FOREST, WILDLIFE AND RANGE EXPERIMENT STATION

COLLEGE OF FORESTRY

UNIVERSITY OF IDAHO

Moscow, Idaho

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

For the Fiscal Year 1957-1958

Ernest Wohletz, Director

E. W. Tisdale, Associate Director

September 1, 1958

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INTRODUCTION

Thirty-four projects were active during the year. Only two of these were completed, and five new projects were begun. Most of the Station projects are long-term in nature due to the type of problems encountered commonly in non-cultivated land management.

The Station staff during the year numbered 18, of whom three were on a full-time research basis. The position in Fishery Management created by the death of Dr. Pratt was filled by the appointment of Dr. Craig MacPhee in August, 1957. The vacancy in Forest Soils will be filled in August, 1958, by the appointment of Dr. Howard Lowenstein.

A major feature of the current year's activities was the starting of a forest genetics program. A major phase of this new program deals with the improvement of ponderosa pine. Dr. Lawrence Inman has been appointed to conduct this work, with his headquarters at Boise supplied by the Boise Research Center of the U. S. Forest Service. Other agencies cooperating in this project are the Southern Idaho Forestry Association and the Idaho State Forestry Department.

The other major development in forest genetics is the establishment of a Forest Service genetics center on the conifers. During the current year the buildings planned for this work were erected and planting of seed tree stock was begun on the 40 acre tract provided for this purpose. This group will continue with research on development of rust resistant strains of western white pine.

Nine graduate research fellows were active in the Station research program during the year, and three of them completed their theses by June, 1958. In addition, two other graduate students did thesis research on Station projects without fellowship status.

Support for the Station research program continued to be supplied mainly from University funds, but substantial contributions of money and facilities were received from other State, Federal and private sources (see Appendix B for details).

A list of staff publications prepared during the year is appended to this report, as well as a list of staff members and research fellows.

Respectfully submitted,

Ernest Wohletz

Ernest Wohletz, Director

E. W. Tisdale

E. W. Tisdale, Associate Director

WORK ACCOMPLISHMENTS

I. Forest Management

A. Projects completed during the year: None

B. Continuing Projects:

Project E.S.1. Wood Preservation Service Tests.

Inspection of post tests at Caldwell Experiment Station, Aberdeen Experiment Station, Heise Hot Springs, Arbon Valley, and University Farm, and mine timbers at the Sunshine Mine was carried out in 1957.

Several wood-decaying fungi have been isolated from decaying posts on the University Farm and efforts to identify them by cultural characteristics are in progress.

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

Annual inspection of the ten plots on which the study is continuing was made in the period between July 28 and August 15, 1957. The only plot maintenance undertaken was repainting identification numbers and bands on trees for which records are continuing on five plots in the Clarkia area. This left five plots, and all trees that are not now being inspected annually on all plots, without painting for the past four years, because of lack of assistance. The old paint is deteriorating rapidly, and location of some trees on which additional data are required may be lost if painting cannot be done during the 1958 field season.

Photographic records, in color and black-and-white, were continued for the cankers in these series that are still living. Of these five, four were photographed June 25, August 14 and November 1, and the fifth on August 14 only. This latter case is unlikely to yield further useful photographs, for it is a trunk canker on a large tree, the bark of which is now developing large, cracked plating that hides all evidence of canker growth.

Transcription of records of canker development from the original data sheets, in use since 1939, to a new sheet was undertaken for the inoculated series in 1957. By the end of the fiscal year, 771 of the 1349 canker records had been transcribed. Transcription of the records of canker development for all 322 of the natural cankers from field notes to the new development sheets was completed during the year. The old type development sheet has never been used for the natural canker series. The new canker development sheet is designed to simplify extraction of data for analyses, removing several potential causes of error, and providing opportunity to present periodic and lifetime growth data for each canker in concise form.

The St. Joe National Forest, through the kindness of Mr. George F. Weyerman, Supervisor, authorized field assistance to conduct plot

inspections on that forest during 1957. One man, Richard Ogle, was assigned to the project from the Clarkia Blister Rust Control headquarters for the period July 29 through August 15. Inspection of the northern plots was assisted by Lowell Dubbels, assigned for two days, August 8 and 9, from the Station's Pole Blight Project, E.S. 20, by the courtesy of Dr. R. L. Gilbertson.

Essential to the survival probability phase of the study, presented as an interim report in F. W. R. Experiment Station Research Note 7 (1953), is the final status of each infected branch in the population under study. Of the 453 branches employed for that report, cankers on 65 had neither reached trunk nor died at the time data were compiled. Thus, prediction of final status of these cases was undertaken (1952), and the predictions included in the data, as discussed in the Station report for 1956-1957. Predictions were strictly subjective, based upon the detailed records of each case independently. It is of interest to note that 18 per cent of cases were in error five years after prediction. However, these errors are virtually compensating, so far as final status is concerned. At the end of the 1957 field season, 50 of the 65 predicted cases had reached their final status. Of these, 9 failed to satisfy prediction; 5 that were predicted to die reached trunk; 4 predicted to reach trunk died enroute.

As reported at the end of the 1956 field season, of the 21 cases then still enroute toward trunk, predictions of 1952 were changed for 4 of them: 3 predicted to die may now reach trunk; 1 predicted to reach trunk will probably die. No reason was found for further changes in predictions during the 1957 field inspections. Between inspections of 1956 and 1957, of the 21 cases still alive and enroute toward trunk in 1956, none had reached trunk, 3 had died, and 3 were recorded as probably dead. All of these cases had been accurately predicted. Thus, no change in the tabulation of data, or tentative conclusions derived from it as presented in the Station report for 1956-1957 is necessary.

Predictions for the remaining 15 cases still alive and enroute toward trunk in 1957 indicate that the 1958 field inspection should find 2 cases that have reached trunk, and 3, or perhaps 4, that have died. There is some uncertainty whether the fourth case will die in 1958 or 1959. Thus, following that inspection there should be only 10, or perhaps 9, cases of branch cankers still alive and enroute toward trunk. Of these, 3 are predicted to reach trunk, the remainder to die before completion of data on the full population for survival probability.

Preliminary to detailed, final analysis of data of the project, interviews were arranged by A. W. Slipp on May 28 and 29 with personnel of the University of California's Statistical Laboratory and Stanford Research Institute. Dr. William Madow of the latter organization, in charge of the Institute's statistical work, regretfully stated that it would be impossible to undertake the analyses. Time required for the complex analyses, earlier commitments, and inadequate personnel were the factors concerned in this decision. Certain aspects of the study, however, notably survival probability, are of particular interest to the University of California group. Talks with their director, who was not

available at the time of the discussions, are now (June 1958) being arranged. Financing of the analyses, which may take a minimum of two years, will be sought from foundation sources, if cost estimates exceed funds available to the Experiment Station.

Project E.S.3. White Pine Stem Anatomy.

Complete data on 30 more samples was compiled during the year. Preliminary analysis of completed data indicates that environmental factors such as site, slope, exposure, may be reflected in the anatomical features of the stem. In particular, the size and numbers of phloem elements seems to vary with environment.

Data compilation and analysis will continue next year as time permits.

Project E.S.6. Diseases of Idaho Tree Species.

Tree disease problems referred to the Station during the past year include the following:

1. Cytospora canker of Mountain ash.
2. Lime induced chlorosis.
3. 2-4-D spray damage.
4. Yellow witches broom of spruce.
5. Aspen leaf blight.
6. Leaf spot of ash.
7. White trunk rot of aspen.
8. "Dry rot" of potato cellars.
9. Cedar-apple rust.
10. Winter drying of spruce.

Needle diseases, particularly Rhabdocline needle cast of Douglas-fir and larch needle cast appear to be particularly severe in the spring and early summer of 1958 as a result of a heavy infestation last year.

A widespread disease of western white pine has also been particularly noticeable this year. A yellowing and death of the foliage is accompanied by the development of necrotic areas in the bark at the base of the discolored fascicles. Death of a large number of needle fascicles and development of necrotic lesions in the bark may result in death of the entire branch. This condition has been observed to be associated with a scale insect in the genus Matsucoccus.

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

Survival and growth observations were continued in each of the experimental plantings during the year. It will be necessary to market a few species in the Parma planting this coming winter. Following cutting, cultural practices will begin.

The Grangeville test will be discontinued with the sale of the property unless an agreement can be worked out with the new owner.

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

I. Intensification and spread of the disease.

A cooperative program of permanent sample plot examination was carried out with the Inland Empire Research Center of the Intermountain Forest and Range Experiment Station, United States Forest Service. A total of 28 plots throughout the range of pole blight in the western white pine type were examined. Trees were rated as 0, I, II, III, or IV according to the system of diagnosis outlined in Table I. A severity index for each plot is calculated by totalling the numerical ratings of all dominant, codominant, and intermediate white pines and dividing that total by the number of white pines in those crown classes on the plot.

Table I. Diagnosis of Pole Blight. For Dominant, Codominant and Intermediate Western White Pines.

	Upper Third of Crown			Entire Tree		
Symptom Stage	Needle Color	Needle Condition	Leader and Branch Internodes	Resinosis, Main Trunk	Lesions or Dead Faces	Crown Density
I Early	Yellow-green	Slight dwarfing, first 1 - 3 years.	Some dwarfing	None to Light	None, or small lesions on upper trunk	Good
II Intermediate	Yellow	Plainly dwarfed. Some old needles cast. Some bunched at branch ends.	Decidedly dwarfed	None, or light to heavy	None, or long, narrow, dead areas in bark.	Fair
III Final	Yellow and Brown	Decidedly dwarfed in all of 1/3. Bunched on upturned branches. Old needles cast. Some dead tips.	Decidedly dwarfed. Tips often dead.	None, or light to heavy	Long, narrow, dead areas in bark.	Poor
IV Dead	With a past history of pole blight and death not attributable to other causes.					

Most of these plots were established in 1948 and 1949 and the results therefore showed the progress of pole blight over a 9 - 10 year period. Severity index figures for the plots examined varied greatly, as shown in Table 2, in which the data for seven University of Idaho plots are summarized. The percent of base affected (dominant, codominant, and intermediate white pines on the plot) also varied considerably. On all of the plots on which pole blight

was present at the time of establishment (including those of the University of Idaho and the Inland Empire Research Center), the severity index and the percent of base affected increased from the time of plot establishment to the 1957 examination. From the observations made on these plots over the past 10 years it appears that no recovery from the disease is occurring once definite crown symptoms develop. The disease has developed rapidly on some plots and gradually on others. Many trees have exhibited pole blight symptoms over the 9-10 year period and were still alive in 1957. On the other hand, trees often deteriorate very rapidly and pass from a rating of 0 or I to III or even IV in one or two seasons.

Table 2. The Progress of Pole Blight on Seven Plots from the Year of Establishment to 1957.

Plot	Base - Number of dominant, codominant & interm. white pine	Year established	Severity Index		% of Base Affected	
			Year of establishment	1957	Year of establishment	1957
Hudlow Ck. - Coeur d'Alene N.F.	65	1949	0.37	0.85	20.0	29.2
Nickelplate Mtn.- Kaniksu N.F.	21	1949	0.48	1.29	28.6	47.6
Kerr Ranch - Kaniksu N.F.	22	1949	0.50	1.32	27.0	45.5
Engle Creek - Kootenai N.F.	46	1949	1.17	1.65	50.0	56.5
Snake Creek - Kootenai N.F.	53	1949	0.81	2.83	48.2	92.5
Charlie Creek - St. Joe N. F.	208	1950	0.13	1.07	9.6	44.7
Big Sands Mtn. - St. Joe N. F.	105	1951	0.57	2.12	44.8	82.9

II. Grafting has been widely used as one means of determining if a virus is the causal agent of tree diseases. Because of interest in the possibility that pole blight might be a virus-caused disease, field grafting trails were initiated in 1954 and continued in 1955 and 1956. Scions from diseased trees were grafted into the upper crown of healthy pole-sized western white pines on 6 areas on the St. Joe and Coeur d'Alene National Forests. Data on the survival of these scions has been given in previous annual reports.

No further grafting was carried out in 1957, but all trees in which diseased scions were grafted in previous years were examined for symptoms of pole blight. No evidence of transmission of the disease was seen on any of the areas where grafting was done. These trees will be examined again during the summer of 1958.

III. Nematodes.

In May, 1958, William R. Nickle completed a Master's thesis on "Nematodes Associated with the Rootlets of Western White Pine in Northern Idaho." This is the first known study of nematodes in forest soils of Idaho. The significance of nematodes to the pole blight complex lies in the possibility that these organisms may weaken the white pine host by their feeding.

In 1957, soil samples from 25 white pine stands were analysed for nematodes. Fourteen of these stands were pole blighted, five were healthy stands within the range of pole blight, and six were healthy stands outside the general range of pole blight. Table 3 shows the twenty-one genera of nematodes found and their distribution over the areas sampled.

It is interesting to note that one of the "stubby-root nematodes", Trichodorus elegans, was found in soil samples from all the pole-blighted stands sampled and was not generally found in healthy stands. Greenhouse tests with seedlings indicate that western white pine is a host of T. elegans.

Unidentified female nematodes of the genus Heterodera or a closely related genus have been found embedded in white pine rootlets taken from a diseased stand.

Other genera, including Criconemoides, Criconema, Rotylenchus, and Tylenchorhynchus, have possible pathogenic significance.

A paper on nematodes in the Western white pine type was given by Mr. Nickle at the 1957 annual meeting of the Northwest Scientific Association.

Project E.S.21. Study of Idaho Small Tree Farms.

Beginning February 1, 1957, considerable time and thought were given to:

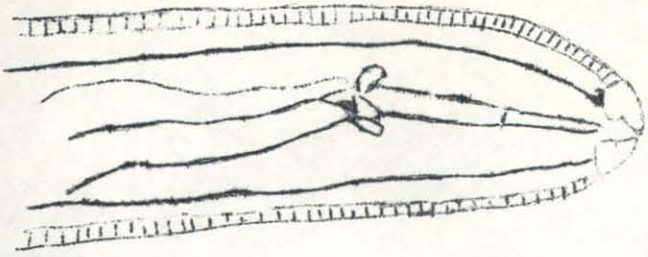
1. Scope of the project.
2. Information available on this subject.
3. What we hope to gain in concrete terms from this project.

As the project was indicated to be a cooperative effort, meetings were held with industry, state forestry officials, Federal foresters and extension foresters to find out the extent of the cooperation they could afford to the project and the particular needs of their offices in the field of farm forestry.

From these meetings it was decided to approach the project with two aims:

TABLE 3. OCCURRENCE OF NEMATODE GENERA IN SAMPLING AREAS

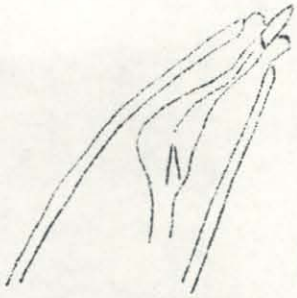
		POLE BLIGHT STANDS														HEALTHY STANDS IN RANGE OF PB					HEALTHY STANDS OUTSIDE RANGE OF PB					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
		Charlie Cr.	Emerald Cr.	Clarkia Pk.	Big Sands Cr.	Hudlow Cr.	Fernan Saddle	Searchlight Cr.	4th of July Cn.	Sands Cr.	Nickleplate Mn.	Priest Riv. R.S.	Binarch Cr.	Kerr Ranch	Moose City	Porcupine Cr.	Martin Cr.	Searchlight Cr.	Hudlow Cr.	Bear Paw Cr.	Pierce R. S.	Rosebud Cr.	Jaype Landing	Alder Cr.	Browns Cr.	Arboretum
Trichodorus	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X			X	X
Heterodera?	P	X		X					X																	
Criconemoides	P						X				X			X												
Rotylenchus	P			X			X		X																X	
Xiphinema	P																									X
Criconema	P						X		X																	
Tylenchorhynchus	P						X																			
Tylencholaimus	U	X					X																			
Tylenchus	U	X		X			X			X			X				X			X		X	X		X	X
Triplonchium	U						X		X		X															
Diphtherophora	U	X		X	X			X	X				X						X	X						
Aphelenchoides	U	X																								
Axonchium	U										X															
Dorylaimus	U	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X	
Dorylaimellus	U	X																								
Pungentus	U	X																								
Mononchus	N	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X	
Plectus	N	X	X	X	X	X			X				X				X		X	X	X		X	X	X	
Prismatolaimus	N	X				X					X									X						
Cephalobus	N	X									X						X						X			
Acrobeloides	N	X		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		
Unidentified	U	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X



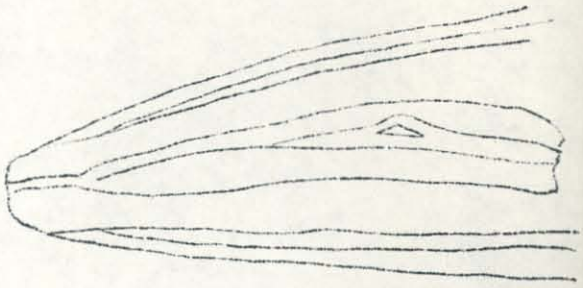
Larva of Heterodera ?

