather Bureau in Washington. Also submitted was a manuscript for review prior to publication on the acetate dew gauge developed during the project.

## Significance of Dew in Forest Areas

One measure of the ecological significance of dew is a comparison with the amount of rainfall. Our second Progress Report (Hungerford and Edgerton, 1963) showed the rainfall at three stations during 1962. At the Meadow Station there were 96.04 mm. of rain from July 26 to September 28. Dew recorded at this same station during this period amounted to 6 per cent of the rainfall. In 1963 we had a longer record of rainfall and dew at the Meadow Station with more complete records of dew. Between July 5 and September 24 there were 55.12 mm. of rainfall and 5.22 mm. of dew. This amounts to 9.5 per cent of the total rainfall. Project Wil-37 - The Scology and Janagement of Browse on Bir Winter -Range, Selway-Hitterroot Wilderness Ires, Idaho.

Chemical analysis was rade of red stor constitut, Constraints anarguineus, mountain maple, Acor glabrum, and willow, Salig app. in red-November and mid-April. The to three inches of the arousl growth of abroated talgs were slipped from shrees of fieldey Grock reademly for about a rile sion; the lower slopes of fieldey Grock until approximately two pounds of browse were slipped from each species.

|                        | A Stations |  | a desidence of |                       | 1.77 |                   |  |
|------------------------|------------|--|----------------|-----------------------|------|-------------------|--|
| a second second second |            |  |                | and the second second | A    | 1. 1. 1. 1. 1. 1. |  |

| 1                | 6.6          | NET Falls              |              |      | er Ash               | Orno<br>Filtre |                 |           |
|------------------|--------------|------------------------|--------------|------|----------------------|----------------|-----------------|-----------|
| 01.0             | 1,00         | 55,16 355<br>12,09 33  | 6,63<br>9,06 | 2.92 | 6 - 2.45<br>6 - 3.20 | 1.12<br>10.8   | 1.36%           | Rad Sten  |
| <br>41.0<br>11.0 | 2.40<br>0.82 | 18, 20 34<br>29, 36 36 | 5.88<br>5.31 | 20,5 | 80.5 £<br>80.5 £     | 10.9E          |                 | MagaM .eK |
| 0,18             | 1.25         | 21,56 35<br>13,17 35   | 6.81<br>6.25 | 2+35 | 08.E 7<br>SE.d 8     | 32.6           | 8.81%.<br>1.57% | WE I dow  |

November Sample April sample

On the basis of the proliminary flures, red star and willow seem to provide forage of a more naturitious nature than mountain maple during the winter.

# roject Wi-b5 - Occurrence and Significance of Dew on Selected Forest Sites in Northern Junte

The project and estimited to completed by June, 196h, and a Final report was submitted to the U.S. Meather Jureau in Mashington. Also submitted was a manuscript for review prior to publication on the sectute dev gauge developed during the project.

#### Sightfloance of Daw in Forest Areas

One concurs of the evolution is significantly of daw is a concertion with the abount of reinfall. Our second Progress Report (hargorized and Edgerton, 1963) aboved the rainfall at three stations define 1962. At the reales Station there were 96.00 rm, of rain from July 26 to September 23. Now recorded at this same station during this period accurted to 6 per cent of the reinfall. In 1963 we had a longer records of day. Between July 5 and September 26 there amplate records of day. Between July 5 and September 26 there were 55.12 rm, of reinfall and 5.22 er, of day. This securit to 9.5 per cent of the total reinfall.

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Another experiment to estimate the significance of dew moisture for vegetation was the canopy profile. A strip of ground was cleared of vegetation from the edge of the canopy of trees toward the center of clear-cut block number 3. This was then seeded to white clover and weeded to provide a uniform vegetative cover. A series of dew gauges was established at 8-foot intervals beginning 4 feet from the edge of the clearing. Data from 1962 and 1963 shows the gradual increase in dew as measured from the edge of the clearing toward the center. In addition a series of maximum-minimum thermometers was placed in shelters which shielded only the top and sides of the instruments. inimum temperatures decreased with the progression toward the center of the clearing. The instruments were not shielded at the bottom to attempt an evaluation of the cooling effect of the ground as long wave radiation was in process. Lowest minimum temperatures were at the center where the maximum dew readings were found. Maximum temperatures were quite similar from station to station along this profile. Usually one or two degrees difference was noted with the highest temperature occurring often but not consistently at the center of the block. Tests of soil surface temperature with Tempils indicated that readings above 150 degrees F. are reached several times during the summer. We found no consistent difference between the edge and center of the block.

