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Robert Lee Livezey for the M.S. Zoology
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Abstract Approved: [REDACTED]

(Major Professor)

Within the oak woodlands of the lower eastern slopes of the Coast Range can be found small areas of land that are practically flat and collect drainage water from the upper hill. On these benchlands there is a decidedly different type of vegetation than on the majority of the hill. This study was made to find out the differences in vegetation and the effects on the vertebrate animals.

Many trees, shrubs, and herbs were found growing in a dense tangle quite unlike the oak woodlands. The wet conditions brought in such trees and shrubs as willows, alder, ash, maple, ninebark, hawthorn, and some minor types. Among the herbs the sedges, hedge nettle, water buttercup, geranium, and miner's lettuce were very abundant.

Overall the climate was the same as in the oak, but in the spring and summer the humidity was noticeably higher.

Two amphibians were noted in the study, the tree frog and Oregon newt. The newt was never found outside of the atypical area, and a few phases of its life history were studied.

There were sixty-three species of birds recorded in the study, of which five were never seen in the atypical area and seven never seen in the typical area. Some time was given to the observations of bird movements and the factors affecting these movements.

Only fifteen species of mammals were recorded. The one receiving most attention was the deer mouse; its home range activities were studied and it was found that it travelled a straight line distance averaging 80 feet with an extreme of 470 feet.

In general such an atypical setting causes the animals to concentrate in this small area, causes the influx of a few species not found in the oak woods, and alters their activities to some degree. It also offers a good source of food and affords protection.

A COMPARATIVE VERTEBRATE ECOLOGY OF
TYPICAL AND ATYPICAL OAK AREAS

by

ROBERT LEE LIVEZEY

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APPROVED:

[REDACTED]

Associate Professor of Zoology
In Charge of Major

[REDACTED]

Head of Department of Zoology

[REDACTED]

Chairman of School Graduate Committee

[REDACTED]

Chairman of State College Graduate Council

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A COMPARATIVE VERTEBRATE ECOLOGY OF
TYPICAL AND ATYPICAL OAK AREAS

I

INTRODUCTION

The basis for this study is water. By this I mean the collecting of water on a benchland located in the middle of a typical oak woodland such as is commonly found on the lower slopes of the Coast Range of mountains. In this study the two main objectives were as follows: (1) to find out what types of vegetation invade such wet locations, and (2) to find out what the effects of this situation are on the vertebrate animals as to species, distribution, and activities.