Criconema sp.

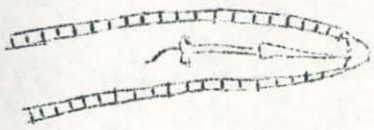
Xiphinema sp.



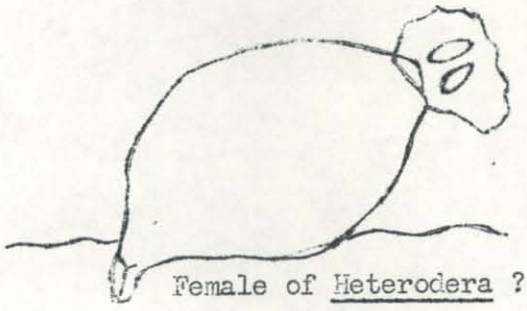
Dorylaimus sp.



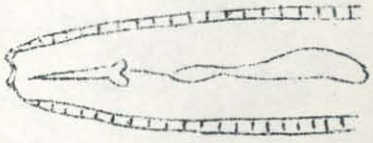
Trichodorus sp.



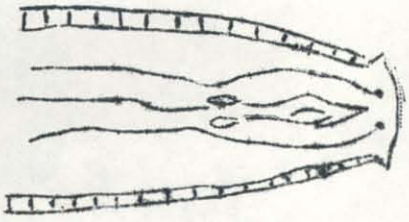
Rotylenchus sp.



Female of Heterodera ?

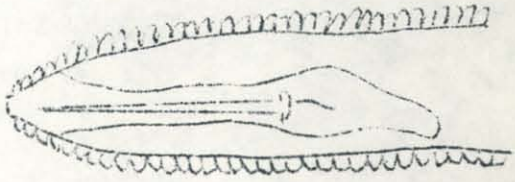


Tylenchus sp.

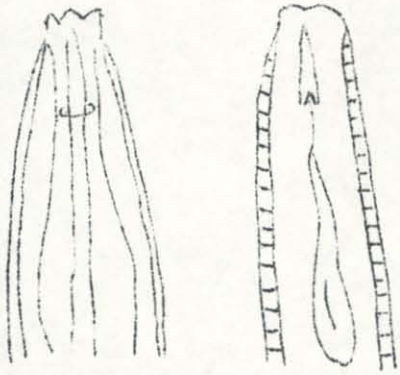


Triplonchium sp. or
Diphtherophora sp.

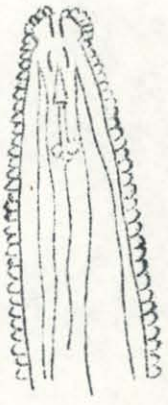
Tylencholaimus sp.



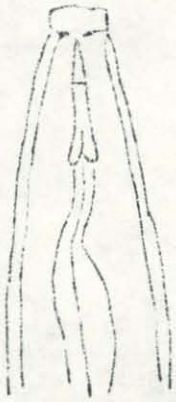
Criconemoides sp.



Pungentus sp. Aphelenchoides sp.



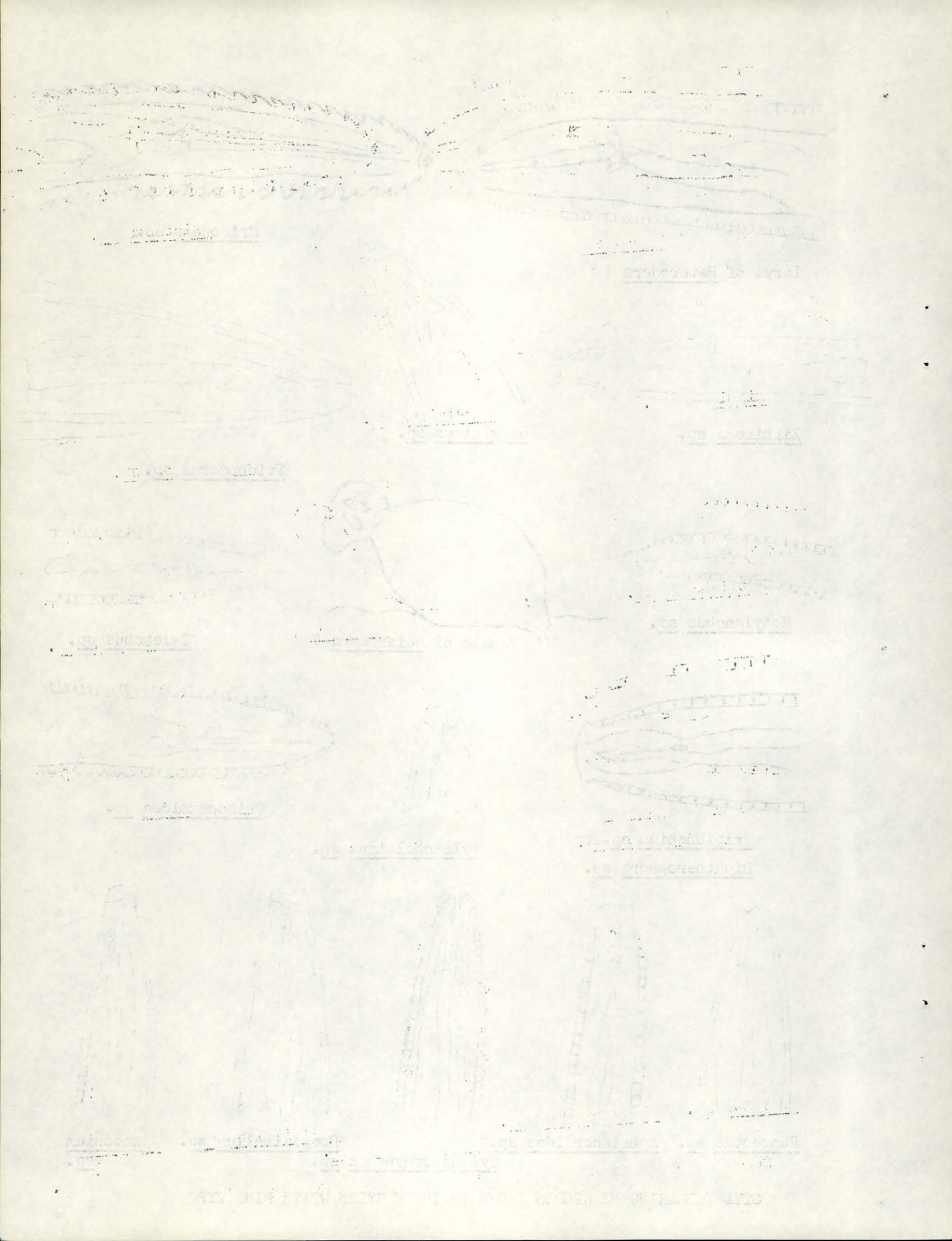
Tylenchorhynchus sp.



Dorylaimellus sp.

Axonchium sp.

STYLET BEARING NEMATODES KNOWN IN THE WESTERN WHITE PINE TYPE



1. Evaluation of the resource held by this group of land owners in terms of quality of land, growing stock, percent stocking, volumes of merchantable, etc.

2. Evaluation of the role which the woodlot plays in the economy of the owner, the county, and the region.

First efforts were joint with the Western Regional Marketing Study -- The Marketing of Non-Industrial Logs and Stumpage -- WM-31, in defining the population with which we would concern ourselves.

After evaluating the project in terms of available cooperation and time and financial resources, we have decided to limit, at least initially, the work to three fairly representative counties: Latah, Benewah, and Bonner.

Names and addresses of non-industrial woodland owners were selected from the total population by counties as follows:

County	No. in Sample
Latah	29
Benewah	15
Bonner	38
Total	82

The number of samples within each county was weighed on a basis of acres owned by this group in the county, value of forest products sold in the county, number of owners in the county, and distribution of type of owners, e.g., farmer, off-farm, etc.

It was decided to evaluate the forest land on a basis of acceptable timber cruising techniques, from the standpoint of assessing the individual owner's woodland resource. At the same time, the owner is questioned regarding his other economic enterprises.

To date the following has been accomplished in terms of numbers of owners and acreage cruised:

County	No. in Sample	No. Interviewed	Percent Completed	Acres Owned	Acres Cruised	Percent Completed
Latah	29	16	55	2363	1128	48
Benewah	15	13	87	2341	365	16
Bonner	38	29	76	4413	260	6
Total	82	58	70	9117	1753	19

The winter has been spent in completing interviews. With the cooperation of the State of Idaho Forestry Department at Sandpoint and St. Maries; and the Soil Conservation Service in Moscow, as well as Potlatch Forests, Inc., at Potlatch, Idaho, it is hoped that these three counties can be completed by October 1, 1958.

It is hoped that the analysis of the data collected will show the following:

1. An economic model representing the role of the woodlot at the present time.

2. An economic model representing the role which can be expected at some determinant time in the future.

3. A transitional economic model illustrating how this class of owner can maximize their advantage under certain cost-price relations.

The analysis of the data will be undertaken using the facilities of the I.B.M. Statistical Service Center at the University, and we are in the process of programming the equipment for our particular analyses.

The contact with this group of woodland owners has revealed several subjective valuations of this class of owners. In general among the farmers in this group:

1. The new income of this group is quite low.

2. At present, they are living on their equipment depreciation allowance.

3. They are at best marginal in their farming enterprise.

4. Their forest resource has been so ill-managed in the past that little in the way of management can be done to secure an additional income in the near future from their woodlands.

5. They have a general apathy toward their woodland as a farm enterprise.

6. They need:

    a. First, a reorganization of their farm enterprises.
    b. Second, to be made aware of the alternatives which are available to them in terms of their woodland enterprise.
    c. Educational materials in the form of more intensive extension work, and more specific literature to answer their management as well as economic problems.

In conclusion they need to be shown by means of demonstration areas that farm woodlands can be a contribution to their total farm economy.

These are, of course, very subjective in value and are not conclusions.

This study is typical of an economic study within the area of agricultural economics. It will be exploratory in nature. The subjective valuations above

are being objectively evaluated with this study. It is highly recommended that it be continued after the conclusion of the two-year present grant, with the idea in mind to build on the results of this study.

Project E.S.23. Marketing Practices and Price Analysis of Idaho Non-Industrial Logs and Stumpage.

The additional testing of the added handwritten P. S. to the questionnaire cover letter was so successful that it was continued in the other counties.

Difficulties were encountered in identifying the population for two counties, Lewis and Nez Perce. These counties were eliminated from the study at this time.

The estimated population data and the number of responses from each county are shown in Table 1.

Table 1. The Population and Response, Numbers of People, by County.

County	Population (f)	NET RESPONSE					
		Non-Seller		Sellers		Total	
		(f)	(%)	(f)	(%)	(f)	(%)
Boundary	664	90	13.6	79	11.9	169	25.5
Bonner	1495	253	16.9	183	12.2	436	29.1
Kootenai	1689	335	17.8	158	9.4	493	29.2
Shoshone	319	64	20.1	16	5.0	80	25.1
Benewah	628	94	15.0	77	12.3	171	27.3
Latah	1121	160	14.3	124	11.1	384	25.4
Clearwater	585	55	9.4	62	10.6	117	20.0
Idaho	413	27	6.5	65	15.7	92	22.2
TOTAL	6914	1078	15.6	764	11.1	1842	26.7

The response numbers in Table 1 are the usuable responses received.

The 6914 people estimated to be non-industrial woodland owners not exceeding 5000 acres in total individual ownership own a total of 941,486 acres of woodland in these 8 counties. The 1842 individuals who responded to the mail questionnaire reported a total of 265,754 acres or 28.2% of the estimated total acreage owned.

Preliminary estimates indicate that this group of owners control 9% of the total forest land and 39% of the privately owned forest land in these eight counties.

The mail questionnaires have all been punched on I.B.M. cards. A chi square analysis, to test the independence of the attributes evaluated for the non-seller responses has been completed. The non-seller responses have been compared with the population data to determine if the "sample" is representative of the population. The test of independence indicates that the non-

seller respondents have a smaller size woodland ownership than the population and the seller respondents have a larger size woodland ownership. A comparison of all respondents to the population indicates that the seller response weight is large enough that the "sample" average size of woodland is larger than the population mean.

At the present time the seller responses are being analyzed. A chi square analysis is being made to determine independence of the attributes evaluated for the sellers. In the near future a price analysis will be made to determine relationships affecting price received.

When the seller analysis is completed a comparison of the sellers with the non-sellers will be made where possible to better determine what characteristics determine whether a land owner is a seller, past or future.

It is expected that most of the analytical work will be completed by September 1, and that a progress report will be issued for limited circulation shortly thereafter. It is hoped to have a final manuscript prepared by January 1, 1959.

Project No. E.S. 24. Forest Tree Breeding in Idaho.

The broad objective of this long range project is to find the most profitable combination of hereditary and environmental improvement for the forests of southern Idaho. Plant breeding methods will be applied for the improvement of forest species in respect to cost of production, yield, and quality of forest products. This cooperative forest tree breeding project is sponsored by the University of Idaho, the Idaho State Forest Service, The Intermountain Forest and Range Experiment Station, and the Southern Idaho Forestry Association.

The first year has been devoted to the acquisition of necessary equipment and the development of plans and techniques for the adaptation of the basic plant breeding methods for the improvement of ponderosa pine. The field work, which was begun in September, has been largely in the Boise Basin near Idaho City. Several seed stands have been selected and are being developed for seed production. About a thousand trees have been selected on the basis of their appearance and work is in progress to determine the best parent trees by the observation of their progenies' performance under commercial forest conditions in the Boise Basin. When feasible the project will be extended to include additional areas and forest species.

Project E.S. 25. Studies on Idaho Wood-Rotting Fungi.

This project was initiated in 1957 to obtain basic information on morphology distribution, host and substratum relationships, type of rot, and cultural characteristics of Idaho wood-rotting fungi.

The late summer and fall of 1957 were not marked by a good development of fruiting bodies of wood-rotting fungi as the late, dry season extended into the period of killing frosts with no long period of wet weather in between. The number of collections of wood-decaying fungi was consequently small.

Studies on Poria zonata Bores., a common but little-known slash-decaying fungus, were carried out through the year and a manuscript has been prepared for submission to Lloydia.

Studies on the olive-green stain in the heartwood of western conifers were continued, and a paper on this defect was given at the 1957 meeting of the Northwest Scientific Association. A paper entitled, "Additions to the Polypore Flora of the Northwest" was also given at that meeting. In this paper, the occurrence in the Northwest of Poria lenta Overh. and Lowe, Poria subradiculosa Murr., Poria fimbriatella (Peck) Sacc., Polyporus minisculoides (Pilat) Lowe, and an undescribed Poria was reported.