Another indication of dew significance **is** the length of time dew persists on the leaves of plants. We used a dew duration recorder similar to that used by Taylor (1956) but with a matted acetate disc rather than ground glass. By observation we found the recorder placed three inches above the ground surface closely followed by the duration of dew on leaves of clover and other ground cover plants. During 1962 we obtained only 7 clear recordings during late August and early September. The average dew duration was 12.14 hours for these 7 days (Hungerford and Edgerton, 1963). During 1963 we obtained 17 clear recordings for the same months. The average dew duration was 11.83 hours. All recordings were made at the RR Grade Station. Lloyd (1961) found foliage remaining wet with dew for an average of 9 hours at Priest River in Idaho.

Our only indication of dew and microclimates effecting animal populations were observations of ruffed grouse using the clearcut blocks. Normally these grouse are found along the ravines and stream courses during the latter part of the summer. However, we found ruffed grouse using the clear-cut blocks all summer, particularly block number 1. Research in northern Idaho has shown that ruffed grouse can obtain their entire daily moisture requirement from the succulence moisture in clover and similar plants;, or from the dew deposited on such leaves (Hungerford, 1951). These observations apparently show that new ruffed grouse habitat can be created by the proper forest cutting pattern designed to properly modify the microclimate. We suspect a similar relationship exists with habitats of white-tailed deer but no real evidence is now available. Another otherizant to stillate the similingnee of her melature to very strong the the cancer profile. A strip of round was cleared of very tation from the edge of the cancer of trees toward the empter of clear-cut block number 3. This was then seened to white closer and weeded to browhee a uniform wey sative cover. A series of dwe gives with eitablished at 3-foot intervals hestad 10/1 shows the result increase in devise measured from the edge of the clearing toward the center, in addition a series of maximum-siniaum thermoreters was olaced in sholtens which stielded domeased with the progression toward the center. In addition a series of the instrum-siniaum thermoreters was olaced in sholtens which stielded domeased with the progression toward the center. In addition a series of the instrum-siniaum thermoreters was olaced in sholtens which stielded to are statice of the colles of the the bottom to stient a strip the top and sides of the instruments. Iniaum tomperatures the conter where the satisfies devised at the bottom to attend an the conter where the satisfies devised of the ground along with the highest temperature counter for station to station along the conter where the satisfies devised of the station to station along with the highest temperature countering often but not consistently with the highest temperature countering often but not consistently with the highest temperature countering often but not consistently with the highest temperature countering often but not consistently with the highest temperature countering often but not consistently with the highest temperature countering often but not consistently with the indicated that readings above 150 degrees f. are not to be consistently with the indicated that readings above 150 degrees f. are

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Our only indication of day and microolivates affecting animal populations were diservations of rulled groups using the dearand shocks, Normally these groups are found along the ravines and stream courses during the latter part of the summer, However, and ruled rulled groups with the clear-out blocks all summer, particularly block number 1. Assembly in normhorn idaho has shown that rulled groups mu outsin their catter daily solature requirement from the succulores metature in clever and mail a plants. Or from the assembly will also their catter daily solature requireter from the succulores metature in clever and mail a plants. Or from the day deposited on much loaves (Hungerford, 1951).

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The most significant ecological effect of the microclimatic pattern at Hatter Creek is apparently the continued transfer of moisture by air drainage and dew deposition, from the higher areas such as Basalt Hill to the low sites in the ravines such as the Meadow Station and the RR Grade Station. This consistent nightly movement of available moisture is supplied by evaporation and transpiration at all elevations but is deposited the following night under radiative dew conditions only in the dew prone areas. The intensity of this moisture transfer is apparently increased whenever precipitation adds more moisture for evaporation and transpiration. We have indications that the advective dew conditions also add more moisture to most of the areas much the same as precipitation, but at a much lower magnitude. With this concept the Hatter Creek area can be type mapped vegetatively using dew pattern along. The non-dew areas on the south and west slopes of Basalt Hill are dominated by stands of Ponderosa pine and Douglasfir and associated vegetation. The dew prone areas are dominated by western red cedar or grand fir types or by early successional stages of these types. The areas between on the minor ridges and plateaus are dominated by mixtures of Douglas-fir and grand fir with plant species normally associated with these trees. The most challenging possibilities lie in the modification of the microclimate and dew pattern in the Douglas-fir - grand fir mixtures on the minor ridges through forest cutting patterns, and manipulating the size and shape of forest clearing, and the density of the stands of timber.

Project WU-48 - The Ecology and Use of Mountain Meadows by Elk.

A Master's thesis of the above title was completed by Stephen I. Kowalsky.

As a result of a severe winter with more snow than normal, elk use of meadows in the Elk City area was atypical. Peak numbers of elk on the meadows occurred two to three weeks later in 1964 than in 1963. The numbers of elk observed utilizing the meadows was about one third less in 1964 than in 1963.