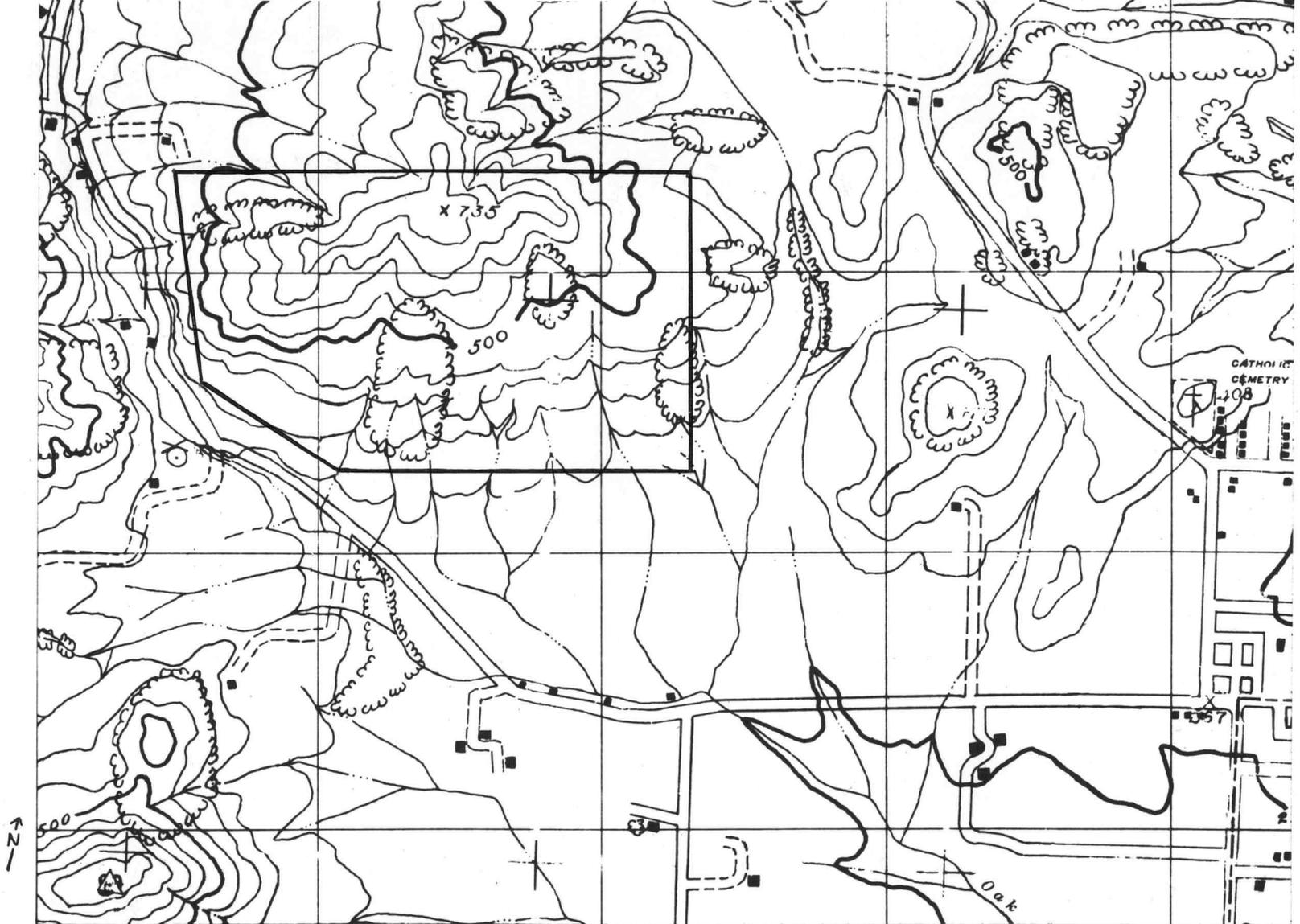
Observations were carried on for the ten months of August, 1942, to May, 1943, inclusive. During the months of August and September daily visits were made to the area. For the remainder of the time the area was visited two or three times a week, usually on week-ends. Both morning and afternoon visits were made so as to cover all sections of the area at various times of the day. No evening or night visits were made to the area; consequently much is lacking in the way of information on the activities of nocturnal animals; nothing was learned about the

owls, bats, and probable other nocturnal animals.

It is felt that because so much material was included in the study many details are lacking on the plants and animals that were under observation. Such a broad subject as this should receive two or more years of constant study to accomplish the task with any degree of completeness.

I am greatly indebted to Dr. Kenneth L. Gordon for the suggestion of the problem, for much guidance during the work, and for the loan of photographic equipment. Also I wish to thank Dr. William Graf for the use of much darkroom equipment.

Fig. 1. The rectangular area marked in India ink is the extent of the area. Corvallis west city limit is the broken line in the lower right hand corner.