Studies on wood rotting fungi in cooperation with the National Forest Disease Laboratory, U.S. Forest Service, Beltsville, Maryland, were also conducted in the past year and a manuscript on "Some Wood-rotting Fungi of the Subalpine Zone" is being prepared jointly with that agency.

Project No. S.R. 11-B. Forest Tree Physiology.

The work on this project consists of establishing the role of mycorrhizae in the physiology of normal and pole blighted western white pine. As explained in the Ninth Annual Report, the initial work here is closely associated with Project E.S. 20 (Pole Blight); the mycorrhizal work for both projects will be reported here.

I. Collection of possible mycorrhizal fungi.

The latter part of the 1957 field season was one of extremely low rainfall; this resulted in a very low production of fungus sporophores. Despite extensive collection trips in many white pine areas, only 15 collections were made (compared to 347 collections in the 1956 field season). These included no new species but yielded 5 new stock cultures. Fungi in the mycorrhizal herbarium now number over 250 with 65 of those in stock culture. Most of the fungi are in the Boletaceae. Collections and culturing will continue in 1958 with the emphasis again on the Agaricaceae.

II. Mycorrhizal Synthesis.

The bulk of the laboratory effort was concentrated on perfecting a method of mycorrhizal synthesis. The first medium used for seedling growth, Terra-lite (a brand of Vermiculite) was abandoned in favor of a new medium called Spong-rok. Spong-rok has less tendancy to compact and test white pine seedlings showed slightly better growth in it. More important, since it was felt that insufficient aeration might be one of the factors responsible for lack of mycorrhizal formation on the seedling roots after inoculation, Spong-rok might be expected to overcome the aeration problem.

In February, Dr. Gilbertson talked with Dr. Ed. Hacskaylo at Beltsville, Maryland. (Dr. Hacskaylo, using different species, has successfully used the technique we are trying for mycorrhizal synthesis). He suggested that

material is low in inflammability. After reweighing, the samples will be discarded and undisturbed samples used for subsequent weighing.

Old plots under ocular appraisal are showing marked declines in fire hazard rating after five years. For example, the slash resulting from a heavy cut of white pine and hemlock, on the Deception Creek Experimental Forest was rated an extreme fire hazard immediately after logging. Now this cut-over area is rated as a moderate fire hazard, that is, from a fire protection standpoint it is reasonably safe. Plots of different slash treatments were established on this area to compare fire hazard reduction by the various methods. Following are the ratings given over the five year period:

Slash Fuel Hazard Rating

	Chipped slash[1]	Piled slash	Lopped slash	Jumble slash[2]
1st year	Nil	High	Extreme	Extreme
2nd year	Nil	High	Extreme	Extreme-
3rd year	Nil	High-	High	High-
5th year	Nil	Mod.+	Mod.-	Mod.

[1] Slash ground up in portable wood chipper

[2] Slash as left by the logger

2. Inflammability Studies. No burning tests have been conducted at the Priest River field fire laboratory for two years. The next and final series of burning tests will be made in 1959 when the slash in the existing plots has aged for 5 years. These plots like those previously tested for rate of fire spread and amount of heat generated, will represent the nine main timber species of the region and three densities of slash for each, namely, 7 1/2 tons, 20 tons and 32 1/2 tons per acre.

It is quite obvious now that fire will advance very slowly if at all in the light density plots after two more years of aging. Loss of needles and disintegration of fine twigs, have greatly reduced kindling fuels and left large voids in the bed of slash fuels that will arrest fire spread.

3. Full Tree Skidding to Remove Slash from the Woods. Almost from the beginning of the slash disposal project, there has been speculation as to the possibility of removing entire trees from the woods to be limbed, trimmed, and in the case of cedar poles, peeled at a central point. Here the slash could be burned progressively or chipped for subsequent use or removal. If economically feasible, this method would be especially desirable for logging cedar for pole making, because of the high fire hazard that results when this operation is carried on in the woods.

Repeated efforts to induce operators to try this method have failed; partly due to the uncertainties of its success and partly due to just a resistance to change. However, gradually, some phases of the

the addition of vitamin B_1 (thiamine hydrochloride) might possibly induce mycorrhizal formation. Accordingly, a revised nutrient solution was formulated; it contained 25.0 gammas of vitamin B_1 per liter - otherwise it was essentially the same as our previous solution.

Mycorrhyal synthesis will continue in 1958.

III. Cultural Studies of Mycorrhizae.

The work on stock cultures and mycorrhizal synthesis extends an excellent opportunity to study the cultural characteristics of our mycorrhizal fungi. Although no conclusive associations have been proven, some of the fungi in our flora are most certainly mycorrhizal on western white pine in addition to having been proven mycorrhizal on eastern white pine and/or other members of the white pine subgenus are the most likely suspects.

Boletus subluteus was the first of such fungi to be investigated. Four isolations were subcultured four times and grown on Hagem's agar at room temperature in the dark. Morphological characteristics of the cultures and growth pattern were noted at weekly intervals for six weeks. Photographs were taken. Eventually, all of our mycorrhizal species should be described on a standardized form and perhaps a cultural key can be constructed for the more important fungi in this group.

Project No. S.R. 24. Slash Disposal Studies.

Numerous facets of the logging slash problem in the western white pine type, recommended for study by the advisory committee for this special research project have been explored and tested insofar as personnel and funds have permitted. Results of that work have been reported in five publications of this Station, four publications of the Forest Service, and in several articles appearing in technical journals. There are two major lines of study in this project that will continue to yield valuable data for some time to come. These are being pursued on a part time basis. At present, one-half time of one person is being devoted to that work. It is planned to reduce time spent on these studies still further next year.

1. Rate of Decay. In the fall of 1957, a series of new plots was established to measure the rate of decomposition and diminishing fire hazard in logging slash. Unlike earlier plots established for this study, in which the degree of fuel reduction was based on ocular appraisals, these new plots will provide accurate weight measurements of fuel reduction that can be correlated with rate of fire spread and radiant heat data obtained from the inflammability studies.

   Fifty-four quadrates were staked in limby slash of six native species. The slash in each was separated from the main mass of fuels by cutting along the borders of the quadrate with a pruning shears. After selecting a small sample for moisture determination, all material within each quadrate was removed, weighed and then replaced. These quadrates are to be used as samples for reweighing at 1, 3 and 5 year intervals. Fine material, resulting from disintegration, that has sifted to the ground will not be included in the reweighing, since tests have shown that such

recommended method have been accepted. For example, it is now fairly common practice to bring the poles out of the woods with bark attached and do the peeling by hand or machine at some central point.

At this writing, a test of full tree skidding for pole making is finally under way. The St. Joe National Forest has provided a timber sale stipulating in the contract that cedar trees are to be cut at standard stump height and the entire trees, from butt to crown tip skidded to an existing landing for manufacture into a finished pole. The contract has been awarded and actual operations will start in June. The first phase of the study will deal with such factors as size limitations for full tree skidding; size of work area needed; synchronizing skidding with peeling operations; and a study of damage, if any, to residual trees and poles. The St. Joe National Forest is providing a portable wood chipper for disposal of the slash on the work area. If no great difficulties are encountered in full tree skidding and slash disposal at a central point, and when the operations have become properly organized, the study will be extended to obtaining cost data and determining salvage values in "trimmings" accumulated at the work area. Such salvage possibilities would include round fence posts from the tops, split fence posts from hollow butt logs, pulp wood and wood chips.

Project No. S.R. 54. Investigation of Log Grading Standards for Important Idaho Tree Species.

The following three studies were made last summer and are now being analyzed:

1) Ponderosa pine study on the Bitterroot.
2) The Grand fir study at Kamiah.
3) The White pine study at Pierce.

Plans for future study in 1958 will develop on progress made on work already started. This is a cooperative undertaking by the Forest Service and other interested groups. This is the first year that the University of Idaho has been cooperating on this work and it is expected that Idaho's activities will increase in the future.

Project S.R. 55. Identification and Ecology of Insects Affecting Cones and Seeds of Forest Trees.

The project on insects of cones and seeds was initiated in 1957. One small scale test of insecticides was conducted with ground equipment against the Douglas-fir cone moth, Barbara colfaxiana, in 1957, and aerial application was tested in 1958. The major emphasis to date, however, has been on an inventory of the cone and seed insect species present in Idaho forests.

The inventory has been set up to determine the insect species found attacking cones and seeds of the various tree species; to develop means of identifying the cause of damage from larval specimens, adult insects, or the cone after the departure of the insects involved; and to take preliminary steps toward assessing the relative importance of the various insect species. To initiate this, collections of infested cones have been made from various parts of the region. The cooperation of the various administrative units of the U. S. Forest Service, Region 1 in submitting some 70 collections is

gratefully acknowledged. In the laboratory, records are taken of such data as tree species, source, and the like and description of the internal and external appearance of the cones.

Larval specimens are collected when present, and the cones are then placed into rearing. In rearing, the cones are held at room temperature for a period to obtain emergence of those insect species active in summer and fall. Following this the cones are subjected to refrigeration to simulate winter temperatures and are then returned to room temperature for emergence of the spring-flying species.

One-gallon cardboard containers have been used for cone-handling units, and refrigeration has been at about 40°F. Rather poor emergence has been obtained with these conditions and it is felt that adequate humidity control to prevent drying and about 6 - 8°F. colder temperatures would improve the emergence rate.

In addition to data on primary pests of cones, records of parasites and associated species are kept. In a given infested cone various insect species may be present as: the primary pest, a parasite of the primary pest, a hyperparasite, or an inquiline. Sorting these relationships out is a primary future objective. In the present report the various insect species that have been recovered and identified have merely been grouped as primary pests and associated species. Identification has been made by the specialists noted, and some of the recoveries are still in the hands of specialists and are unreported. Species recovered and determined to date are shown in Table 1.

A single comparison of 3 insecticides applied at very heavy concentrations by ground equipment was made on Barbara colfaxiona, infesting Douglas-fir cones in 1957. Applications were directed at the first instar larvae between hatch and entrance into the cones. Oviposition by the adult moths was first observed on May 10, 1957. Treatments were made on May 17, and the first hatch occurred about May 20.

Of the materials tested, 2 pounds of 50% wettable DDT per 100 gallons of water proved the most effective. Volumes applied were estimated at about 7 gallons per 30-foot tree. Effectiveness was estimated by grouping cones from treated and control as to: no larvae present and one or more larvae present. The treatment resulted in the reduction of infested cones from a range of 73 - 98% (8 trees; 3,047 cones) to a range of 3.4 - 8.7% (5 trees; 852 cones).

In the spring of 1958, an attempt was made to extend the test to field conditions with aerial application of lower volumes. Applications were made of 50 pounds of 50% wettable DDT in 150 gallons of water at approximately 5 and 10 gallons per acre; 50 pounds 50% wettable Sevin in 150 gallons of water at approximately 5 and 10 gallons per acre; and 20 pounds EMV DDT in 40 gallons of oil at approximately 2 gallons per acre.

The analysis of the effectiveness of these tests will be made in September, 1958.

PRIMARY PESTS OF CONES

HOST TREE SPECIES	INSECT SPECIES	ORDER	FAMILY	SPECIES DETERMINATION BY
PONDEROSA PINE	DIORYCTRIA AURAMTICELLA	LEPIDOPTERA	PHYCITIDAE	H. RUCKES, JR., UNIV. CALIF.
PONDEROSA PINE	LASPEYRESIA MISCITATA	LEPIDOPTERA	OLETHREUTIDAE	H. RUCKES, JR., UNIV. CALIF.
PONDEROSA PINE	LASPEYRESIA PIPERANA	LEPIDOPTERA	OLETHREUTIDAE	H. RUCKES, JR., UNIV. CALIF.
PONDEROSA PINE	EUCOSMA SP.	LEPIDOPTERA	OLETHREUTIDAE	H. RUCKES, JR., UNIV. CALIF.
PONDEROSA PINE	CONOPHTHORUS SP.	COLEOPTERA	SCOLYTIDAE	E. C. CLARK, UNIV. IDAHO
WESTERN WHITE PINE	CONOPHTHORUS SPP.#	COLEOPTERA	SCOLYTIDAE	H. RUCKES, JR., UNIV. CALIF.
WESTERN WHITE PINE	LASPEYRESIA SP.	LEPIDOPTERA	OLETHREUTIDAE	E. C. CLARK, UNIV. IDAHO
DOUGLAS-FIR	BARBARA COLFAXIANA	LEPIDOPTERA	OLETHREUTIDAE	J.F.G. CLARKE, A.R.S.
DOUGLAS-FIR	DIORYCTRIA SP.	LEPIDOPTERA	PHYCITIDAE	E. C. CLARK, UNIV. IDAHO
DOUGLAS-FIR	MEGASTIGMUS SPERMOTROPHUS	HYMENOPTERA	TORYMIDAE	B. D. BURKS, A. R. S.
ENGELMANN SPRUCE	LASPEYRESIA YOUNGANA	LEPIDOPTERA	OLETHREUTIDAE	PROBABLE

INCLUDES C. MONTICOLAE AND POSSIBLY C. LAMBERTIANAE AND/OR C. CONTORTAE.

ASSOCIATED SPECIES

HOST TREE SPECIES	INSECT SPECIES	ORDER	FAMILY	SPECIES DETERMINATION BY
DOUGLAS-FIR	EXOCHUS EVETRIAE	HYMENOPTERA	ICHNEUMONIDAE	L.M. WALKLEY, A. R. S.
DOUGLAS-FIR	HYSSOPUS THYMUS	HYMENOPTERA	EULOPHIDAE	B.D. BURKS, A. R. S.
DOUGLAS-FIR	ELACHERTUS PINI	HYMENOPTERA	EULOPHIDAE	B.D. BURKS, A. R. S.
DOUGLAS-FIR	TORYMUS SP.	HYMENOPTERA	TORYMIDAE	B.D. BURKS, A. R. S.
DOUGLAS-FIR	TETRASTICHUS SP.	HYMENOPTERA	EULOPHIDAE	B.D. BURKS, A. R. S.
DOUGLAS-FIR	BRACON RHYACIONIAE	HYMENOPTERA	BRACONIDAE	C.F.W. MUESBECK, A. R. S.
DOUGLAS-FIR	GLYPTA EVETRIAE	HYMENOPTERA	ICHNEUMONIDAE	C.F.W. MUESBECK, A. R. S.
DOUGLAS-FIR	CALLIEPHIALTES COMSTOCKII	HYMENOPTERA	ICHNEUMONIDAE	C.F.W. MUESBECK, A. R. S.
PONDEROSA PINE	BRACON RHYACIONIAE	HYMENOPTERA	BRACONIDAE	C.F.W. MUESBECK, A. R. S.
WESTERN WHITE PINE	TETRASTICHUS COERULESCENS	HYMENOPTERA	EULOPHIDAE	B.D. BURKS, A. R. S.
WESTERN WHITE PINE	HABROCYTUS PHYCIDIS	HYMENOPTERA	PTEROMALIDAE	B.D. BURKS, A. R. S.
WESTERN WHITE PINE	BRACON RHYACIONIAE	HYMENOPTERA	BRACONIDAE	C.F.W. MUESBECK, A. R. S.
WESTERN WHITE PINE	LATHRIDIUS MINUTUS	COLEOPTERA	LATHRIDIIDAE	L.M. WALKLEY, A. R. S.
ENGELMANN SPRUCE	PLECTOPS SP.	DIPTERA	LARVAEVORIDAE	C.W. SABROSKY
ENGELMANN SPRUCE	APROSTOCETUS SP.	HYMENOPTERA	EULOPHIDAE	B.D. BURKS, A. R. S.
ENGELMANN SPRUCE	HABROCYTUS PHYCIDIS	HYMENOPTERA	PTEROMALIDAE	B.D. BURKS, A. R. S.
ENGELMANN SPRUCE	TORYMUS SP.	HYMENOPTERA	TORYMIDAE	B.D. BURKS, A. R. S.
ENGELMANN SPRUCE	AMBLYMERUS SP.	HYMENOPTERA	PTEROMALIDAE	B.D. BURKS, A. R. S.
ENGELMANN SPRUCE	BRACON RHYACIONIAE	HYMENOPTERA	BRACONIDAE	C.F.W. MUESBECK, A. R. S.