Meadows in the Elk City area are either dry or wet and differ considerably in ground cover. The average ground cover of the dry types based upon 36 100-feet transects was litter 12.8 per cent, mosses 2.9 per cent, bare ground 4.8 per cent, grasses 43.0 per cent, grasslike plants 0.8 per cent, and forbs 35.7 per cent. The average ground cover of the wet meadow type based upon 23 100 feet transects was litter 2.2 per cent, moss .07 per cent, bare ground 0.9 per cent, grasses 50.0 per cent, grasslike plants 31.4 per cent and forbs 14.3 per cent.

The average floristic composition of the dry and wet type of mountain meadow showed that seven species of grasses made up 46.0 per cent of the dry type and 49.8 per cent of the wet type. The sedges and rushes (grasslike plants) made up 1.5 per cent of the dry type and 26.6 of the wet type. Eleven species of forbs made up 52.5 per cent of the dry type and 23.6 per cent of the wet type.

Froject WU-up - The Scology and Use of fountain Fradows by Elky

A Marter's thesis of the above title was completed by Stephen I.

As a result of a severe winter with more dury than normal, eik use of readors in the Sik Sity area war stypical. Feek numbers of dic on the readors occurred two to three some inter in 1961 than in 1973. The mulbers of eik observed willtain, the madews was about one third lass in 1965 than in 1953.

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| Animal Units | May 12-<br>June 1 | June 2-22 | June 23-<br>July 13 | July 24-<br>Aug. 3 |
|--------------|-------------------|-----------|---------------------|--------------------|
| Livestock    | 198               | 620       | 604                 | 529                |
| Elk          | 116               | 145       | 89                  | 16                 |

Table 1. Animal Units of Livestock and Elk Using Three Meadows North of Elk City 1964.

Elk use of the three meadows dropped rapidly from the peak period of June 2-22. The shape of the meadows had no relationship to the amount of elk use. Rectangular square, long and narrow meadows were equally used. Seclusion from man and availability of forest cover appeared to be the most important factors in relation to daily use. The densities of elk on six meadows, 27 to 94 acres in size, ranged from 0.6 to 8.8 per acre during the period May 25 to July 31. The study showed that there was no significant difference in elk use where elk were "herded" and where they were unmolested.

Utilization of pastures by all grazing animals was estimated at three week intervals. Season-long grazing by a combination of elk in the spring and cattle in the summer is in excess of the proper use of the plants, and results in decreased forage yield after only one year.

Project WU-49 - Beaver Productivity and Movements in Southeastern Idaho.

A Master's thesis by the above title was completed by Thomas A. Leege.

In = 119 live trapped beavers and 233 carcasses the sex ratio was 113:100. A heavier mortality among adult males was apparent since the sex ratio was 88:100, while the ratios for yearlings was 142: 100 and 171:100 for kits.

Fall trapping showed an age distribution of 24 per cent kits, 25 per cent yearlings, and 51 per cent adults. Spring trapped beavers showed an age distribution of 20 per cent kits, 38 per cent yearlings and 42 per cent adults. Average litter size in 1962 was 3.5 and 2.9 in 1963 according to placental scar counts. In 1963 and 1964 fetal counts averaged 2.9 and 4.5 respectively. In 1962 35.6 per cent of the females examined had bred the previous spring. In 1963 the per cent of females bred dropped to 28.6.

Of 52 tag returns on marked beaver only ten showed significant. movement. The range of movement was 2 to 14 miles. Of the ten animals which moved a significant distance, five were two-year olds exhibiting a natural movement out from the home range. The movements were predominantly from national forest land in the higher elevations, downstream to private lands where beavers interferred with irrigation and other agricultural practices. Thelefi Antion State of Livestory and Mik Uning Three Mendors .

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Project Mi-L9 - Braver Productivity and Yov econts in Southbantaris Ideno.

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In the late transmit deleter and the cattered the pay ratio was 133:100, A near a mortality said adult value was dependent wince the sax rates for 100, while the moldor for reastings was 162: 100 and 171-101 for lates.

Fail trapping anomad an age distributions of 31 per contributes 25 per dont plearlings and 41 per dent adults, bonday inapped tearming drived in equ distribution of 20 per contributes 38 per cont verticing and 10 per contractiveled of 20 per contributes and 102 and 2.5 and 100 in 1960 according to placental near counts. In 1953 and 1960 fetal counts at rejed 2.9 and 8.5 respondivels. In 1952 [5.5 per centred the families manifed bed to 5 respondivels. In 1953 [5.5 per centred the families manifed bed to 50.6.6.

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The increased use of sagebrush eradication as a range improvement technique to increase production of livestock forage has aroused concern for the birds and mammals living in the sagebrush environment. Sage grouse is an important game bird in much of the sagebrush vegetation type, and since the brush control measures directly affect these birds, a study has been initiated on sage grouse habitat.