II

DESCRIPTION OF THE AREA

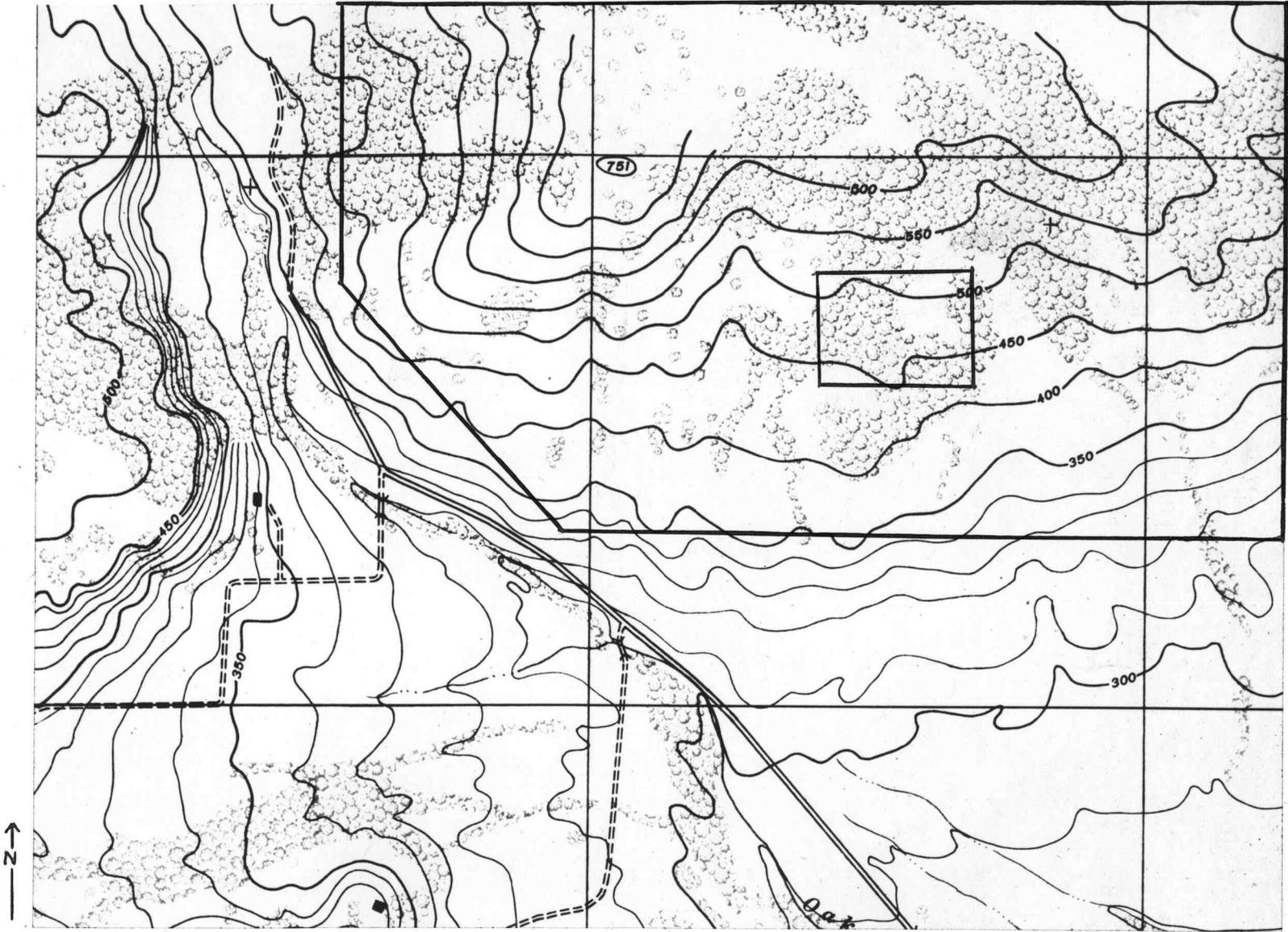
Location and Physiography

The area chosen for this study is an oak-covered hill located west and slightly north of Corvallis about two miles from the west city limit (Fig. 1).

Generally rectangular in shape, the hill is about 2,200 yards long and 1,000 yards wide. Only the western 1,500 yards on the southern slope were used for consideration (Fig. 2). Fig. 2 also shows the section of the area used as atypical for comparison with typical. Ranging in elevation from 350 feet to 750 feet above sea level, the hill is of about average height for the most easterly spurs of the Coast Range.

From the valley floor to about the 400-450 foot level the slope is very gradual, but above this the hill's slope rises rapidly to the crest. It is at this 400 foot level that we find an occasional rather large bench of land that is practically flat and serves as a collecting sump for drainage water from the upper hill. A bench of this sort is the basis for the atypical area of this study. Along the entire hill there are steep gullies cut by small seasonal creeks that drain the hill.

Fig. 2. Within the large rectangular space marked with India ink is the typical area; within the small rectangle is the atypical area.



↑
2

Geology and Soil

Immediately under the surface soil of the hill is an unknown thickness of soft, coarse, Eocene sandstone. The weathering of the upper twenty-four to thirty-six inches of this sandstone and its mixture with the constantly forming humus forms a dark, sticky, 'dobe type of soil.

Drainage

Several seasonal creeks drain the area of surface and most seepage waters. Although these creeks dry up in the summer, there is enough sub-soil water to keep small pools on the benchland full throughout the entire year. All drainage water eventually finds its way to small creeks in the valley which finally empty into Oak Creek.