II. Range Management Research

A. Projects completed during the year -- None.

B. Continuing projects:

Project E.S. 7. Evaluation of Salt-Desert Shrub Ranges.

The data for this project are again reported this year in conjunction with those for Project E.S. 15, Ecology and Control of Halogeton.

Project E.S. 8. Study of Medusa-Head Range on Idaho Ranges.

The relative rate of root development of medusa-head and cheatgrass was found to be similar in a field study conducted in 1957 (Table 1). Root elongation of both species continued throughout the winter period (mid-December to mid-March) with the exception of the coldest period (mid-January to mid-February). Elongation of the aerial portion of the plants did not occur during this same period. It was observed that the coleoptile is replaced by true blades during the latter part of this period and accounts for the seemingly "non-growth" of the aerial portion while root elongation continued.

Because the two species are annuals, the study is being continued for a second year. Results to date (mid-April) indicate that in some years, medusa-head roots may develop more rapidly than that of cheatgrass (Table 2). However, by mid-April the root length of cheatgrass had nearly attained the length it had the previous year. This slight advantage medusa may have over cheatgrass for soil moisture may possibly be offset by cheatgrass' earlier maturity (about 2 weeks).

In addition, crested and intermediate wheatgrasses were included in the study the second year. Root penetration of wheatgrasses were from 1/2 to 1/4 the length attained by the annual grasses by mid-March, even though all species germinated at about the same time in the fall. This clearly indicates the great difficulty these perennial species must overcome to become established in a stand of medusa or cheatgrass. This handicap is greatly increased when the perennial seedlings emerge in the spring.

The difficulty encountered to reduce medusa-head competition to a tolerable level to permit successful establishment of perennial species is the primary reason why reseeding in medusa-head infested ranges have not been undertaken. Burning does not destroy many seed that is lodged in the litter and soil. Because seed of medusa is able to retain its viability in the field for at least one year, the elimination of the current seed crop does not prevent it for becoming dominant the following growing season. Studies at present are directed towards finding a suitable method of destroying two consecutive seed crops before reseeding.

Table 1. Average root and aerial lengths of medusa-head and cheatgrass from mid-December to mid-June 1956 - 1957. (Av. of four measurements)

Date of Recovery	Root length (in.)		Aerial length (in.)	
	Medusa	Cheatgrass	Medusa	Cheatgrass
12/12/56	13.2	13.5	3.2	2.7
1/12/57	16.2	16.1	3.1	2.6
2/12/57	18.4	16.5	3.1	2.8
3/14/57	25.3	25.4	3.1	2.2
4/13/57	36.4	32.4	4.4 (a)	4.9 (a)
5/22/57	37.6	32.5	8.7 (b)	11.6 (c)
6/9/57	38.2	31.9	15.8 (c)	15.0 (d)

(a) 3-4 blades
(b) early boot stage
(c) pre-anthesis
(d) dough stage

Table 2. Average root and aerial lengths of medusa-head and cheatgrass from mid-December to mid-April 1957-58 (Av. four measurements)

Date of Recovery	Root length (in.)		Aerial length (in.)	
	Medusa	Cheatgrass	Medusa	Cheatgrass
12/12/57	7.7	7.3	3.1	2.5
1/14/58	16.1	6.8	3.5	2.2
2/12/58	15.0	10.4	2.7	2.1
3/13/58	20.4	14.4	3.5	2.8
4/15/58	36.6	30.2	4.3 (a)	3.9 (a)

(a) 3-4 blades.

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

Emphasis continued to be placed on the recognition and analysis of plant communities based on joint vegetation soil studies. There appears to be no point in spreading our efforts over additional objectives of the project until this first basic one is well advanced. During the field season of 1957 seventeen new sites were sampled, bringing to 48 the total for the three seasons of operation. Two vegetation types not previously studied were covered in this season's work and needed replications obtained from some of the types already recognized. Geographically the work was conducted mainly in south-central and eastern Idaho, following the policy of gradually extending the work from the western to the eastern side of the State.

More attention was given this year to the correlation of areas by their vegetational and soil characteristics. It was found that knowledge of the major types studied is beginning to pay off in this regard. In several areas it was found possible to assign vegetation in various successional stages to specific climax types. Often this could be done by inspection of the vegetation alone. In other cases a soils examination was needed also. Ability to recognize the varieties of sagebrush-grass vegetation is increasing rapidly as a better understanding of the climax types is developed. For example, in 1956 we were still undertain as to the status of the Artemisia tridentata/Stipa thurberiana type. Additional sites in 1957 established its position as a type of permanent vegetation and a fair idea was obtained of the area originally occupied, despite the present badly depleted condition of most of the vegetation.

The Oregon, Washington and Idaho project leaders, along with one other member of the Idaho staff, made a week's trip in September through western Montana and eastern Idaho. The Montana portion of the trip was made in response to invitations by both college Range Management groups in that state. A great variety of sagebrush-grass and grassland vegetation was seen in Montana through the cooperation of Melvin Morris of Montana State University and Gene Payne and John Rumley of Montana State College. Joint field trips provided an opportunity to discuss the objectives and procedures of our tri-state project and to see how this approach might be of help with similar problems in Montana. Some vegetation types were recognized as equivalent to those studied in eastern Washington or southern Idaho, while others did not fit in any category which our group has studied. Extensive areas were seen of the contact between sagebrush vegetation and that of both the Agropyron spicatum and Stipa/Bouteloua provinces. In Idaho, one day was spent with U. S. Forest Service range men from the Dubois Experiment Station.

A week was spent in the field by the Oregon and Idaho project leaders with Messrs. Vern Hughie and Howard Passey of the Regional SCS soils-vegetation research team. Study areas in southwestern Idaho and southeastern Oregon were visited and the concepts and procedures being followed in our tri-state project were discussed with them. It appears that the objectives of the SCS group parallel those of our projects to a considerable degree. Close coordination of work is planned to avoid unnecessary duplication and to expedite each other's progress.

Because of their unique vegetational and soil characteristics, and the lack of available information concerning them, special attention is being given to these types, particularly those dominated by Artemisia arbuscula. A start was made this year at additional studies of the ecology of this species of Artemisia, and of the morphology and genesis of the soils on which it occurs.

To date, seven major types of sagebrush-grass vegetation have been recognized in Idaho. These are distinctive communities which can usually be distinguished by their dominant species alone. In 3 of the 7 types the species of Artemisia involved is different from that of the other 4, while the combination of dominant shrubs and grasses is unique for each of the seven.

At least 3 of these major communities, however, are quite heterogeneous and capable of further sub-division. Work on the process of sub-division is now under way and the results are not all available. It is apparent that the differences are of a finer order than those mentioned previously. The relative basal area and frequency of dominant grasses, while differing somewhat among the sub-types, appear to be less valuable characteristics than the frequency and constancy of occurrence of less abundant species, especially perennial forbs and the less common grasses and shrubs. Certain annual species may also have indicator value, but these relationships have not been clarified to date. Another kind of information which would probably help in these sub-divisions would be yield data. A start will be made at yield studies in 1958.

Project E.S. 10. Ecology and Grazing Relationships of the Douglas-fir Zone in Interior British Columbia.

Work on the first phase of this project was completed and the results published in July, 1957. A summary of the results and conclusions is presented herewith:

The present study was made chiefly on the Tranquille Forest near Kamloops, with less detailed observations in other parts of the region. Following a broad preliminary study detailed data were obtained on permanently marked sample plots located in each of the communities recognized.

The climax in the areas studied is the Pseudotsuga/Calamagrostis association, with the tree stand dominated by Pseudotsuga menziesii var. glauca and the understory by Calamagrostis rubescens. Mature stands are composed almost exclusively of Pseudotsuga and are relatively open, with the trees spaced about 15 feet apart. The trees are smaller than the coastal form of Douglas-fir, seldom exceeding 115 feet in height and 40 inches in d.b.h.

The relatively sparse shrub cover is dominated by Shepherdia canadensis, Rosa gymnocarpa and Spiraea betulifolia. The herbaceous and dwarf shrub stratum is well developed. Important species in addition to the dominant C. rubescens include Arnica cordifolia, Aster conspicuus, Carex richardsonii, Fragaria glauca, Lathyrus ochroleucus, Arctostaphylos uvaursi, Berberis repens and Linnaea borealis. Lupinus glacialis, lacking at lower elevations in the zone, is common to abundant in the higher portions.

The poorly developed moss-lichen layer is characterized by species of Brachythecium, Cladonia, and Peltigera.

The principal seral community is the Pinus/Calamagrostis associes. Here the tree cover is more or less even-aged, due to its origin following fire. Mature individuals attain heights of 60-70 feet and diameters of 12 to 18 inches. The understory vegetation is similar to that of the Pseudotsuga/Calamagrostis association, but somewhat more vigorous and productive.

The second seral type is the Populus/Calamagrostis, which is characterized by the most open tree cover and best-developed herbaceous understory of any of the three communities. Most of the Populus stands are even-aged and apparently have resulted largely from sucker shoots. However, numerous seedlings of aspen have been observed on recently burned areas. The shrub cover varies considerably within this community, with Symphoricarpos albus dominant in the drier sites and Shepherdia canadensis in the more mesic areas.

Understory vegetation in the zone is strongly affected by the amount, age and kind of tree stand. The amount of herbaceous cover, as measured by clipped plots, is highest in Populus stands, intermediate in Pinus contorta and mixed conifer-Populus stands, lowest under Pseudotsuga cover.

Certain differences in species composition occur between the conifer-dominated communities and the Populus/Calamagrostis associes. While no species could be classed as exclusive to either group, 11 were rated as selective and 15 as preferential according to the fidelity classification of Braun-Blanquet. The plants classed as selective to conifer-dominated communities include several evergreen species (Pachistima myrsinites, Chimaphila umbellata, Pyrola asarifolia) and several lichens and mosses. All of the species in this conifer-selective group were represented in the Picea/Abies zone also.

The vegetation of the Pseudotsuga zone is clearly distinguished from that of the Pinus ponderosa and Picea/Abies zones which contact it in the zonal sequence of forest types. Pinus ponderosa acts as a seral species in the lower portion of the Douglas-fir zone, as does Pseudotsuga to a limited extent in the Picea/Abies zone. Pinus contorta is a major seral species in both the Pseudotsuga and Picea/Abies zones.

Over considerable areas where Pinus ponderosa is lacking in the zonal sequence, the Pseudotsuga zone abuts directly on the Agropyron/Festuca association of the Pacific Northwest grasslands. This boundary is sharp, and for the most part appears stable. In limited areas tree invasions of the grassland is taking place, with Populus and to some extent Pinus contorta acting as pioneer species and forming groves in local situations favored in regard to soil moisture.

The Pseudotsuga/Calamagrostis community appears to constitute the climax over a large part of the Pseudotsuga zone. The Pseudotsuga/Physocarpus association common in northern Idaho and adjacent Washington occurs in the southeastern portion of the region. Further subdivision of the Pseudotsuga zone may be indicated when further studies have been made.

Although present conditions favor establishment of the climax tree cover over the region, there are large areas in which this process will be

extremely slow due to lack of a seed source of Pseudotsuga. The Pinus/ Calamagrostis community in particular now extends over large areas in which Pseudotsuga is lacking or rare. In such areas this fire-induced disclimax must be considered as a semi-permanent type from the viewpoint of one or two generations at least.

No further field work was done during the current year, but additional studies have been planned in cooperation with staff members of the Canada Range Experiment Station at Kamloops.

Project E.S. 13. Studies of Ecotypes in Important Range Grasses.

Seven seed or clone collections of Festuca idahoensis made during 1956 were propagated in the greenhouse and transplanted into the field during the spring of 1957. In 1957 most of these plantings had produced good-sized plants which showed considerable variability within and between collections.

Plans have been made for further study of the population complex involved in F. idahoensis and closely related forms will be made by E. W. Tisdale in cooperation with the Carnegie Institute of Biology at Stanford. Collections of fescue vouchers will be made during the summer of 1958, with field and laboratory studies to follow.

Project E.S. 15. The Ecology and Control of the Halogeton.

Due to the lack of a research fellow on this project during 1957-58 the data gathered was limited to obtaining the permanent records from the majority of transect cluster areas located in the Raft River Valley.

Favorable growing conditions during the spring of 1957 caused an increase in the foliage cover in fair to good condition saltsage stands and an increased number of seedlings with little or no change in annual plant populations. Annual populations showed a slight increase over 1956 in the depleted saltsage stands.

Halogeton first appeared in one particular winterfat stand (F-II) in 1956 but occurred only infrequently that year. A moderate increase was experienced in 1957 and a larger increase is expected in 1958. Another winterfat stand in the Raft River Valley was invaded by halogeton in 1956 at which time it occurred in one percent of the loops. The record in 1957 showed halogeton in 44 percent of the loops on the three permanent transects. This same stand was invaded by big sagebrush as the vigor of the winterfat plants declined. The percentage of loops striking foliage of big sagebrush increased from 1.0 percent in 1951 to 14.3 percent in 1957.

A large population of rabbits in 1957 and in 1958 is having a marked affect on vegetational trends in the salt-desert shrub type of the Raft River Valley. Evaluation of these effects will be attempted in the coming year.

Project E.S. 22. (R-296). Beef Cattle Nutrition on Seeded and Native Forage in Idaho.

The results of the 1957 spring and fall grazing trials on the Point Springs pastures are summarized below.

Spring Grazing Trial

Initial production samples were taken over a four day period, April 28 to May 1. New leaf growth ranged from 4 to 9 inches and averaged approximately 6 inches. Growing conditions during the spring period were even more favorable than the conditions during the spring of 1956. Approximately 0.4 inches of rain fell on the area between the 14th of April and May 1st (see Table 1). Total precipitation during the month of May was 4.78 inches and an additional 1.14 inches fell in June. Storms were well scattered through the grazing period and growth of grass was greater than in any of the previous years.

Animals for the experimental trials arrived on May 4 and were weighed and distributed to the pastures on May 5. A total of 158 animals was placed in the pasture during this time. Due to very favorable growing conditions in the following four weeks, additional animals were requested and added during the second weighing. The number added was 135 making a total of 293 animals in the pastures for the last two weeks of the trial period. An additional nine University animals grazed the pastures for part of the trial period, when they were not being used in the digestion studies being conducted on the area.

Production and Utilization

Sampling to determine production at the beginning of the trials was completed three days before the animals were weighed and distributed to the pastures. The average production per acre before grazing and the amount remaining after grazing is shown in Table 2. Growth measurements during the grazing period were largely unsuccessful due to the destruction of the cages by the animals while grazing. A more substantial cage is planned for use in 1958. Utilization at the end of the trial was calculated on the basis of the number of plants grazed in the clipped samples. These figures are generally higher than those determined on a weight basis. In general, the use of the pastures was considerably less than the desired level.

Livestock Gains

A summary of the livestock gains made during the grazing period is presented in Table 3. The animals added during the second weighing gained at a lesser average daily rate than those that had been on the pastures from the beginning of the period. The average daily gain was also somewhat less than in previous years although there was a greater quantity of forage available.

Table 1. Precipitation record for the Point Springs experimental area, 1957.