A review of literature indicates that a considerable amount of the ecology of this bird is still unknown; therefore, it is felt that a study of sage grouse ecology is more important at this time than one involving management. The reproductive period is believed to be one of the most critical portions of the annual life cycle and it is with this portion of sage grouse ecology that this study will deal. The research is being carried out on the U. S. Sheep Experiment Station, Dubois, Idaho, and vicinity.

The U. S. Forest Service is providing quarters for the investigator, and during the first summer provided a  $\frac{1}{2}$  ton pick up truck for the project.

The general objectives are to (1) correlate nest density with habitat types, and describe the microenvironment of the nest site and (2) correlate brood use with habitat types and describe the microenvironment in habitat by hens and their broods.

The first field season was devoted to laying out 40 acre plots, locating nest sites, and population trend survey. Vegetation transects were run and a map prepared of the Sheep Station for locating broods. Several field techniques were revised after testing during the first summer.

Project WU-53.- The Development of a Dental Cement Annuli Technique for Aging White-Tailed Deer.

The purpose of this study is to develop an accurate rapid technique for determining the age of white-tailed deer. Tooth eruption and wear vary with the physiology and nutritional history of the individual animal. Mule deer, and black tailed deer have been aged within two months by means of annual growth rings in the cementum of the root of the first incisor. The technique should work for white-tailed deer.

Known aged deer jaws are difficult to obtain. To date 44 specimens of known age are on hand, and 127 aged by tooth eruption and wear secured from various parts of the white tail range. In addition 339 jaws are available from Ohio.

Grinding, polishing equipment is now on hand and sections ground to 226 microns begin to show growth lines or rings. Thinner sections, however, are needed. Total time for grinding, polishing, staining and mounting a section is about 35 minutes.

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The U.S. Forent Service is providing quarters for the investigator, and during the first surger provided a 5 ton pick up trick for the project.

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Project MU-53. - The Merelowant of a Sental Camero Schuldt Technique for Aging White-Tailed Coar.

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## Project WU-54 - Habitats Used by Mountain Quail in Idaho

This project was initiated at the request of the Idaho Fish and Game Department in February, 1964. Hr. John Ormiston was chosen as research fellow on the project. While Mr. Ormiston was in classes during second semester, a number of reconnaissance trips to various quail ranges were conducted. With the advice of state bird biologists the Pittsburg Landing area on the Snake River was chosen as the primary project location. The field work was begun in June with emphasis on trapping and marking individual quail to facilitate study of their daily movements through various habitats.

The objectives of this project will be to (1) study the daily and seasonal movements of mountain quail in relation to habitats used, and (2) ascertain the sex and age structure of the fall population.

## Project WU-55 - Browse Fertilizing Tests at Hatter Creek

This project initiated during the last year is aimed at testing the response of individual shrubs to early spring fertilizing. Another objective is to determine the relative utilization of fertilized and unfertilized shrubs of the same species within the deer study area.

Some tests have been made on burned areas (spring burning) and unburned areas with no measurable difference in response. Other tests with species which are relatively unpalatable to deer indicate that increased utilization of these species may be expected through proper applications of fertilizer. One application of 16-16-8 fertilizer applied in April at a rate of 4CO pounds per acre, apparently increased the use by white-tailed deer of Syringa (Philadelphus lewisii) normally used very little by whitetailed deer.

Project WU-56 - Experimental Burning in Deer Winter Range.

This project was initiated during the last year to investigate the use of fire as a tool in managing winter deer ranges. To date burning experiments have been conducted at the Hatter Creek Experimental Area in spring burns, fall burns and one lightning caused August fire. The response by individual shrubs of several species are being studied.

To date only the preliminary results of spring burning are available. It is apparent that April burning of the accumulated cured grass and litter will supply enough heat to kill shrub crowns and cause resprouting. Snowberry, serviceberry and willow show immediate resprouting and good growth following the crown killing.

The April fires cause little or no damage to the site. Normally, only the last year's dead vegetation is consumed and the moist humus layer is not even warmed.

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## Projects Inactive During the Year

Project WU-18 - Productivity of Ruffed Grouse in Morthern Idaho.
Project WU-19 - Ruffed Grouse Populations and Census Methods.
Project WU-41 - Productivity of Mule Deer on an Over-Used Low Grade
Range.

## IV. Fisheries Management

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

## Larvacides

Fertile squawfish eggs for culturing larvae were difficult to obtain and for larvacide tests, two- to five-day-old larvae were used from eggs which had been briefly subjected to potential spermacides when fertilized. As these larvae were lively, they were apparently not affected by the previous exposure of the eggs to chemicals. Squawfish eggs were fertilized and placed in an incubator on June 26. Hatching occurred 9 to 11 days after fertilization. The chemical tests included 488 chemicals tested as larvacides, 535 as piscicides and 301 tested for both purposes. Of these, twenty-two chemicals gave some indication of being squawfish larvacides. As stream water was used for controlling the temperature of the larval toxins, the temperature varied between 51 and 68 degrees F. In contrast, piscicide work was conducted at 50 degrees F. with few exceptions.