Climate

Because of a lack of apparatus that could be used constantly on the area, climatic data had, of necessity, to be obtained from available records and from personal meager observations on the area. The only instrument used with any degree of consistency was a thermometer with a Fahrenheit scale; this was used only to determine the difference in temperatures at different locations in the area during comparable hours of the day. All other data are taken from the government publications of Climatological Data, compiled for the city of Corvallis from observations made at

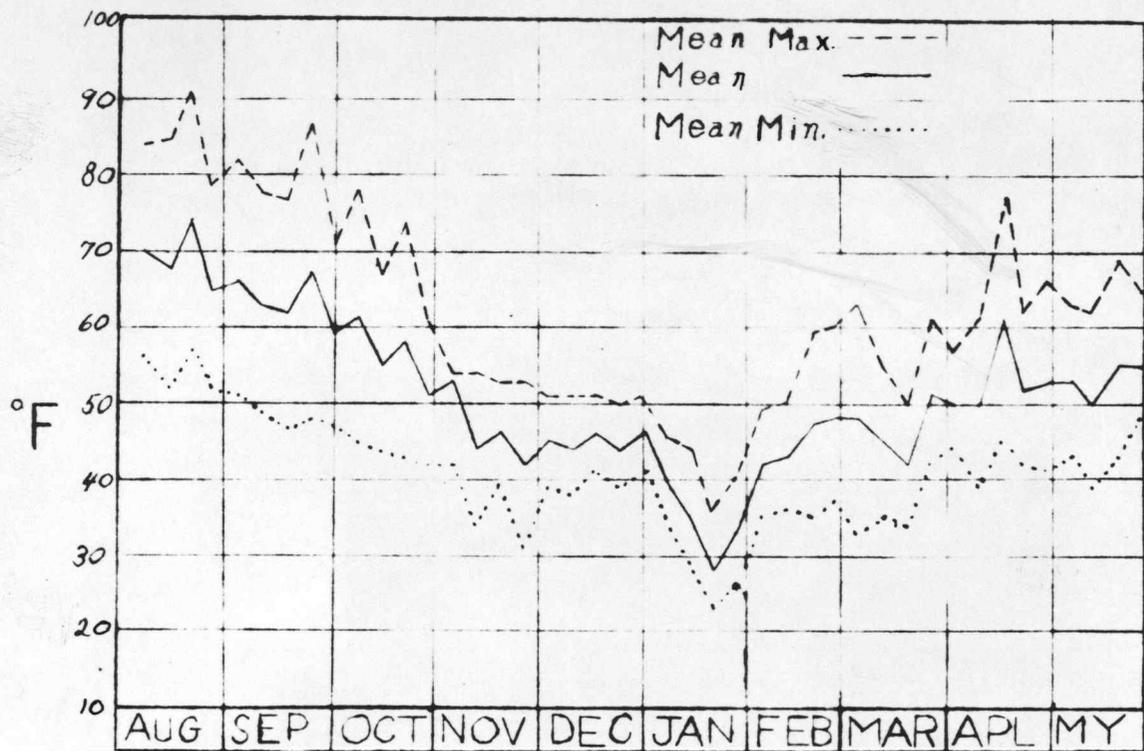


Fig. 3. Mean maximum, mean minimum, and mean temperatures by weeks for the ten month period of the study.

Oregon State College.

Temperature:

Fig. 3 shows the mean maximum, mean, and mean minimum temperatures by weeks for this locality over the period of ten months during which this study was made. It is based on figures in Climatological Data. Temperature recordings taken on the area average two to three degrees lower than the records taken at Oregon State College.

Temperature varies considerably at different locations on the area itself. When there is a light to strong wind, temperatures on the crest of the hill will usually range from two to five degrees lower than at the wouth-west corner of the atypical section (Fig. 2) of the study area. If there is no wind, the crest will be approximately the same or one to two degrees higher than the wouth-west corner. Temperatures taken at a point nearly two-thirds of the distance to the top of the hill compare favorably with those taken at the southern margin of the atypical section; any difference at all would be one or two degrees higher uphill, for this point is protected from winds, except from the south-west, by the thick growth of trees.

For the period of this study the highest temperature was 102°F. on the fourteenth of August, 1942, and the lowest was 11°F. on the twenty-fourth of January, 1943.

Humidity:

From the later part of October until the first of A-

pril there is little or no difference in the humidity in various sectors of the area, but from the middle of April until October the difference becomes very noticeable between the atypical section and the typical. During this period the humidity is lowest in the open sections, much more noticeable in the oaks, and extremely high in the dense, brushy, atypical bench sector.

Precipitation:

Table 1 gives a summary of precipitation for the period of August, 1942, to May, 1943. It may be noted that the rainfall was somewhat heavier than normal for the time of the study, and the snowfall may be considered "unusual", for there is very seldom any appreciable amount of snow in this region. The last recorded snowfall was in the late winter of 1937-38.