Measurements Taken Date	Time	Precipitation Inches
4/14/57	8:00 a.m.	0 *
4/28/57		.365
4/30/57	8:00 a.m.	.009
		.374
5/2/57	8:00 a.m.	.002
5/4/57	8:00 a.m.	.028
5/9/57	8:00 a.m.	.322
5/9/57	3:00 p.m.	.699
5/12/57	9:00 a.m.	.641
5/13/57	9:35 a.m.	.799
5/14/57	8:00 p.m.	.043
5/15/57	6:10 p.m.	.352
5/19/57	9:00 a.m.	.691
5/21/57	9:35 a.m.	.058
5/21/57	7:00 p.m.	.076
5/28/57	7:10 p.m.	.080
5/29/57	8:30 a.m.	.015
5/30/57	7:15 a.m.	.011
		4.775
6/2/57	4:30 p.m.	.257
6/6/57	10:00 a.m.	.024
6/10/57	10:00 a.m.	.330
6/12/57	5:45 p.m.	.052
6/15/57	8:00 a.m.	.002
6/16/57	8:40 a.m.	.009
6/20/57	5:30 p.m.	.229
6/29/57	7:10 p.m.	.186
6/30/57	9:05 a.m.	.039
7/1/57	7:30 a.m.	.009
		1.137
7/15/57	7:00 p.m.	.209
7/29/57	8:00 a.m.	.039
7/29/57	7:00 p.m.	.237
		.485
8/12/57	4:00 p.m.	.542
8/22/57	10:30 a.m.	1.183
8/27/57	5:30 p.m.	.201
8/31/57	9:40 a.m.	.291
		2.217
10/1/57	4:00 p.m.	.145
10/2/57	6:10 a.m.	.045
10/3/57	2:30 p.m.	.799
		.989
10/27/57		.404
		.404
11/12/57	5:30 p.m.	.429
11/13/57	5:45 p.m.	.039
11/14/57	4:00 p.m.	.553
11/18/57	8:50	.052
		1.073
Total from 4/14/57 to 11/18/57		11.454

* Rain gauge established on the area April 14, 1957.

Table 2. Forage production and utilization by blocks within pastures as determined from clippings and counts of grazed plants for the spring period, 1957.

Pasture	Block	Initial Production Per Acre	Forage Per Acre Remaining at End of Grazing Season	Plants Grazed In	
				Clipped Samples	Photo Plots
		Pounds	Pounds	Percent	Percent
East	A	267	307	88	
	B	670	883	49	
	C	792	972	54	
	Average	577	720	60*	77
West	A	265	521	62	
	B	483	666	55	
	C	444	910	58	
	Average	397	699	58*	45
Southeast	A	361	320	88	
	B	523	454	81	
	C	591	730	74	
	Average	492	501	80*	80

* Computed from total number of grazed plants and total number of plants in the clip sample for each pasture.

Table 3. Summary of cattle gains for the spring grazing period, May 5 to June 20, 1957.

Grazing Intensity	Number of Animals	Average Initial Weight	Average Final Weight	Average Total Gain	Average Daily Gain
Light	45	378	478	100	2.22
East	44*	391	421	30	1.76
Moderate	45	385	484	100	2.22
West	36*	409	434	25	1.47
Heavy	68	387	496	109	2.42
Southeast	55*	423	455	32	1.88

* Animals added at the end of the first four weeks of grazing.

Fall Grazing Trials

Sampling to obtain production for the fall grazing trials was accomplished during the early part of September (September 3 and 4). Animals arrived on September 29 and were weighed on September 30.

Production and Utilization

Forage production and utilization data for the fall trials are presented in Table 4.

Table 4. Forage production and utilization by blocks within pastures as determined from clippings and count of grazed plants for the fall grazing period 1957.

Pasture	Block	Initial Production Per Acre	Forage Per Acre Remaining at End of Grazing Season	Utilization	Plants Grazed In Clipped Samples	Plants Grazed In Photo Plots
		Pounds	Pounds	Percent	Percent	Percent
Northeast	A	822	557	32	70	
	B	944	484	49	64	
	C	890	410	54	67	
	Average	885	484	45	67*	67
Northwest	A	834	477	43	72	
	B	1162	374	68	79	
	C	844	320	62	82	
	Average	943	390	59	78*	85
Southwest	A	712	203	72	91	
	B	954	324	66	93	
	C	872	208	76	95	
	Average	846	245	71	93*	97

* Computed from total number of grazed plants and total number of plants in the clip sample for each pasture.

Production was generally greater than in previous years. This greater production resulted from more favorable growing conditions in the spring and also from the increased density of the stand of crested wheatgrass, particularly in the northwest and southwest pastures. New growth began with the rains that occurred in August and remained green throughout the fall grazing trials.

Utilization, based on weight of forage at the beginning and conclusion of the trials, approximated the desired levels in each of the pastures.

Livestock Gains

Livestock gains were greater during the fall period than in either of the previous two years (see Table 5). This probably resulted from the additional fall green growth that was available this year and from the more adequate water supply furnished by the electric pump installed in the spring of 1957.

Table 5. Summary of cattle gains for the fall grazing period, September 30 to November 14, 1957.

Grazing Intensity	Number of Animals	Average Initial Weight	Average Final Weight	Average Total Gain	Average Daily Gain
Light Northeast	102	586	610	24	.53
Moderate Northwest	155	591	620	29	.64
Heavy Southwest	175	604	630	26	.58

Miscellaneous Information

Vegetation

Seedling production in the spring grazed pastures was more than in 1956 but less than in the fields grazed in the fall. A large number of seedlings produced in 1956 in the fall grazed pastures grew into mature plants during 1957. This caused some increase in the density of the stand in the burned sections of the northeast and northwest pastures and in the poor section of the southwest pasture. Particularly noticeable was the invasion by crested wheatgrass of the annual plant cover existing on the fire lane in the northwest pasture.

Stocking Rates

The acres per animal unit month of grazing were calculated on the basis of the average initial weight of the animals. At the beginning of the spring period the animals weighed approximately 400 pounds, whereas at the beginning of the fall period the average weight was approximately 600 pounds. The animals used in the trials were equated to animal units on the basis that consumption is proportional to the 3/4's power of the body weight. On this basis, a 400 pound animal is equivalent to 0.5 animal units and a 600 pound animal is equivalent to 0.68 animal units. The stocking rates during 1957 are shown in Table 6.

Table 6. Stocking rate for the Point Springs pastures during the spring and fall grazing trials of 1957.

Pasture	Average Number of Animals	Average Initial Weight	Months of Grazing	Animal * Unit Months of Grazing	Acres Per AUM
Spring Grazing					
East	63.2	384	1.5	47.4	3.4
West	60.2	396	1.5	45.2	3.5
Southeast	90.4	403	1.5	67.8	2.4
Fall Grazing					
Northeast	104.0	586	1.47	104.0	1.5
Northwest	157.2	591	1.47	157.2	1.0
Southwest	176.6	604	1.47	176.6	0.9

* A 400 pound animal considered as the equivalent of 0.5 animal units and a 600 pound animal as the equivalent of 0.68 animal units.

Project S.R. 27C. Ecology and Control of Goatweed (Hypericum perforatum).

Arrangements were made to resample all the major study sites during the summer of 1958. Most of this work was accomplished by Mr. Joseph Oppe, a graduate student in the Department of Botany who will use some of the data in a M.S. thesis.

Only a few sites were resampled during June, 1958, but at some of these it was evident that there has been a partial restoration of Hypericum.

In addition to the field sampling studies, Mr. Oppe is investigating the effects of extracts of Hypericum on germination and growth. Australian workers have reported a strong inhibiting effect of seed capsule extracts on germination of Hypericum perforatum var. augustifolium. Tests of extracts from Idaho grown Hypericum plants collected after curing and winter exposure were made in the early winter of 1958. Results were inconclusive, but the tests will be repeated with fresh, unleached material during the coming year.

The principal data obtained in the life-history phases of the project from its inception in 1951 to the present were brought together during the current year. This paper has been accepted for publication in ECOLOGY and will appear early in 1959.

Table 6. Stocking rate for the Point Springs pastures during the spring and fall grazing periods of 1959.

Pasture	Average Number of Animals	Average Initial Weight	Months of Grazing	Animal Unit Months	Acres Per AUM
Spring Grazing					
East	63.2	284	1.5	179.3	3.4
West	60.2	396	1.5	90.2	3.5
Southeast	50.0	403	1.5	47.0	2.1
Fall Grazing					
Northeast	104.0	586	1.17	100.0	1.9
Northwest	157.2	593	1.17	157.3	1.0
Southwest	176.6	601	1.17	176.0	0.9

a A 1000 pound animal considered as the equivalent of 0.5 animal units and a 600 pound animal as the equivalent of 0.60 animal units.

Project I.R. 270. Ecology and Control of Goatweed (*Hypericum perforatum*).

Arrangements were made to resample all the major study sites during the summer of 1958. Most of this work was accomplished by Mr. James [illegible], a graduate student in the Department of Botany who will use some of the data in a M.S. thesis.

Only a few sites were resampled during June, 1958, but at some of these it was evident that there has been partial restoration of Hypericum.

In addition to the field sampling effort, a project is investigating the effects of extracts of Hypericum on germination and growth. Russian workers have reported a strong inhibiting effect of seed coat extracts on germination of [illegible]. Tests of extracts from Idaho goatweed plants collected after curing and winter exposure were made in the early summer of 1958. Results were inconclusive but the tests will be repeated with fresh, unleached material during the coming year.

The principal data obtained in the earlier phases of the project from its inception in 1951 to the present were brought together during the current year. This material has been prepared for publication in ECOLOGY and will appear early in 1959.

Project S.R. 38. Evaluation of Range Reseeding.

Yearly measurements of production have been obtained from several selected crested wheatgrass seedings in southern Idaho. The production values show a direct relationship with the April-May precipitation for the year in which they were taken, Table 1. Production was least in 1954 on all seeding and greatest in 1957, the years in which the least and grestest amount of April-May precipitation occurred during the study.

The Bridge Canal-Deep Creek area was planted during the fall of 1953 and even though the first growing season occurred during the dry year of 1954 the stand was well established at the end of the 1955 growing season.

This study is in its sixth year and a thesis covering this period of time will be submitted during the year.

Table 1. Average annual production, average annual precipitation, April-May precipitation and total animal unit months of use by years for selected crested wheatgrass seedings in southern Idaho.

Name of Seeding	Year	Average Annual Precipitation (inches)	April-May Precipitation (inches)	Production Per Acre (pounds)		Total Animal Unit Months Of Use	Acres Per Animal Unit Month
Warm Creek							
	1953		3.32	597		1528	3.27
	1954		1.30	287		1177	4.25
	1955		1.88	236		177	28.25
	1956		3.93	367		671	7.45
	1957	9.60	4.17	930		-	
Ward							
	1954		1.31	484		-	
	1955		3.54	566		-	
	1956		3.45	552		-	
	1957	10.67	4.91	964		-	
Ellis				Lower	Upper		
	1953		3.64	557	1937	546	2.42
	1954		1.69	202	429	546	2.42
	1955		2.31	497	719	546	2.42
	1956		2.60	-	-	546	2.42
	1957	10.20	4.92	1158	1460	-	
Bridge Canal-Deep Creek							
	1954		0.69	1/			
	1955		2.89	1132		782	6.12
	1956		3.77	-		985	4.86
	1957	9.35	5.33	2463		-	

1/ First growing season - production not determined.

III. Wildlife and Fisheries Management

A. Projects Completed During the Year:

Project WU-30: Clearwater Fisheries Investigations

Cooperators: Idaho Fish and Game Department, University of Idaho.

Part I of this investigation was initiated by the late Dr. Virgil S. Pratt, was continued by Mr. Ted Bjornn and was completed by Dr. Craig MacPhee.

Part II was developed and completed by Dr. Owen Weeks, Department of Bacteriology.

Part I
Age-Growth Studies of Rainbow Trout

As a part of a general program for the assessment of the Snake River fishery resources, the Clearwater River fishery was singled out for special investigation in order to determine the importance of juvenile steelhead trout to sport catch. In order to make this evaluation, it was first necessary to determine characteristics which would distinguish young steelhead from wild and planted rainbow trout also present in the river.

The plan, scope and details of sampling were the concern of the Idaho Fish and Game Department whereas the statistical treatment and interpretation of the data were the responsibility of the Idaho Cooperative Wildlife Research Unit.

Fourteen tributaries or sections of the Clearwater River were sampled by means of angling, traps and electric shockers. These methods of capture provided data from a total of 541 resident rainbow which included juvenile steelhead, wild rainbow trout and planted rainbow trout. In addition scale samples and weight and length measurements of 353 adult steelhead trapped at the Lewiston Dam by Mr. Charles R. Whitt in the year 1952 were utilized in this study.

For the sake of brevity, figures of the following relationships have been omitted from this annual report.

(1) The logarithms of the weight/length relationships of adult steelhead in the Clearwater River.

(2) The age-growth relationships of rainbow captured in the Clearwater River and its tributaries.

(3) The logarithms of the scale radius body/length relationships of rainbow and adult steelhead.

(4) The averages of the scale radius/body length relationship for the non-sport catch of rainbow.

The size range of a sample of 103 spring run, adult steelhead extended from 503 to 1,061 millimeters in length and 1,497 to 9,344 grams in weight. Using a direct proportion method of back calculation of total length from scales, age-growth characteristics of steelhead are illustrated in Figure 1. A marked difference in growth rate between freshwater and saltwater phases of life is apparent in that juvenile growth in freshwater is very slow compared with that in saltwater. Three migration classes also exist each depicted by the number of years of growth in freshwater. The graph indicates that there is a tendency for the fish which grow the fastest in freshwater to migrate to saltwater earlier than those which grow more slowly.

The reliability of back calculating lengths of adult steelhead in their freshwater phase of life for comparison with those of resident rainbow were explored. The method of back calculation was rejected for such comparisons due to the large amount of extrapolation involved, the amount of variation in total lengths of the sample for any one year class and the amount of variation in scales as well as uncontrollable error in scale reading.

The lengths of the scale radius measured to the first annulus were compared directly for adult steelhead and rainbow in an attempt to separate resident rainbow and juvenile steelhead trout. The amount of variation in these lengths was tested between years, between tributary streams and between age classes for rainbow and between years and migration classes for adult steelhead. Almost all of the variation among the averages of the above mentioned variables for rainbow did not overlap that of the averages for steelhead. Consequently, for the purposes of this study the various averages for rainbow and steelhead were considered relatively homogenous and were combined to form two grand averages.

The grand average of the lengths of the scale radius to the first annulus for 360 rainbow was 17.5 millimeters (magnified 81 times) and for 273 steelhead was 25.5 millimeters. The standard error of the difference between these two averages is 0.5 scale units and "t" equals 16.0. The value of "t" at the 0.01 level of significance for 631 degrees of freedom is less than 2.59. Consequently, the difference between the two averages is highly significant which means that the two groups of fish are not derived from the same population. Figure 2 portrays the frequency distribution of the scale radius measured to the first annulus for rainbow and steelhead.

On the basis of observations by anglers and fishery biologists of the area, the resident rainbow are thought to be composed mostly of juvenile steelhead. If this be true, then it would appear that considerable mortality occurs in that only a small percentage of these juvenile steelhead over return to the Clearwater as adult spawners and those that do return are the ones which had their most rapid growth rates during their first year of life.