Out of 121 chemicals which were toxic to squawfish larvae, 17 proved, on preliminary screening, to be nonlethal to juvenile squawfish and salmonids. Some variation in concentration exists between the larvacides and piscicides; however, the concentration of the piscicide was always greater or equal to that of the larvacide. Usually each piscicide test utilized one fish of each species. The fish tested were squawfish, chinook, coho salmon and steelhead trout.

In 123 cases in which lethal toxins were found, two age groups of larvae were used. The younger larvae were five days younger than the older larvae (7 and 12 days respectively). In 79 cases the older ones died before the younger ones when exposed to the chemicals. In 4 cases younger ones died before the old ones. In 40 tests both age groups of larvae died at the same time. Apparently, there is a tendency for older larvae to be more susceptible to the chemicals than younger ones.

## Piscicides

Bioassays for the determination of piscicides selectively lethal to squawfish were made in the laboratory. Hatchery-raised chinook.

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Project Wi-10 - Frederivity of Hulfed Grouse in Performance. Project Wi-19 - Buffed Grouns Formlations and Gauss Pathods. Project Wi-11 - Frederivity of Hule Deer on an Sver-Wal Lev Grade

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salmon, coho salmon and steelhead trout and cutthroat fry were used in addition to larger native cutthroat and planted rainbow trout. Squawfish under five inches in fork length were captured and tested with the salmonids.

Initial piscicide tests were conducted at concentrations of 10 ppm. When necessary, additional tests were made at concentrations of 15 ppm, and at 5 ppm and 2 ppm to find minimum lethal concentrations. None of the chemicals tested was lethal at 2 ppm.

Piscicide bioassays conducted during the year included a total of 842 tests, involving 535 chemicals. Chemicals lethal to squawfish totalled 251, with 24 selectively lethal to this species. Of these, Chemical A was tested at varying concentrations, temperatures, volumes, and with varying numbers of fish.

During the fall, tests were conducted in the St. Joe River Fishery Laboratory where large fish holding facilities and running water were available. Such conditions were required:

- 1. To determine the amount of delayed mortality incurred by fishes subjected to selected doses of Chemical A and afterwards held in fresh-running water.
- 2. To minimize any neutralizing effect that large numbers of fish placed in small amounts of water might have on the effectiveness of the toxin.
- 3. To test simultaneously a large enough number of several species of salmonids and squawfish so that the results would be conclusive.

Bioassays were made in plywood vats  $(8! \times 4! \times 2!)$  which were halffilled with Chemical A (620 liters) and afterwards with runningwater. Five species of fish were exposed on November 5, to concentrations of 7 and 8 ppm of Chemical A for 19 hours and on October 30 to concentrations of 9 ppm for 27 hours. Subsequently, the treatment was terminated by flushing the toxin out of the vats with water pumped from the creek. Creek water was continuously pumped into the vats after treatment for the remainder of the tests. The experiments using concentrations of 7 and 8 ppm of Chemical A were conducted for 28 days and the test using 9 ppm for 20 days. The temperature of the toxin treated water varied between 39 and 43 degrees F.

Table 1 summarizes the effect of a concentration of 7 ppm of Chemical A on five species of fish. This table gives the ultimate numbers, lengths and ranges of fishes which survived in the experiment. The percentages of fatalities, the mean fork lengths and the minimum and maximum times at which fish died are also given.

The relationship between the percentage of survival and the time of death is graphically displayed in Figure 1. The figure shows that

salmon, coins stimm, and strollowd trout and outtamout ing were used in additions to larger nullyo outs root and planted ratibou trout, Squarfleb under 15 vs suches in fort longth, such apoined and tested with the salmondar

Individe placing the serie conducted at concentrations of 10 pro-When measurant, outlitional tests very made as concentrations of 15 pro, and at 5 provand 1 to 10 field similar lathal concentrations. None of the chemicals tested will be held at 2 parts

Pisoloide bloassays, conducted during the year included a total of Piscicida bicassays conducted during and but not interest as squawfish Bh2 tests stavelzing 336 dochtoals. Chemicals isthal to squawfish totalled 2°1, with 21 selectively lethal to this special. Of those, Chemical & was toried at varying concentrations, topperatures, volwee, and with varying rembers of fich.

Doring the fall, tasts very conducted in the St. Jos River Flohony Leboratory where large fish molding facilities and running water were realisples. Such conditions were required: · 25% H. 1914

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2. To initiate any postalizing effort that large manbus of fish placed in stall amounts of water wight have on the effectiveness \*, 4 m of the texts. 