Wind:

Westerly winds predominate in this entire region with quite a bit of southerly wind in the winter months of November to January. North-easterly winds occur at the change from summer to winter and winter to spring. Table 2 is a list of the months and the corresponding prevailing winds for the time of this study.

Within the area the topography and trees have considerable effect on the velocity and movement of the wind. At the ridge of the hill the wind may be blowing with considerable force, while down among the tall trees and dense

Table 1. Summary of precipitation.

Month	Rain (inches)	Departure from normal	Snowfall (inches)
August	0.0	- 0.45	0.0
September	Trace	- 1.71	0.0
October	1.22	- 1.69	0.0
November	12.69	5.77	0.0
December	10.37	3.74	2.0
January	5.09	- 1.45	18.0
February	3.78	- 1.54	Trace
March	5.60	1.41	0.0
April	2.01	- 0.42	0.0
May	1.16	- 0.57	0.0
Total inches	41.92	3.09	20.0

Table 2. Prevailing winds, by months.

Month	Prevailing wind from
August	west
September	west
October	north-east
November	south
December	south
January	south-west
February	north-east
March	west
April	west
May	west

Table 3. Number of clear, partly cloudy, and cloudy days.

Month	No. of days clear	No. of days partly cloudy	No. of days cloudy
August	21	9	1
September	19	7	4
October	9	15	7
November	2	13	15
December	0	10	21
January	2	13	16
February	9	12	7
March	6	13	12
April	8	13	9
May	7	17	7
Total Days	83	122	99

brush of the wet atypical section the wind may be only barely perceptible. The arrangement of the trees and gullies on the area usually modifies the movement from a westerly direction to a south-westerly direction.

Sunshine:

Table 3 gives by month the number of clear, partly cloudy, and cloudy days. It may be seen that the number of cloudy and partly cloudy days far exceeds the number of clear days, the ratio being 2.5 : 1 in favor of cloudy or partly cloudy days.

Although no measurements of light intensities were made on the area it should be noted that during the months when the trees are leafless there is little difference in light intensity except between sections covered with trees and those which are entirely open. When the trees and bushes are in full leaf, there is a very noticeable difference in light intensity in the various sectors.

In going from the open section to the oak wooded sections, one is aware of the great decrease in intensity; the oak growth forms quite a dark woodland. Even more conspicuous is the decrease in intensity among the brush, vines, ferns, and willows of the atypical area. Here near the ground there is practically no light whatever.

Plant Constitution

Some idea as to the comparative numbers of plants in the typical and atypical areas may be had from table 4; it

Table 4. List of plants in study area, with comparative abundance in typical and atypical areas.

Ab -- Abundant; Co -- Common; Oc -- Occasional.

	Typical			Atypical		
	Ab	Co	Oc	Ab	Co	Oc
Trees						
Willow -- <i>Salix Scouleriana</i>				X		
Red Alder -- <i>Alnus oregona</i>				X		
White Oak -- <i>Quercus Garryana</i>	X			X		
Western Hawthorn-- <i>Crataegus Douglasii</i>					X	
Broad Leafed Maple -- <i>Acer Macrophyllum</i>			X	X		
Cascara -- <i>Rhamnus Purshiana</i>						X
Creek Dogwood -- <i>Cornus occidentalis</i>						X
Ash -- <i>Fraxinus oregona</i>				X		
Apple -- <i>Malus (sp)</i>			X			X
Shrubs and Brush						
Western Hazel -- <i>Corylus rostrata</i>					X	
Scrub Oak -- <i>Quercus Garryana</i>	X			X		
Ninebark -- <i>Physocarpus capitatus</i>				X		
Wild Blackberry -- <i>Rubus macropetalus</i>				X		
Common Wild Rose -- <i>Rosa nutkana</i>	X			X		
Poison Oak -- <i>Rhus diversiloba</i>	X			X		
Herbs						
Death Camas -- <i>Zygadenus venenosus</i>		X			X	
Pussy's Ears -- <i>Calochortus Tolmiei</i>			X		X	
Fawn Lily -- <i>Erythronium oregonum</i>		X		X		
Small Camas -- <i>Camassia quamash</i>		X		X		
Sessile Trillium -- <i>Trillium sessile</i>		X		X		
Ovate Trillium -- <i>Trillium ovatum</i>		X		X		
Flag -- <i>Iris tenax</i>		X				
Blue-eyed Grass- <i>Sisyrinchium idahoense</i>		X			X	
Curly Dock -- <i>Rumex crispus</i>		X			X	