The possibility that many of these rainbow trout may be residual steelhead exists. It is recommended that a weir or a temporary dam be placed at a suitable location on a small tributary where steelhead spawn in

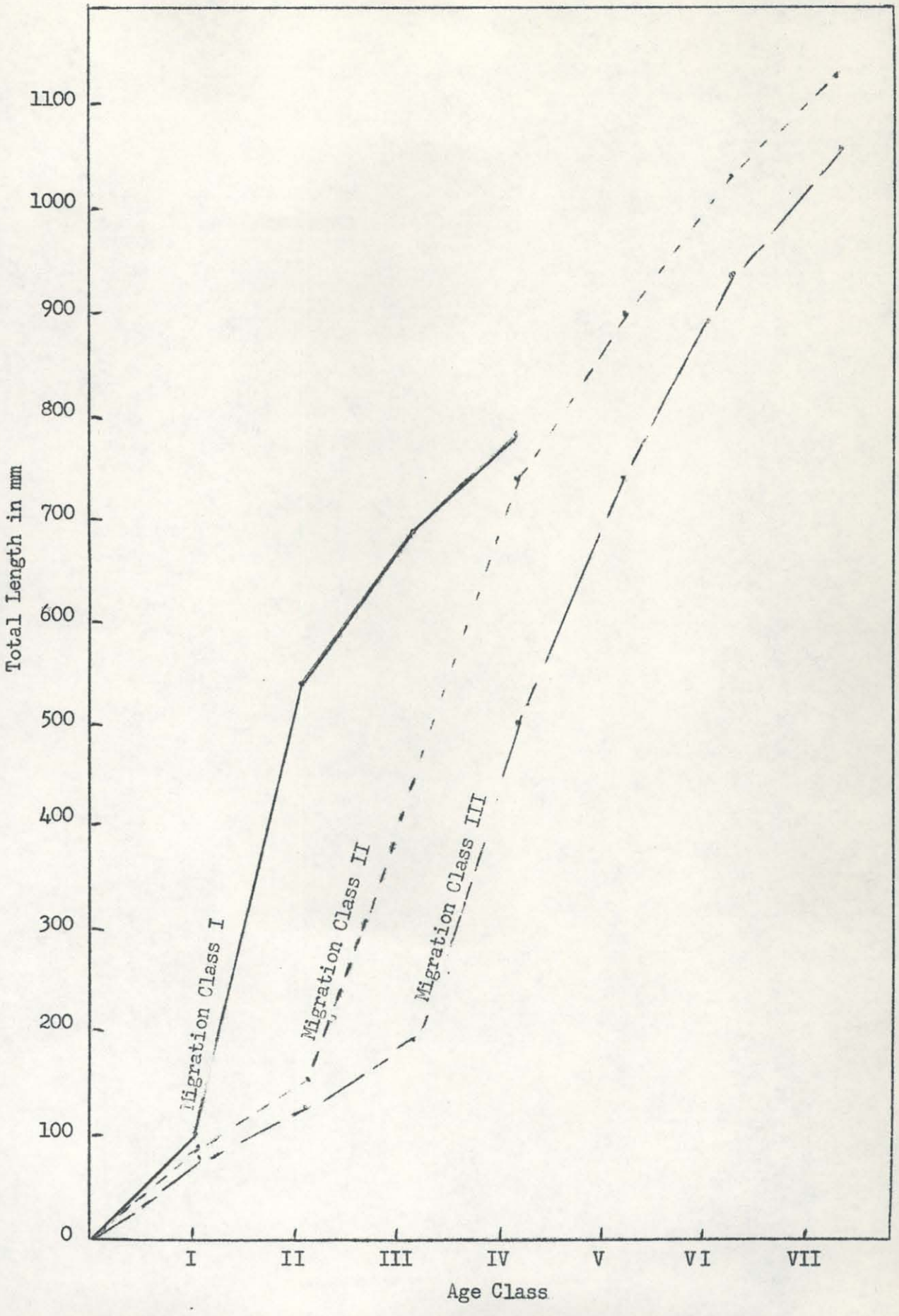
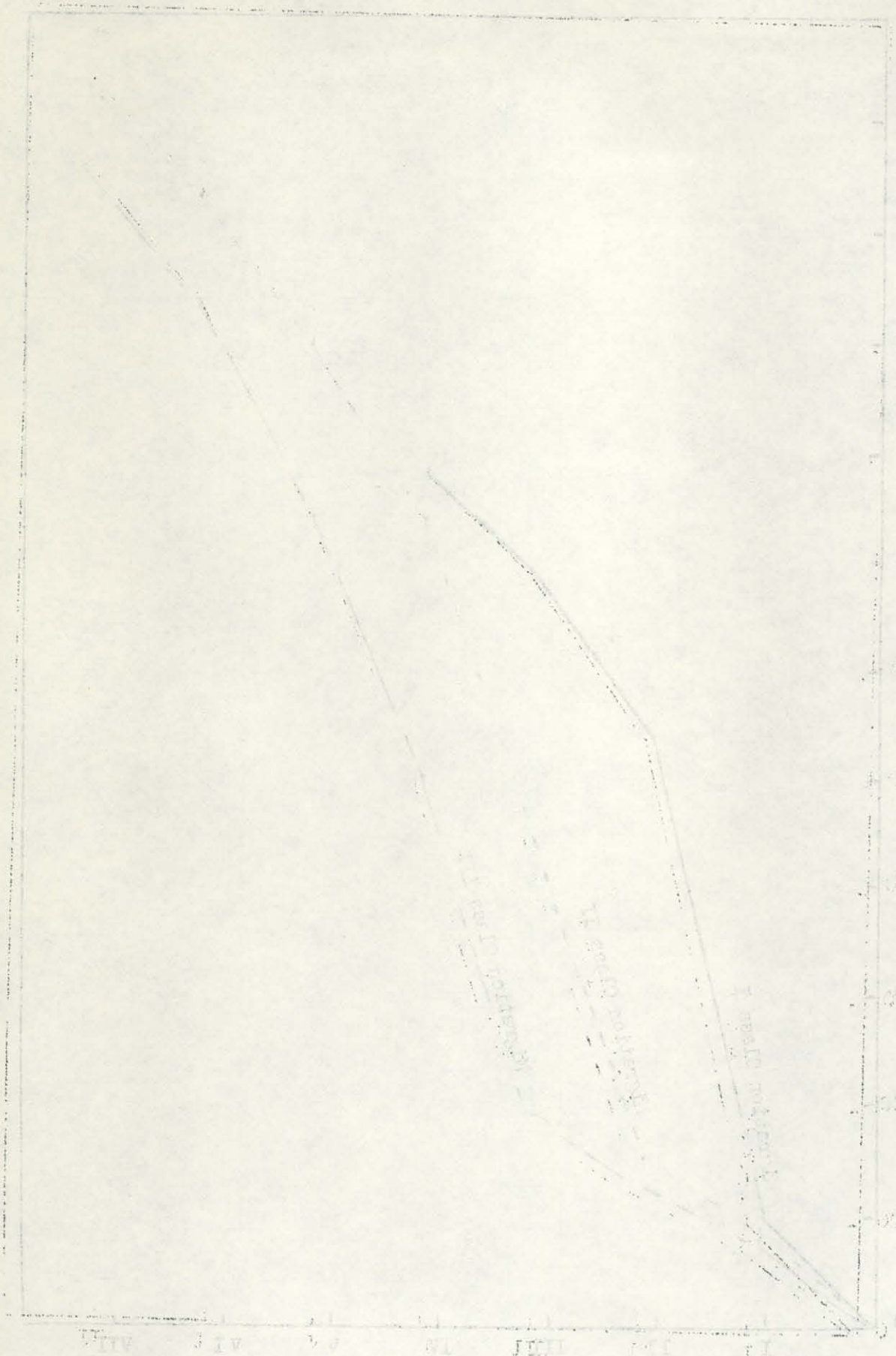


Figure 1. Age-growth relationships of steelhead trout graphed according to the number of years spent in freshwater.



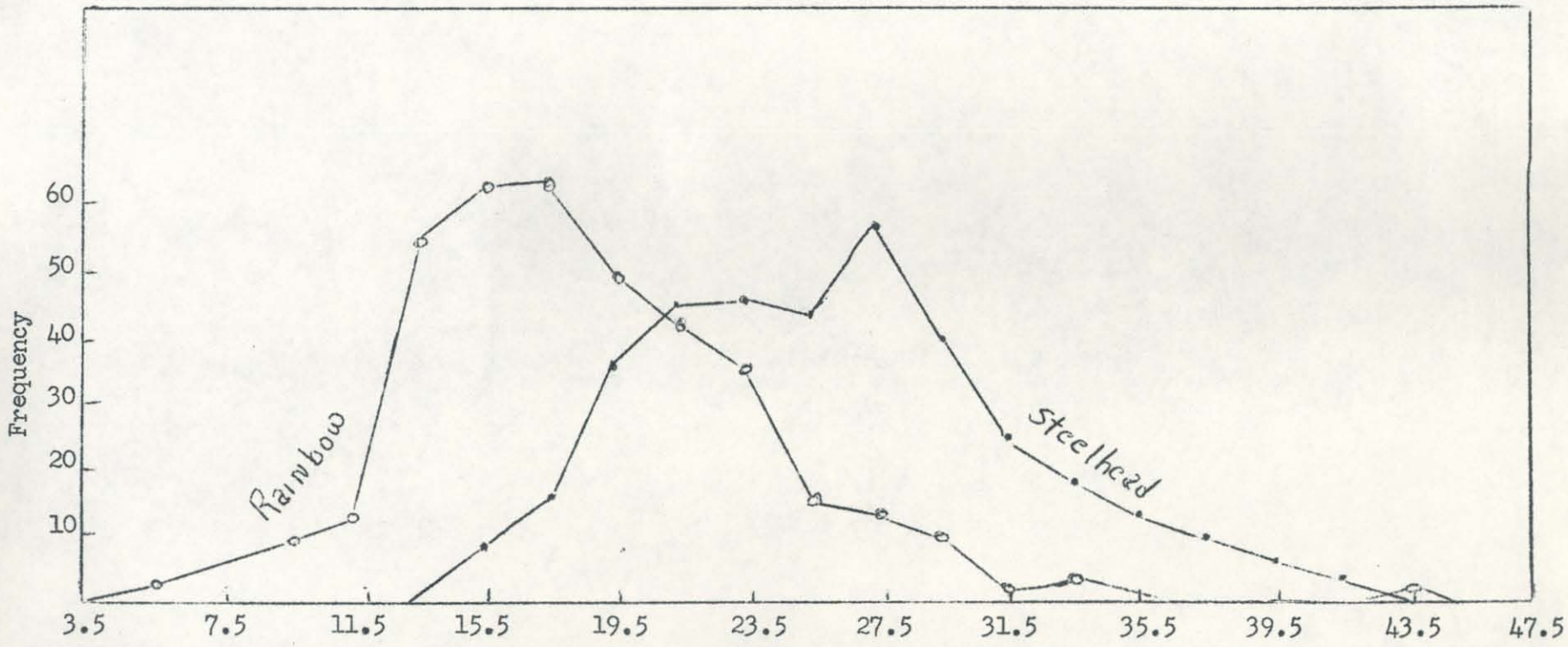
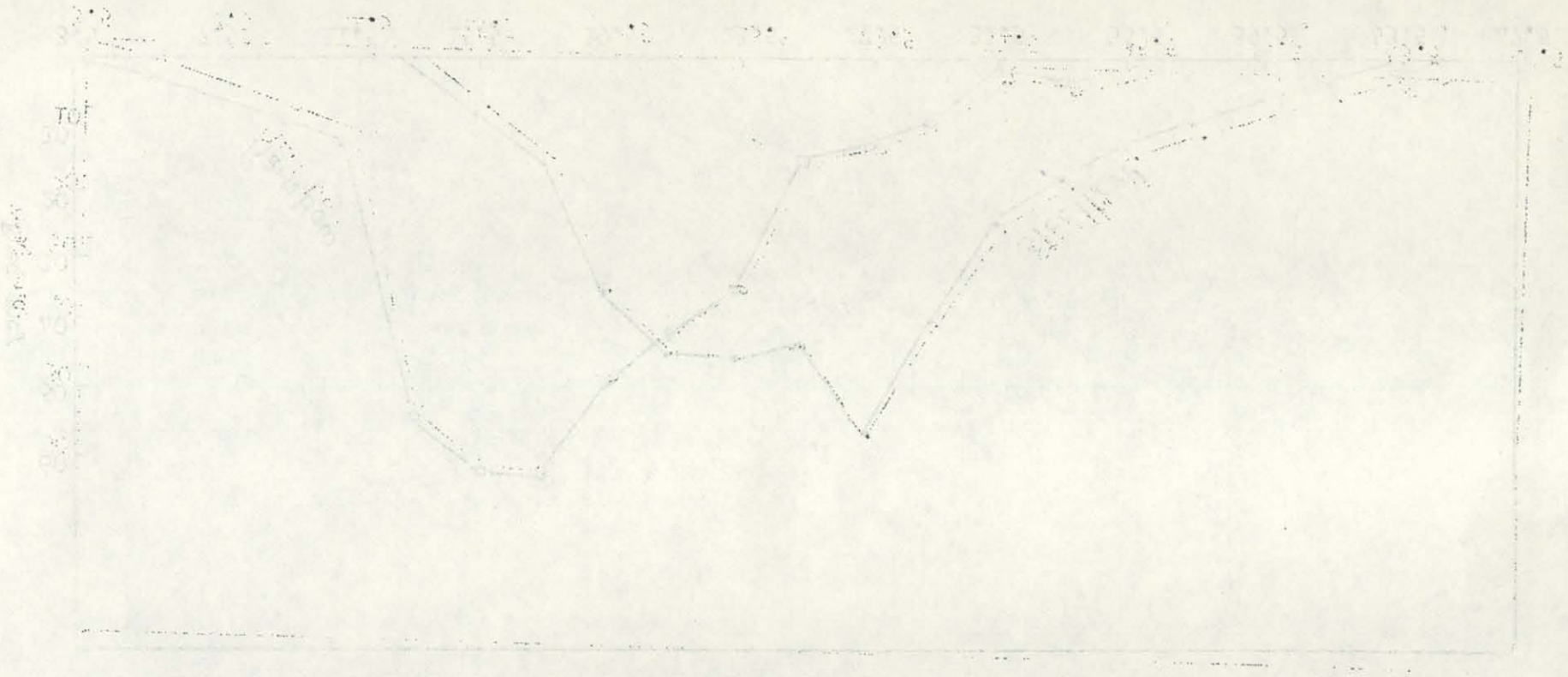


Figure 2. Length frequency polygons of the lengths of the scale radius measured to the first annulus for the non-sport catch of rainbow and adult steelhead.



order to determine the proportion of juvenile steelhead and wild trout and to determine whether or not residual steelhead exist.

A continuation of the age and growth studies as previously outlined would be of little value in arriving at a definite proof of the identity of the small rainbow in the Clearwater drainage.

Part II
Serological and Tissue Studies of Rainbow Trout

The part of the Clearwater Fisheries research program which was supervised by the Department of Bacteriology, with the aid of personnel from the Physical Sciences Division, was concerned with the differentiation of steelhead and resident rainbow trouts. These exploratory studies used corresponding tissues from the two types of fishes. Investigations were made of the antigenic composition of tissues, of submicroscopic patterns on the surfaces of fish scales, and of elemental differences of several tissues as seen in omission spectra. In no instance were the results found to be unequivocal. Carbon replicas of metalshadowed fish scales were examined by electron microscopy and neither type of scale showed a characteristic submicroscopic structure such as has been found for certain reptiles. Emission spectra prepared from ashed gill, bone, liver, kidney, milt, and egg tissues showed no readily observable differences in elemental composition. It was thought that migration to the ocean might result in storage of elements not usually found in freshwater, or at least in quantitative differences. The lack of apparent chemical differentiation of comparable tissues of the two types of fishes is supported by the results of serological studies. No major antigenic differences were found when whole bloods, plasmas, erythrocyte stromal tissues, milts and eggs were compared. In each instance the homologous systems reacted and also cross-reacted. Reactive serological differences were observed, however. These were exploited and magnified by laboratory manipulations. The result has been that specifically absorbed sera have been used to distinguish blood of steelhead from that of rainbow trout. The absorbed antisera can be prepared in which activity for steelhead blood is retained but that for rainbow blood is diminished or abolished. Whether this serological differentiation of the two fishes is usable as a practical field technique can be determined only through additional and extensive field testing.

These reports on age-growth and serological studies will form the basis of a completion report for a Federal Aid to Fish Restoration Project which will be published by the Idaho Fish and Game Department.

Project WU-32. The Species and Incidence Helminth Parasites Found in the Wild and Domestic Ruminants of Idaho and their Possible Transmission from the Wild to the Domestic Ruminants.