3. To took abautancousty a large enough number of neveral spectom of selecteds and squaining the that the results would be conand the second second

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|          | Species     | Num- | Per-         | Lethal       | Fork length |        |
|----------|-------------|------|--------------|--------------|-------------|--------|
|          |             | ber  | cent-<br>age | range,<br>hr | Mean,<br>mm | Range, |
|          | Squawfish   | 0    | 0            |              |             |        |
|          | Brook trout | 3    | 10           |              | 102         | 95-105 |
| Survival | Steelhead   | 11   | 85           |              | 72          | 57-84  |
|          | Chinook     | 42   | 89           |              | 108         | 82-142 |
|          | Coho        | 38   | 100          |              | 108         | 92-128 |
|          | Squawfish   | 21   | 100          | 19-182       | 96          | 75-130 |
|          | Brook trout | 26   | 90           | 108-303      | 109         | 80-126 |
| Fatality | Steelhead   | 2    | 15           | 88-140       | 54          | 51-56  |
|          | Chinook     | 5    | 11           | 122-403      | 98          | 79-118 |
|          | Coho        | 0    | 0            |              |             |        |

Table 1. Summary of results of bioassay conducted with 7 ppm of Chemical A in which five species of fish were exposed to the toxic chemical for a 19-hour period and delayed mortality observed for 28 days.

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| 1 95-20                                       |       |          |       |       | diona koont  |               |
| 57-64   | 14    | *        | 85    |       |              | Sorvivel 1    |
| 1 62-14                                       | 108   |          |       | 42 1  |              |               |
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| e seriel                                      |       |          | 100   |       | Southing     |               |
| 1 80-12                                       | 109   |          |       |       | Brdok trout  |               |
| 22-12   |       | 1001000  | 1.5   | 2     | Steelhesd !! | Patalicy      |
|   |       | 1226-603 | 11    |       | Chrando -    | A Contraction |
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| and a state                                   |       |          |       |       |              |               |





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no salmonids died during the exposure period but that mortalities occurred after the treatment was ended, and all the squawfish died in every test;

At 9 ppm, almost complete fatalities were observed in all species except coho of which about one-half died. Except for coho, all mortalities occurred in a ten-day period. At 7 ppm, all the coho, 89 per cent of the chinook and 85 per cent of the steelhead survived the toxin. At 8 ppm, intermediate results were obtained. After 400 hours the lower portions of the curves reached for chinook and steelhead become asymptotic in nature. This indicates that maximum mortalities attributable to the chemical treatment had been attained.

The order of susceptibility to all three concentrations of Chemical A for the five species tested was: squawfish, Eastern brook trout, steelhead trout, chinook and coho salmon.

# Size as a Variable

Figure 2 shows the relationship between fork length and time of mortality for squawfish exposed to concentration of 7, 8 and 9 ppm of Chemical A. The regression lines show that larger squawfish take longer to die than smaller ones. Theoretically, a curvilinear relationship is expected. However, a linear relationship was considered representative of the regression within the length ranges used and, for simplicity, was adopted.

The high values of the correlation coefficients for squawfish in Table 2 indicate that a close relationship exists between their fork lengths and hours of survival. At a concentration of 9 ppm, the low values of the correlation coefficients for the salmonids indicate that the relationships were weak but significant with the exception of the chinook salmon. At lower concentrations, a correlation between fork length and hours of survival could not be demonstrated for any of the salmonids. The data used for the calculation of the correlation coefficients include only those for fish which succumbed to the toxin.

In the experiments, steelhead were slightly more susceptible than chinook salmon. This may have been due to the steelhead being considerably smaller than the chinook salmon rather than due to differences in the tolerances of the species.

## Discussion

Exploratory experiments conducted during the summer indicated that considerable post-treatment mortality could be expected with Chemical A. These experiments adequately establish that a relatively long time interval exists between treatment and total extinction of young squawfish at concentrations nonlethal to salmonids. This delayed mortality should enable reduced concentrations of chemical or a shorter exposure period to be used than what has already been determined. For field applications, a long exposure period at low concentrations might prove to be the most economical. no salmonids died during the expensive period but that mortalificat accurred after the treatment was ended, and all the equation died in every test,

At y pam, almost complete fabilities were obtained in all species except coke of which about one-half dief. Except for sche, all mortalities eccurred in a ten-day paried, at y prm, all the cohe, 69 per cant of the chinock and 55 per cent of the specihed survived the toxin. At 8 per, intermediate results were obtained, after all hours the lower partices of the curves reached for chinock and attailed become asymptotic in nature. This indicates that maximum mortalities stiributable to the clouded broatment had been attained.