Table 4. Continued

Herbs	Typical			Atypical		
	Ab	Co	Oc	Ab	Co	Oc
Indian Pink -- <i>Silene Hookeri</i>			x			x
Candy Flower -- <i>Montia sibirica</i>			x	x		
Miner's Lettuce -- <i>Montia perfoliata</i>				x		
Water Buttercup -- <i>Ranunculus aquatilis</i>				x		
Field Buttercup -- <i>Ranunculus occidentalis</i>	x			x		
Field Larkspur -- <i>Delphinium Menziesii</i>		x			x	
Spring Beauty -- <i>Dentaria tenella</i>	x			x		
Fringe Cups -- <i>Tiarella grandiflora</i>				x		
Ragged Starflower -- <i>Tellima parviflora</i>			x		x	
Wild Strawberry -- <i>Fragaria cuneifolia</i>		x				x
Five Finger -- <i>Potentilla gracilis</i>		x		x		
Carolina Geranium -- <i>Geranium carolinianum</i>			x	x		
St. John's Wort -- <i>Hypericum perforatum</i>	x			x		
Yellow Violet -- <i>Viola glabella</i>		x			x	
Wild celery -- <i>Oenanthe sarmentosa</i>				x		
Wild Carrot -- <i>Daucus carota</i>		x			x	
Shooting Star -- <i>Dodecatheon Hendersonii</i>		x			x	
Self Heal -- <i>Prunella vulgaris</i>		x			x	
Giant Hedge Nettle -- <i>Stachys ciliata</i>				x		
Moth Mullin -- <i>Verbascum Blattaria</i>					x	
Spring Queen -- <i>Synthyris reniformis</i>	x			x		
Black Plantain -- <i>Plantago lanceolata</i>		x			x	
Wild Cucumber -- <i>Echinocystis oreganus</i>						x
Common Dandelion -- <i>Taraxacum officinale</i>		x			x	
Canada Thistle -- <i>Cirsium arvense</i>		x				x
Sedge -- <i>Carex</i> (sp)				x		
-- <i>Eleocharis</i> (sp)					x	
Grasses -- (various kinds)	x			x		

Table 4. Continued

Ferns and Miscellaneous	Typical			Atypical		
	Ab	Co	Oc	Ab	Co	Oc
Sword Fern -- <i>Polystichum munitum</i>			x		x	
Bracken Fern -- <i>Pteridium aquilinum</i>	x				x	
Shield Fern -- <i>Dryopteris</i> (sp)				x		
Mistletoe -- <i>Phoradendron villosum</i>	x			x		
Mosses -- (various kinds)	x			x		
Fungus -- (various kinds)		x		x		
Lichens -- (various kinds)	x			x		

is a listing of the more noticeable plants in the entire study area with their relative occurrence in both typical and atypical parts. All plants listed, except such things as grasses, sedges, mosses, fungus, and apple, may be found described in Gilkey's Handbook of Northwest Flowering Plants.

Typical Area:

This is the characteristic oak woodland (Figs. 4 and 5) of the lower east slopes of the Coast Range. On this particular hill the woodland more or less follows the ravines and gullies that run up and down the south and west slopes. Alternating with these groves of oak are small to large open grass sections which usually occupy the rises between creek-cut gullies. Along the crest of the hill for most of its length (Fig. 6) there is only open grassland with scattered single and clumped oaks and rose bushes. Only the eastern end of the hill and a small section in the center have any considerable amount of dense woodland.

At present this situation is kept fairly stable by the grazing of sheep, particularly at the western end, throughout most of the year.

Atypical Area:

Caused only by the one factor of water collecting in a level benchland, this area differs greatly in plant constitution from the ordinary oak woods of these hills. Fig. 7 shows the general cover of the area (600' x 900') marked



Fig. 4. Characteristic oak covered hill of this region.



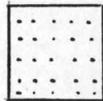
Fig. 5. Oak woodland in winter.



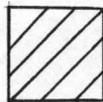
Fig. 6. Crest of hill in typical area.

Fig. 7. General cover of the atypical area.