The Veterinary Science Department is engaged in a project to determine the source of internal parasite infections in domestic sheep and cattle. An M.S. thesis by Algirdas Greichus of the above title is a preliminary study of this broader investigation.

A summary of the M.S. thesis by Greichus follows:

1. In 1956 a series of parasitological studies were started in the State of Idaho. The primary aims of these studies included the determination of the species and incidence of internal parasites in the wild and domestic ruminants within the state and determination of whether there might be some transmissibility of these parasites from the wild to the domestic ruminants.

2. The domestic ruminant fecal samples examined in this study were collected primarily from Southeastern Idaho and the wild ruminant samples were obtained from the Farragut Wildlife Refuge, Hatter Creek Enclosure, Selway drainage in Idaho County and from Southeastern Idaho. All fecal samples were preserved in a 10 per cent formalin solution.

3. The technique utilized in preparing the fecal material for examination was the sedimentation technique. This method was chosen after several flotation methods proved to be less efficient.

4. Identification of the ova encountered in this study was accomplished through the use of the following differential characteristics: (a) the over-all size of the ovum, (b) proportion of length to width, (c) shape and contour of the shell, thickness and structural details of the shell, (d) color of the ovum and opacity of the central protoplasmic mass, and (e) stage of development of the embryo.

5. The nodular worm, Oesophagostomum radiatum was present in 33 per cent of the 367 cattle samples examined. Haemonchus contortus was next in occurrence being present in 5 per cent of the cases. This species was closely followed by Neoascaris vitulorus, Trichostrongylus sp., Nematodirus spathiger and Fasciola hepatica.

6. In the sheep samples the nodular worm, Oesophagostomum columbianum was present in 23 per cent of the 174 specimens examined. This species was closely followed by the thread-necked strongyle, Nematodirus spathiger, which was present in 21 per cent of the cases. The other species ranked in order of their importance include: Trichostrongylus sp., Chabertia ovina, Haemonchus contortus and Fasciola hepatica.

7. The cattle used in the transmissibility experiments were treated with a therapeutic dosage of Phenothite (12.5 gms. phenothiazine per fluid ounce) until they were considered parasite free. They were then placed in a low-fence enclosure in the Hatter Creek area where they could freely associate with the white-tail deer that are located in that area.

8. Fecal samples were collected from these cattle during the summer of 1956 and 1957. They were examined for parasite infections and it was noted that Oesophagostomum radiatum and Haemonchus contortus were found in 45 per cent of the samples collected in 1956. Other parasite species found in this year included Chabertia ovina, Nematodirus spathiger and Bunostomum phlebotomum. In the summer of 1957 it was noted that Oesophagostomum radiatum and Haemonchus contortus were again the most abundant parasite species encountered. They occurred in 37 per cent of the samples obtained while Chabertia ovina and Trichuris ovis were found in 10 per cent of the samples.

9. The majority of the wild ruminant fecal samples collected for this project came from the white-tail deer (Odocoileus virginianus ochrouris, Bailey).

Collections also included moose and elk samples. In the deer samples it was noted that 27 per cent were infected with Haemonchus contortus and Dictyocaulus viviparus. Oxyuris equi and Ascaris sp. were also found to a lesser extent.

10. The nematode parasites Nematodirus spathiger, Dictyocaulus viviparus and Capillaria sp. were found in the samples of elk and moose that were on hand. The number of specimens available were too few to be of any significance.

B. Continuing Projects:

Project WU-11. Study of Blue Grouse in Idaho.

This project remained inactive due to the lack of staff to work on it.

Project WU-15. A Study of Sage Grouse Populations in Eastern Idaho to Evaluate Booming Ground Activity and Census Methods.

Delineation of winter range and correlation of large flocks of sage grouse with cover types, together with movements on the winter range as influenced by weather, were stressed during the winter of 1957-58. Flocks of sage grouse varying from 50 to 1,000 were observed in the Dubois area. Snow depths controlled their movements, and during December, January, and February, large concentration of grouse were associated with black sage, Artemisia arbuscula var nova. Winter range is 1,000 feet to 2,000 feet lower than the summer range in Shotgun Valley.

Separation of the sexes was quite in evidence at times. Mature males in small flocks were commonly observed. Groups of 50-100 birds often flew short distances for mid-morning and mid-afternoon feeding, usually on black sage.

It is believed that sage grouse banded on the Red Road strutting grounds winter in the Dubois-Hamer area, but no marked birds have yet been observed in this wintering area.

First indications of the approaching spring strutting season were noted as early as January 23 when a number of adult males were observed strutting in a half-hearted manner.

Sixty-one sage grouse were trapped and banded on the Red Road strutting grounds in the spring of 1958. There were 32 sage grouse observed that were banded in 1956 and 1957. Retrapped grouse marked in 1956 showed no deterioration of the plastic neck-band.

On one strutting ground nearly all of the males were individually marked as well as many females. Daily observation showed that the same males occupied the same relative social order throughout the strutting season.

The number of males appearing on 19 strutting grounds decreased in 1958 as compared to 1956 and 1957. For the period 1952-1958 inclusive, 1956 was by far the outstanding year for both numbers of strutting grounds occupied and numbers of male grouse on each ground.

Project No. WU-18. Productivity of Ruffed Grouse on Northern Idaho Forests.

Much of the activity on this project has been the completion of the punched card analysis system for comparison of ruffed grouse brood ranges. All past records are now on the marginal punched cards and many new brood ranges have been added to the card files. Purpose of this analysis is to determine why some ruffed grouse brood ranges may produce a brood each year while others will produce a brood only during peak years. Brood ranges at the Priest River Experimental Forest, the Flat Creek Study Area, Hatter Creek Deer Enclosure, the Moscow Mountain Area, the Selway-Lochsa Area, the McCall Area and Boise Basin are all represented by punched cards in this analysis.

Another phase of this project is the IBM analysis of the microclimate records. Tabulation of these records is nearly complete for all data since 1949. Three new microclimate stations were established in thinned plots in timber stands at Hatter Creek. Plans for next year include some clear-cut blocks in timber stands with analysis of the microclimate, the use by grouse and by deer. It is anticipated that many phases of this project will be amplified in the new projects being planned.

The manuscript mentioned under Project WU-19 will also include much of the data and results of this project.

Project WU-19. Ruffed Grouse Populations and Census Methods.

The major activity of this project was terminated in September 1956 when the last full scale grouse census was conducted on the Flat Creek Study area. This completed ten years of census activity, or one complete grouse cycle. Much of the fall census information has been correlated with the spring drumming counts and brood counts during this ten year period. On a maintenance basis during the past year, the drumming counts and the brood counts have contributed valuable information on population trends which has been requested by sportsmen and the Fish and Game Cepartment.

Another activity during the last year has been work on a manuscript of which the population information obtained in this project, will be a part. This will be a major publication with a target date in 1959.

Project No. WU-23. Food Habits and Productivity of White-Tailed Deer.

Although no graduate students have been assigned to this project during the year, the summer food habits study at Hatter Creek was continued. The data covering the period from April through November has been analyzed and added to that from previous years.

Project No. WU-24. The Influence of Magpie Predation on Nesting Pheasants and Waterfowl Populations in the Wilson Lake Area.

This year 778 magpies were marked on the night roosts with red, yellow, and orange paint. Ninety-two returns from these marked birds were recorded. This included 54 red magpies, and 37 orange birds. Only one observation record was made of birds painted yellow. The birds were detected at a maximum of six miles from the marking sites. A definite directional pattern of movement was noted.

Census studies of magpies and pheasants indicated that there was in general larger populations of both on the study area this year. The nesting population of magpies was 270 birds within the bounds of the 5000 acre census area. In 1957 the counts revealed 162 adult magpies. Pheasant trend counts indicated an increase from 16.4 in 1957 to 20.2 crows per station in 1958. There was a high rate of production and survival in magpie nests and young this year with 4.01 fledglings per nest produced in 50 per cent of the active nests. This brought the post-breeding population of magpies to 599 birds.

Food habits studies have revealed that the magpies diet consists of 42.3% insects, 1.5% invertebrates other than insects, 53.3% vertebrate carrion, 0.5% mineral, and 2.4% plant materials. Eggshell contributed slightly over one per cent to the vertebrate carrion figure. Especially important items in the diet were grasshoppers which reached a total of 62% of the content in July. Larval insects and rodents were especially important food items during the month of April.

Dummy nests were placed in various cover types to determine the influence of kind and quality of vegetation on magpie predation. A summary of the dummy nest study is given in the following table. This includes investigation taking place in 1955, by Clyle Novak, 1957 and 1958 by the present investigator.

Vegetation type	No. Nests	No. Molested	Percent Molested
Cheat grass	32	31	96.9
Sagebrush	65	61	95.4
Willow	59	53	89.9
Tall weeds	61	49	80.3
Alfalfa	68	28	40.6
Irrigation ditch	60	21	35.0
Bulrush	61	18	29.5
Cattail	61	15	24.6
Grainfields	62	2	3.2

Project No. WU-26. Salt in the Management of Elk in the Lower Selway River Area, Idaho.

A second M.S. thesis in this project on evaluating the use of salt by elk was prepared in the fall of 1957 by Frederic J. Kindel with the above title.

The summary of Kindel's thesis is as follows: This thesis presents the second phase of a continuing study on the use of salt as a management tool for elk in Idaho. The primary objective of the use of salting in Idaho's management of elk is to attempt to draw the animals off their winter range earlier and/or faster in the spring than they would normally move so as to prevent destructive overuse of browse food plants on the winter range. The major objective of this study is to investigate and determine if salting is actually accomplishing its primary objective.

A survey of the literature on certain important aspects of salting is presented and discussed. Salting in cattle management is only one method among many which are used together to effectively manage range cattle. Cattle salting is an intensive management tool, while salting as used in big game management is generally extensive and less effective because it cannot be integrated with other related management tools as used in cattle management. Big game have often been observed to heavily use both artificial and natural licks and it is pointed out that such use does not necessarily indicate a need for the salt, but only desire.

Several studies of natural game licks were presented and discussed with the conclusion that common salt, sodium chloride, or possibly just sodium, appears to be the attracting substance in most of these licks. Several studies of the use of salting in big game management were reviewed and discussed. Most studies failed to find any evidence supporting the effectiveness of the use of salt in influencing big game movements. One exception was that in Montana it was reported that artificially supplied salt can attract elk away from natural salt licks located on winter ranges where concentrations of the animals cause destructive use of browse plants in the vicinity of the licks.

The area in which this study was conducted is located in the Nezperce National Forest on the lower Selway River, in Idaho County, Idaho. The study area was divided into a salted portion and an unsalted portion, with an unsalted buffer area as well. Two sample ridge trails were selected in both the salted and the unsalted areas on which to conduct studies of the movement of elk from the winter range during the spring and compare movements between the salted and unsalted areas. Methods used for measuring and comparing the spring movements of elk were pellet counts, counts of elk seen and observations of the tracks observed on the trails at biweekly intervals. Other methods included location and observation of salt licks, determining when use of the licks began in the spring, gathering data on phenology and the appearance of amorphic elk pellet groups, observation of licks and elk from the air, and the use of dyes.

A total of 113 licks were found and studied in the study area to date, including 105 artificial game salt licks, nine cattle salt grounds, and two separate natural licks. Salt was distributed by pack horse in the fall of

1956 for the next spring instead of by airplane drop as in previous years. Melting snow made salt licks available a week or more before elk actually started using them. Use of the Ballinger Creek natural licks began during the second week of April while use of the lower artificial licks began during the last week of April. Elk and deer often prefer to lick the salty ground at the base of a salt block instead of the salt block itself, although salt blocks were quite often licked heavily also. Stock salt used by cattle, elk and deer, as well as that dissolved by precipitation amounted to 2.4 pounds per head of cattle per month for the summer grazing period of three and one-half months. It is felt that this is not an excessive amount of salt. Several observations of elk at the Ballinger Creek natural licks on various dates were presented.

In agreement with Beeman (1957) it is suggested that licks, especially natural licks, may be important to elk as a center of certain social behavior patterns, although more study on this point is needed.

An effort was made to tag elk calves on Glover Creek ridge in the study area in conjunction with several members of the Idaho Department of Fish and Game. Only four calves were tagged, but some valuable experience was gained which will be useful for future elk calf tagging. It is recommended that future calf tagging efforts in this area be started about May 27 or 28 and not earlier.

Analysis of the pellet counts and elk counted on the sample trails during the spring of 1957 showed that there was no significant difference in the movements of elk upward between the salted and unsalted areas.

A method of using dyes as fecal markers was developed during this study to attempt to study certain elk movements. A limited amount of information and elk movements was obtained by this method which indicated that elk move downward during the spring drift toward summer range as well as upward. Dyes were also used in spray guns to attempt to mark elk but with no success.

Data collected on snowline, plant phenology, the appearance of amorphic elk pellet groups and on salt use which reflected the onset of salt desire indicated that a close correlation between salt desire and plant phenology existed during the spring of 1957. In other words, when new succulent vegetation appeared, and elk began eating it, they then began seeking out salt licks.

Data on the monthly use of salt by elk and deer were collected on an experimental salt line on Slide Creek ridge. The salt was weighed each month and losses of salt recorded to the nearest ounce. It was found that these figures were not significant because of the variability of salt loss between salt blocks at different elevations and between salt blocks at the same elevations. The relative degree of use was noted each month and this was more effective in showing the monthly desire of elk for salt.

The third phase stressing movements of elk in this area will appear in the next annual report.

Project No. WU-28. A Study of the Influence of Logging on Trout Streams in Northern Idaho.

A second M.S. thesis in this project on the effect of logging on trout streams was prepared in the spring of 1958 by Roger W. Bachmann with the above title and the following is his summary.

Four the last three years, four streams in northern Idaho have been under study as a part of a long-term project to determine the influence of logging on trout stream ecology. This paper is concerned with the influence of forest road construction in one of the study streams as well as the pre-logging conditions on the three other streams.

Physico-chemical measurements on the streams included periodic determinations of water temperature, volume of flow, turbidity, bottom types, sedimentation, dissolved oxygen, alkalinity and pH. Among the biological measures were age, growth and food habits of the fish, standing crops of bottom organisms and rates of algal growth.

On one of the streams, Crystal Creek, an access road was under construction from July 1956 through October 1957. In about three miles two crossings of the main stream were constructed. The road, which had a maximum grade of 4 percent, had culverts installed for all flowing streams.

During the construction phase, several direct disturbances to the stream channel were noted. These included the installation of culverts, the skidding of logs through the stream and the construction of new channels with a bulldozer.

In the spring, erosion was evident by rills, gullies, mud flows and landslides. Most of this material apparently never reached the stream due to the location of the road in relation to the main channels and tributaries.

Turbidities were shown to have been increased due to the road construction on Crystal Creek, particularly when there was rapid runoff from rainfall or snowmelt or when there were direct disturbances to the stream channel. It was also found that sedimentation had been increased in both riffles and still waters. Water temperature, volume of flow and the water chemistry showed no change from the previous years.

No changes were found in the species composition of fish in Crystal Creek. No changes in fish populations, growth rates or coefficients of condition could be detected by the methods used.

The food habits of the trout showed a great deal of variability which was apparently a function of the availability of the insects at various times of the year. No quantitative relationship could be found between the stomach contents and the composition of the bottom fauna.

A qualitative analysis of the bottom dwelling aquatic insects showed that no changes had occurred from previous years. Quantitative analyses, using a modified t-test, showed that there was a significant difference between the standing crops of Crystal Creek and its control stream; although the mean volumes were not very different. In previous years no significant difference could be found.

The relocation of stream channels away from road fills appeared to decrease the amount of eroded material entering the stream. In these new channels a population of aquatic insects equal to that in the undisturbed portions of the stream was established over the winter. When short sections of stream were relocated, fish were found to utilize them for feeding.