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Table 2. Summary of correlations between fork lengths of five species of fish and hours of survival on exposure to concentrations of 7 and 8 ppm of Chemical A for a 19-hour period and concentrations of 9 ppm for a 27-hour period.

| Species     |                            | Concent | Concentrations, ppm |            |  |
|-------------|----------------------------|---------|---------------------|------------|--|
|             |                            | 7       | 8                   | 9          |  |
| Squawfish   | Number<br>Correlation      | 21      | 25                  | 74         |  |
|             | Probability                | 0.789   | 0.767               | 0.702      |  |
| Brook trout | Number<br>Correlation      | 26      | 18                  | 69         |  |
|             | coefficient<br>Probability | 0.103   | 0.381               | 0.282      |  |
| Steelhead   | Number<br>Correlation      | 2       | 20                  | 57         |  |
|             | coefficient<br>Probability |         | -1.75               | 0.471 0.01 |  |
| Chinook     | Number<br>Correlation      | 5       | 19                  | 62         |  |
|             | coefficient<br>Probability |         | 0.181               | 0.089      |  |
| Coho        | Number<br>Correlation      | 0       | 4                   | 31         |  |
|             | coefficient<br>Probability |         |                     | 0.382 0.05 |  |

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| 31<br>9.32<br>9.05              | · · · · · · · · · · · · · · · · · · · |                                       | Runne<br>Constantin<br>colfition<br>colfition                | 2005, -       |





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Although several variables determine the effectiveness of Chemical A, water temperature is one of the most important. If the data are roughly representative of actual temperature effects, water temperature is a more critical variable than toxin concentration and further experimentation at various temperatures is warranted.

The mean fork length and age class of a sample of squawfish obtained about the same time and in the same location as the experimental fish was measured. A comparison of the fork length values indicates that Age Classes 1 and 2 were used predominantly in the experiments. Age Class 0 (young-of-the-year) squawfish were not present.

Further investigation needs to be conducted on salmon and trout fry. To protect the fry of some species, especially cuthroat trout, the concentration of Chemical A might have to be reduced to the point where it would be only completely lethal to the first and possibly the second year classes of squawfish.

# Project Inactive During the Year

Project WU-28 - Influence of Logging on Trout Streams in Northern Idaho.

Alterior Exversi ratiobles determine the of Schleinesh of Chimical A. Wener threemature is one of the most innortant. Thitle devices roughly representative of actual temperature efforts. When temperature is a cire artical vulticals than toks concentration and durther experimentation at ver ous topperatures is versionted.

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Forberg, N. A. and N. Hironaka. 1901. Soll properties afforting the distribution of the and low so whrush entrumities in routharm Idaha. Near, Soc. A gran. Special Pub. No. 5:130-236.

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# II. Miscellaneous Publications

- Tisdale, E. W. 1963. Modern Man and the natural environment. Phi Kappa Phi Jour. Fall, 1963. pp. 32-37.
- Tisdale, E. W. 1964. Sidney E. Clarke and the early history of Canadian range science. Jour. Range Mngt. 17:15-16.
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- Wohletz, E. 1962. Should more emphasis be placed on applied and developmental research in conservation. Proc. 53rd Western For. Conference (A Debate).

# III. Graduate Theses (M. S. June, 1964)

Crooks, James R. Geographic variation of tangential tracheid diameter in Idaho western redcedar, Thuja Plicata Donn.

- McNamara, William S. Wettability of Western Larch veneers as affected by drying schedules and some extraction treatments.
- Nelson, DeVon O. A comparison of forb-grass sites with sagebrush sites in the Centennial Mountains of southern Montana.

Stroup, Stanley W. Some aspects of the growth of grand fir.

#### II. Madollopequa Publications

Hadale, R. W. 1963. Modern Han and the natural environment. Fld Kappa Fin Jours. Fall, 1963. pr. 12-37.

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Melson, DeVan D. A comparison of fort-grass sizes with segulruch sites in the Centennial Hountains of southern fontana.

Stropp, Stanley M. Some acpects of the growth of grand fir,

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# APPENDIX A. F.W.R. EXPERIMENT STATION STAFF 1963-64

# I. Regular Staff Members

Ernest Wohletz, Director and Professor (Forest Management) E. W. Tisdale, Associate Director and Professor (Range Management) H. R. Alden, Assistant Professor (Forest Management) Donald W. Chapman, Leader, Cooperative Fisheries Research Unit and Professor (Fisheries Management) P. D. Dalke, Leader, Cooperative Wildlife Research Unit and Professor (Wildlife Management) M. E. Deters, Professor (Forest Management) R. H. Giles, Instructor (Wildlife Management) Minoru Hironaka, Assistant Professor (Range Management) A. D. Hofstrand, Assistant Professor (Wood Utilization) J. P. Howe, Associate Professor (Wood Utilization) K. E. Hungerford, Professor (Wildlife Management) F. D. Johnson, Assistant Professor (Forest Management) Howard Loewenstein, Associate 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 Richard Ruelle, Acting Research Associate (Fisheries Management) R. H. Seale, Associate Professor (Forest Management) J. E. Schenk, Assistant Professor (Forest Entomology) L. A. Sharp, Associate Professor (Range Management) Robert N. Thompson, Assistant Leader, Cooperative Fisheries Research Unit and Assistant Professor (Fisheries Management) Chi-Wu Wang, Associate Professor (Forest Genetics)