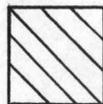
Legend



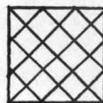
-- Ash



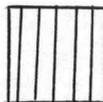
-- Oak



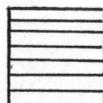
-- Maple



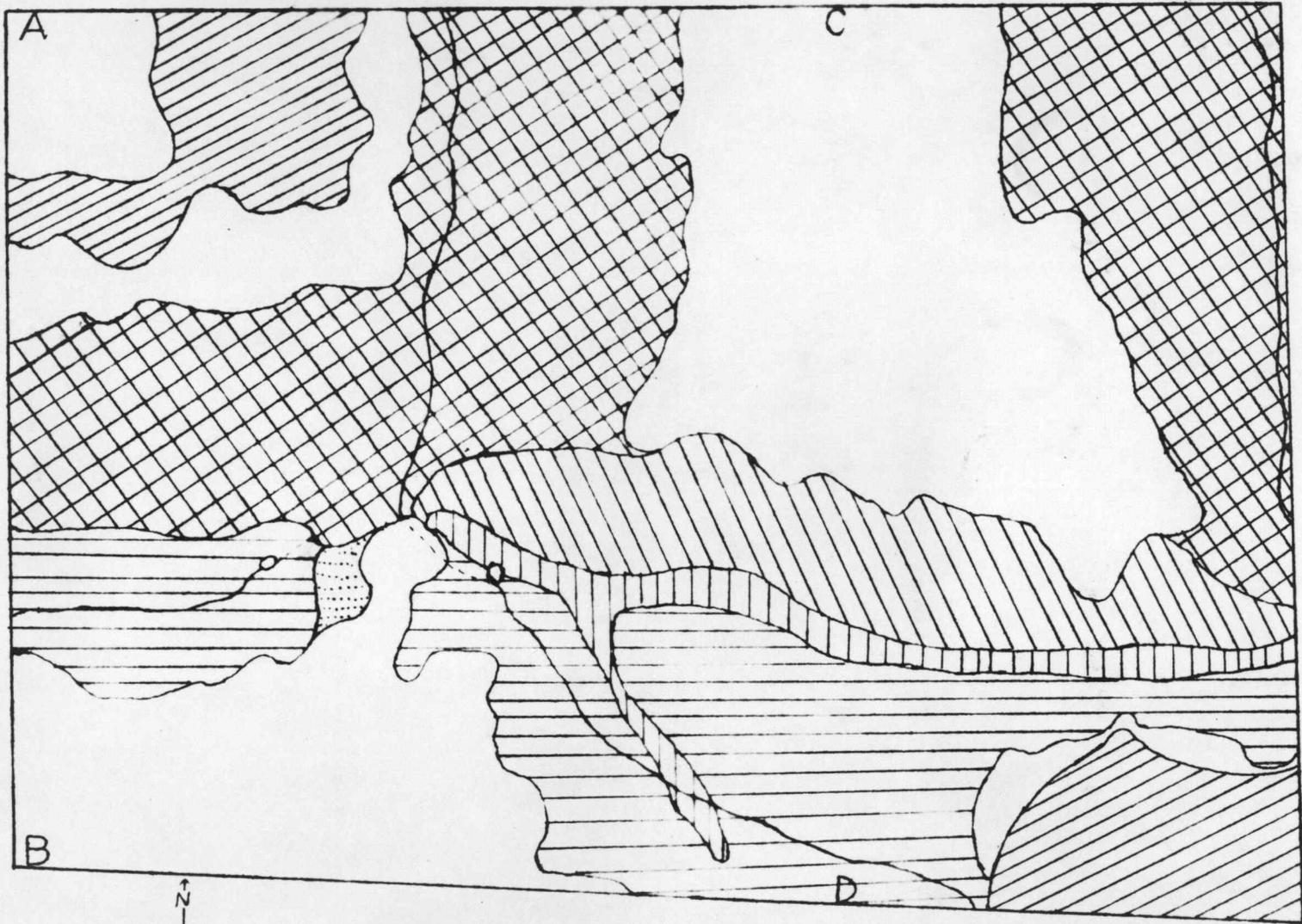