On Gold Creek, one of the other study streams, a small logging operation was carried out on the headwaters. Of the measurements made during the dry part of the summer no changes could be found in the study sections located about seven miles downstream.

In a comparison of the measurements made in Simmons and Gold creeks for the last three summers it was found that Simmons Creek was the most productive of the two. The fish had faster growth rates, lived a year longer and were caught more readily by sport fishermen. This stream also had a larger standing crop of bottom organisms, and the rate of algal accumulation was higher. The data suggest that the differences are due in part to water temperature and chemistry.

Project No. WU-33. Post-Larval Development and Diet of the Largescale Sucker, Catastomus macrocheilus, Girard.

This research has been conducted jointly by Craig MacPhee and Osborne Casey, a graduate student.

That the sucker is a serious competitor of trout for food and a predator of salmonoid eggs has long been known. Detailed knowledge of its early development and food habits are essential for a complete understanding of the coarse fish problem and for the irradication of the species from trout waters. The morphological details obtained will be an aid for those who have difficulty in distinguishing the post-larval stages of this sucker from those of other minnows which may coexist in the same river or lake.

Interest in this project centers principally on the physiognomy, length-weight relationships and feeding habits of the post-larval stages. Although many phases in the development and food habits of the coarse scale sucker rather closely parallel that of the white sucker, Catastomus commersoni (Lacepede); yet, the importance of extending our knowledge to other localities and with other species in order that certain generalizations might evolve for the sucker family as a group is recognized. The fish described were collected in 1957 from the Payette River, Idaho, by Mr. Casey, who is on educational leave from the Idaho State Fish and Game Department.

External development and growth were characterized by changes in the relative size of the eyes, in the location of the mouth which shifted from a terminal to a ventral position, in the shape of the caudal fin from a rounded to a forked condition, in the sequence of development of the dorsal, pelvic and anal fins and rays and in the gradual loss of the pellucid, median fin fold. The average dates and sizes of the larvae at which such well-marked physiognomic changes occurred have been computed.

Larval suckers which have the mouth terminal are surface feeders. As development proceeds and the mouth shifts ventrally, they become bottom feeders. Consequently, changes in morphology, weight-length relationships and feeding habits can be interrelated. The form of the length-weight relationship when plotted on logarithmic scale for fish of about 2 cm. in length and larger yielded an expected straight line regression. Suckers smaller than this length were thinner or lighter in weight than was anticipated and reflected the adjustment the larvae have to make morphologically and behaviorwise in order to fit their particular ecological niche as bottom feeders.

Certain phases of this study are still being continued, emphasis being placed on increasing the number of replicates for statistical treatment.

Project No. WU-34. Bear Lake Fisheries Investigation - Bioassay of Artificial and Natural Bear Lake Waters.

Cooperators: Idaho Fish and Game Department.

As part of an overall water quality program undertaken by the Idaho Fish and Game Department, the Wildlife Unit is cooperating by evaluating the productivity of Bear Lake water using bioassay methods. The project has the following objectives:

1. To determine the relative degree of productivity of Bear Lake water.

2. If productivity is low, to determine what factors may be responsible for its low productivity in terms of plankton production.

3. If the factors responsible for low productivity can be isolated, to determine, if possible, some practical method of improving the productivity of Bear Lake water.

A preliminary review of the literature pertinent to bioassay studies have been made. Utilizing a modified controlled temperature bath and artificial lighting in order to establish a more or less uniform environment, cultures of Chlorella are being tested as indicator organisms for phytoplankton growth. At the present time, Chlorella is being cultured in the following solutions:

1. Natural Bear Lake water.
2. Natural Bear Lake water with added nutrients.
3. Artificial Bear Lake water without heavy metal ions.
4. Artificial Bear Lake water without heavy metal ions but with nutrients added.
5. Artificial Bear Lake water with heavy metal and nutrients added.
6. Artificial Bear Lake water with nutrients added and in which the megnesium-calcium ratio is equivalent.
7. Artificial Bear Lake water with added nutrients but without magnesium.
8. An optimum nutrient solution.

Some of the solutions listed above are experimental and some are control solutions. The experimental solutions are exploratory and are designed to test for the following possibilities:

1. Whether or not the combination of heavy metal ions (copper, lead, and zinc) found in Bear Lake water is inhibitory to phytoplankton production.
2. Whether or not the magnesium-calcium ratio found in Bear Lake water is inhibitory to phytoplankton production.
3. Whether or not lack of nutrients in Bear Lake water results in reduced phytoplankton production.

At the present time, the experimental work is incomplete but the scope and direction of this research will depend somewhat on the findings of these preliminary experiments.

Thesis Project: The Life History of the Columbia River Squawfish, Ptychocheilus oregonensis, in the Cascade Reservoir, Idaho.

The squawfish is native to many lakes and rivers west of the Rocky Mountains. This study will extend knowledge of the life history of the races of squawfish in the State of Idaho, in particular, the squawfish in Cascade Reservoir. The spawning habits of the squawfish in this reservoir are peculiar in that they are not known to spawn along the shores of the reservoir but only in certain streams entering the impoundment, mainly, the Payette River. Because the squawfish is one of the most predaceous of the minnows found in this area, details of food habits, growth rates, and age at maturity will be invaluable from the standpoint of practical management as well as basic research. Due to the fact that this study was partly initiated for the purpose of determining some practical method of irraticating or controlling the population of Cascade squawfish, considerable field observations have been made with regard to spawning sites, spawning times and other factors which may govern spawning activity.

Field observations were made in the summer of 1957 and collections of fish and other data pertinent to the life history study were obtained at the same time. Additional observations and collections are planned for the summer of 1958 at which time it is planned to poison the spawning runs. This project will continue through the next college year.

IV. Miscellaneous Projects

Rroject No. E.S. 26. Stabilization of Waste Settling Ponds.

The study was undertaken at the request of Bunker Hill Mining Company. The objective is to determine if it is possible and practical to grow vegetation on the mill settling ponds to decrease the amount of blow sand which is affecting the Kellogg community.

Test plantings of eight grass species and two tree species were made in April with an additional three tree species and one grass species in May.

Observations will be made monthly to obtain data on germination and plant growth of the species being tested and to make further test plantings if necessary.

SUMMARY OF F. W. R. EXPERIMENT STATION PROJECTS 1957-1958

No.	Title	Started	Present Status	Personnel
	I. FOREST MANAGEMENT			
E.S.1	Wood Preservation Service Tests	1946	Cont. Act.	Howe, Burlison
E.S.2	Study of White Pine Blister Rust	1940	" "	Slipp
E.S.3	White Pine Stem Anatomy	1953	" "	Johnson
E.S.6	Idaho Tree Diseases	1950	" "	Gilbertson, Slipp
E.S.19	Christmas Tree Test Plantings	1953	" "	Pitkin, Burlison
E.S.20	Mortality of Young White Pine	1948	" "	Gilbertson, Johnson
E.S.21	Study of Idaho Small Tree Farms	1956	" "	Deters, Seale, Frazier
E.S.23 (WM-31)	Marketing Practices and Price Analysis of Idaho Timber	1956	" "	Seale, Frazier,
E.S.24	Forest Tree Breeding In Idaho	1957	New	Inman
E.S.25	Studies on Idaho Wood-rotting Fungi	1957	New	Gilbertson
S.R.11b	Forest Tree Physiology	1951	Cont. Act.	Johnson
S.R.24	Slash Disposal Studies	1949	" "	D. Olson, Gilbertson
S.R.54	Log Grading Standards for Idaho Trees	1957	New	Howe
S.R.55	Insects Affecting Cones and Seeds of Forest Trees	1957	New	Clark
	II. RANGE MANAGEMENT			
E.S.7	Evaluation of Salt-desert Shrub Ranges	1951	Cont. Act.	Sharp
E.S.8 (SR-27d)	Study of Medusa-head Rye	1950	" "	Hironaka, Tisdale
E.S.9 (R-287)	Ecology of Sagebrush Ranges	1949	" "	Hironaka, Tisdale
E.S.10	Ecology of Douglas-fir Zone in British Columbia	1946	" "	Tisdale
E.S.13	Ecotypes of Idaho Range Grasses	1956	" "	Tisdale, R. Olson
E.S.15 (BLM #1)	Study of Halogeton	1950	" "	Sharp, Johnson
E.S.22 (R-296)	Nutritional Study of Idaho Range Forages	1955	" "	Sharp, Bullock
S.R.27c	Study of Goatweed (Hypericum).	1951	" "	Tisdale
S.R.38	Evaluation of Range Re-seeding	1952	" "	Sharp, Kimsey

III. WILDLIFE AND FISHERIES MANAGEMENT

W.U.11	Study of Blue Grouse	1952	Cont. Act.	Dalke
W.U.15	Study of Sage Grouse	1952	Inactive	Dalke
W.U.18	Productivity of Ruffed Grouse	1952	Cont. Act.	Hungerford
W.U.19	Ruffed Grouse Population Study	1951	" "	Hungerford
W.U.23	Food Habits and Productivity of White-tailed Deer	1952	" "	Hungerford
W.U.24	Magpie Predation on Pheasants	1955	" "	Hungerford, Jones
W.U.26	Salt in Elk Management, Selway Area	1955	" "	Dalke, Beeman, Kindel
W.U.32	Helminth Parasites in Ruminants	1957	Completed	Hungerford, Greichus
W.U.28	Influence of Logging on Trout Streams	1955	Cont. Act.	Pratt, Oien, Bachmann
W.U.30	Clearwater Fisheries Investigation	1956	Completed	MacPhee, Bjornn, Spiker, Weeks
W.U.33	Post-Larval Development and Diet of the Largescale Sucker, Catastomus macrocheilus, Girard	1957	New	MacPhee, Casey
W.U.34	Bear Lake Fisheries Investigation - Bioassay of Artificial and Natural Bear Lake Waters	1957	New	MacPhee

IV. MISCELLANEOUS PROJECTS

E.S.26	Stabilization of Waste Settling Ponds	1958	New	Pitkin

PUBLICATIONS AND MANUSCRIPTS

I. Technical Publications

Dunkeson, Robert; Paul D. Dalke; Thomas S. Baskett; and S. Clark Martin. 1958. Seventeen Years of Succession in Exclosures on an Overbrowsed Ozark Game Preserve. For Journal of Wildlife Management.

Gilbertson, R. L. 1958. Studies in western wood-rotting fungi. I. Poria zonata Bres. Manuscript to be submitted to Lloydia.

Howe, J. P. 1958. Tests with Silvicides on Idaho Conifers. Res. Note #14, F.W.R. Exp. Sta., Univ. of Idaho.

McClure, Norman R. 1958. Grass Seedings on Lodgepole Pine Burns in the Northwest. Accepted for publication in Journal of Range Management.

McConnell, Burt R. and Paul D. Dalke. 1958. A Productivity Study of the Cassia Deer Herd. For Journal Wildlife Management.

MacPhee, Craig. 1958. A Large Torrent Sculpin, Cottus rotheus, from Idaho. Manuscript scheduled for publication in Copeia No. 4.

MacPhee, Craig. 1958 Clearwater River Fisheries Investigations, Age-Growth Studies of Rainbow Trout. Submitted to the Idaho Fish and Game Department for publication as part of a Federal Aid to Fish Restoration Project.

Mohler, Levi L.; Paul D. Dalke and Wesley M. Shaw. 1958. Elk and Elk Hunting in Idaho. Paper delivered at 23rd North American Wildlife Conference, March, 1958. To be published in Transactions North American Wildlife Conference 23.

Nickle, W. R. and R. L. Gilbertson. 1958. Nematodes in the Western white pine type. Proceedings of the Fifth Western International Forest Disease Work Conference. In press.

Tisdale, E. W.; M. Hironaka and W. L. Pringle. 1958. Observations on the Autecology of Hypericum perforatum. Accepted for publication in Ecology.

Wohletz, Ernest. 1958. Conservation in the Atomic Era. In Proceedings, Thirty-eighth Annual Conference, Western Association of State Fish and Game Commissioners.

II. Extension and Miscellaneous

Gilbertson, R. L. 1958. Identification of Defects. Chapter IV. Manual of Instructions for the Measurement of Forest Products in Idaho.

Hungerford, K. E. 1958. Review of the Roosevelt Elk by William Graf. Northwest Science 32:74-75.

Johnson, F. D., and R. L. Gilbertson. 1958. Identification of Tree Species. Chapter III. Manual of Instructions for the Measurement of Forest Products in Idaho.

Tisdale, E. W. 1958. Report of the President, American Society of Range Management. Journal of Range Management 11:57-59.

Wohletz, Ernest. 1958. Review of the Federal Lands by Clawson and Held. For. Journal of Forestry.

III. Graduate Theses (M. S. June 1958)

Bachmann, Roger W. 1958. The Ecology of Four North Idaho Trout Streams with Reference to the Influence of Forest Road Construction. M. S. Thesis.

Greichus, Algirdas. 1958. Species and Incidence of Helminth Parasites Found in the Wild and Domestic Ruminants of Idaho and their Possible Transmission from the Wild to the Domestic Ruminents. M. S. Thesis.

Kindel, Frederic J. 1958. Salt in the Management of Elk in the Lower Selway Drainage, Idaho. M. S. Thesis

Nickle, William R. 1958. Nematodes Associated with the Rootlets of Western White Pine in Northern Idaho. M. S. (For.) Thesis.

APPENDIX A. STAFF 1957-58

I. Regular Staff Members

Ernest Wohletz, Director and Professor (Forest Management)
E. W. Tisdale, Associate Director and Professor (Range Management)
E. C. Clark, Assistant Professor (Forest Entomology)
P. D. Dalke, Leader, Cooperative Wildlife Research Unit and Professor (Wildlife Management)
M. E. Deters, Professor (Forest Management)
G. D. Frazier, Assistant Forest Economist, Jr.
R. L. Gilbertson, Assistant Professor (Forest Pathology)
Minoru Hironaka, Assistant Range Ecologist, Jr.
J. P. Howe, Assistant Professor (Wood Utilization)
K. E. Hungerford, Associate Professor (Wildlife Management)
L. L. Inman, Assistant Professor (Forest Genetics)
F. D. Johnson, Acting Instructor (Forest Management)
Craig MacPhee, Assistant Professor (Fishery Management)
D. W. Olson, Research Silviculturist
F. H. Pitkin, Nurseryman
R. H. Seale, Associate Professor (Forest Management)
L. A. Sharp, Assistant Professor (Range Management)
A. W. Slipp, Assistant Professor (Forest Pathology)

II. Research Fellows

Roger Bachmann -- Fishery Management
Arnold Bullock -- Range Management
John Crawford -- Wildlife Management
John Davis -- Range Management
Joseph Helle -- Range Management
Robert Jones -- Wildlife Management
Fred Kindel -- Wildlife Management
William Nickle -- Forest Pathology
Robert Robel -- Wildlife Management

APPENDIX B. SOURCES OF RESEARCH FUNDS AND OTHER SUPPORT 1957-58

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

2. University of Idaho, Special Research Fund. Projects S.R. 11, 24, 27c, 27d, 38, 54 and 55.

3. Idaho State Fish and Game Department. Regular support for the Wildlife Research Unit, plus additional funds for Clearwater Fishery Study and other projects.

4. Idaho State Department of Forestry. Partial support for Forest Genetics project.

5. Potlatch Forests, Inc. Potlatch Research Fellowship.

6. Sears-Roebuck Foundation. Funds for project ES-21 (Small Tree Farms).

7. United States Bureau of Land Management. Funds for project ES-15 (Halogeton), plus facilities and manpower on Point Springs grazing study.

8. South Idaho Forestry Association. Partial support for Forest Genetics project.

9. United States Bureau of Sport Fisheries and Wildlife. Regular funds for Wildlife Research Unit.

10. United States Forest Service. Office space (Boise Research Center), field living accomodation, and numerous other facilities.

11. United States Department of Agriculture. Funds from Regional Research Projects WM-31, W-25, W-34.*

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