#### E. L. Williams, Assistant Forest Economist

#### II. Research Fellows

- J. R. Crooks--Forest Genetics
- B. E. Dahl--Range Management
- R. A. Goyer -- Forest Entomology
- D. A. Klebenow--Wildlife Management
- S. I. Kowalsky--Wildlife Management
- T. A. Leege--Wildlife Management
- H. R. McEwen--Forest Soils
- J. D. McKendrick--Range Management
- W. S. McNamara--Wood Utilization
- J. R. Nelson--Range Management
- J. Ormiston--Wildlife Management
- S. W. Stroup--Forest Management

APPENDIX B. SOURCES OF RESEARCH FUNDS AND OTHER SUPPORT 1963-1964

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

# WE HALL A. FALL, STONAR BEATING STATE 1963-44

## Pacific Instant Instant

R. M. Heiletz, Director and Protocor ("orest Humsgement)
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2. L. Williams, Austitiant Forest Branowist.

#### II. Rosearch Fallows

J. R. Crocks-Forest Deposite
B. S. Dedi-Hange Hangerand
R. J. Coverst Hangerand
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A. Leage-Wildlife Hangerand
T. A. Leage-Wildlife Hangerand
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J. Hangerand-Magerant
J. Driston-Range Managerant
J. Orniston-Wildlife Hangerant
Stroup-Forest Scils
Stroup-Forest Hangerant

#### VIA DIX F. SOURCES OF RESERVED FOR US AND ATHER SURVERS 1963-1981

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

- University of Idaho Special Research Funds for Projects 27-D, 54, 55, 63, 65, 70, 77, 80, 94 and 95.
- 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 and Fisheries Research Units.
- 6. Inland Paper Company. Labor, equipment and field accommodations for work on tree hybridization, seedling survival and forest fertilization.
- 7. Potlatch Forests, Inc. Potlatch Research Fellowship and a special grant for work on forest site influences on wood properties of inland Douglas-fir.
- 8. Southern Idaho Forestry Association. Financial support for forest genetics research.
- 9. United States Bureau of Commercial Fisheries. Funds for research on determination and development of sperm toxins for control of undesirable species of fish.
- 10. 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.
- 11. United States Bureau of Sport Fisheries and Wildlife. Funds for the Cooperative Wildlife and Fisheries Research Units.
- 12. United States Department of Agriculture. Funds from the McIntire-Stennis Act; and Regional Research Projects WM-42, W-25 and W-71, through cooperation of Agricultural Experiment Station, University of Idaho.
- 13. United States Forest Service. Funds for a growth-quality study of western red cedar, for research on cone and seed insects, 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.
- 14. United States Weather Bureau. Funds for research on distribution and significance of dew on selected forest sites.
- 15. Wildlife Management Institute. Funds for wildlife research.

- University of Make Special Research Funds for Projects 27-0, 54, 55, 63, 65, 70, 77, 80, 94 and 95.
- 3. Boisse Castado Company. Assistance in forest gametics research.
- Idairo State Repartment of Forestry. Support for forest guietics research.
  - 3. Ideno State ('Ish and ise's Department. Regular support for the Vildiffe and Finiterica Research Units.
- 6. Inhere Paper Company. Lawor, equiverate and field neoexpedicions for work on trop hydridization, seeding survival and forest fortilization.
- Fetlates Forests, Inc. Fotlates Research Fellowship and a special grant for work on forest site influences on wood propersies of inland Bow Ree-fir.
- Gouthern Idaka Borestry Aprocietica, Financial Aupport for forest, genetics retearch.
- 9. United States Entend of Connected Finherics, Funds for resonance on deformination and development of spera toxing for central of indefinable species of figh.
  - 10. United States Baress of Land Management. Fauld for research on Walt-depart shreb tan es, faoilitzes and assistance for Foith Sprin & Fraging project, codeshed recend, and forest reprises toolet.
  - 11. United States Suress of Spart First rise and Wildlife. Finds for the Cooperative Wildlife and Fisherics descends Datas.
- 12. United States Besarbaret of Automatance. Funds from the Maintiss-Shemia hot; and ever onal expected Frederic Weeks, Wells and Weik, through comparative of Automatanet Expects Station. University of Idence.
- 13. United States Forest Service, Fanks for a provie-quality study of western red codes for restarch on cose and seed insects, plyice space at the Bohe office of the Isternovarials format and Rage Groeffront Statist, field Livity successdations and assistance in collection of revences material for revocal projects.
- Inited States Worther Furst, Funds for rostanch on distribution and significance of dow or selected forest rives.
  - 137 Wildlife Hunawment institute, Funds for wildlife research.