-- Oak-Maple



-- Alder

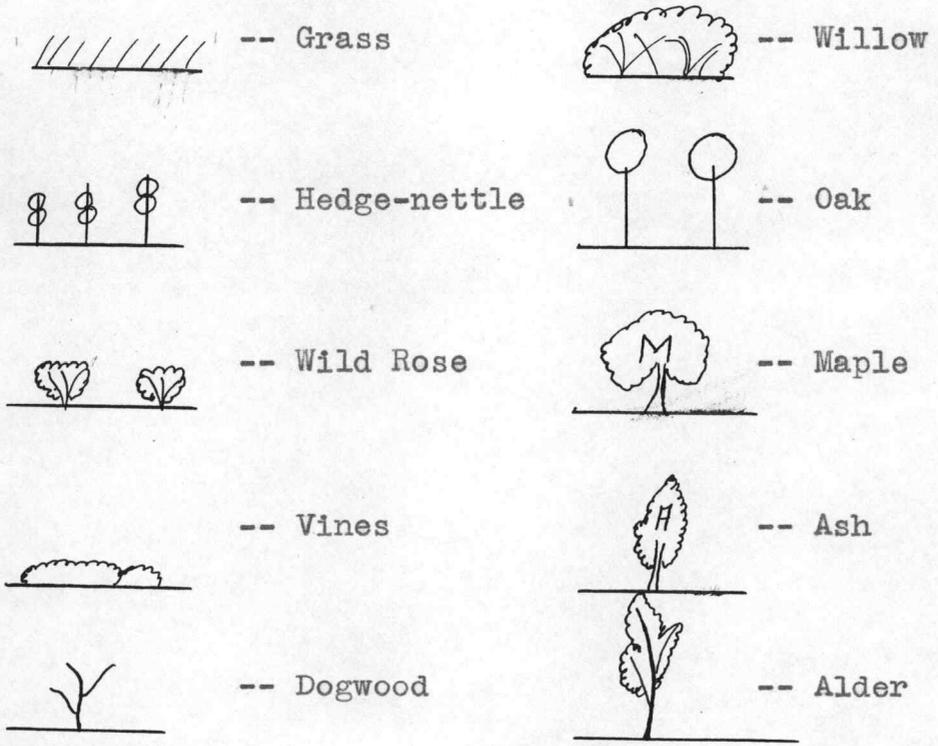


-- Willow



Figs. 8 & 9. Diagrams of cross sections through figure 7 at points A-B and C-D respectively.

Legend



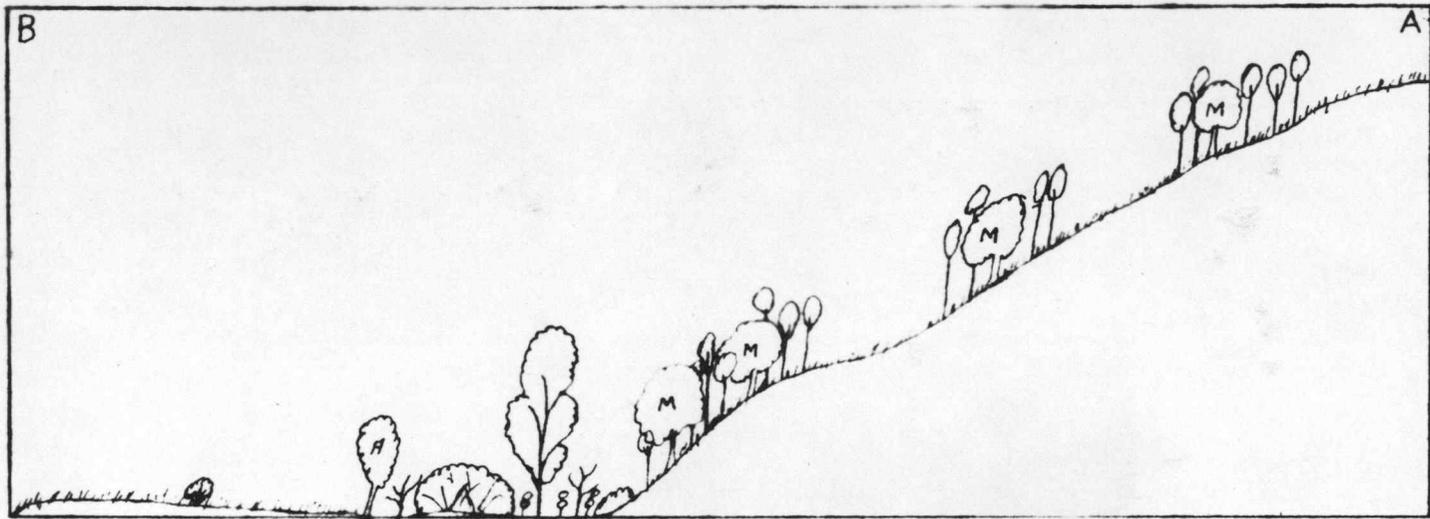


Fig. 8.

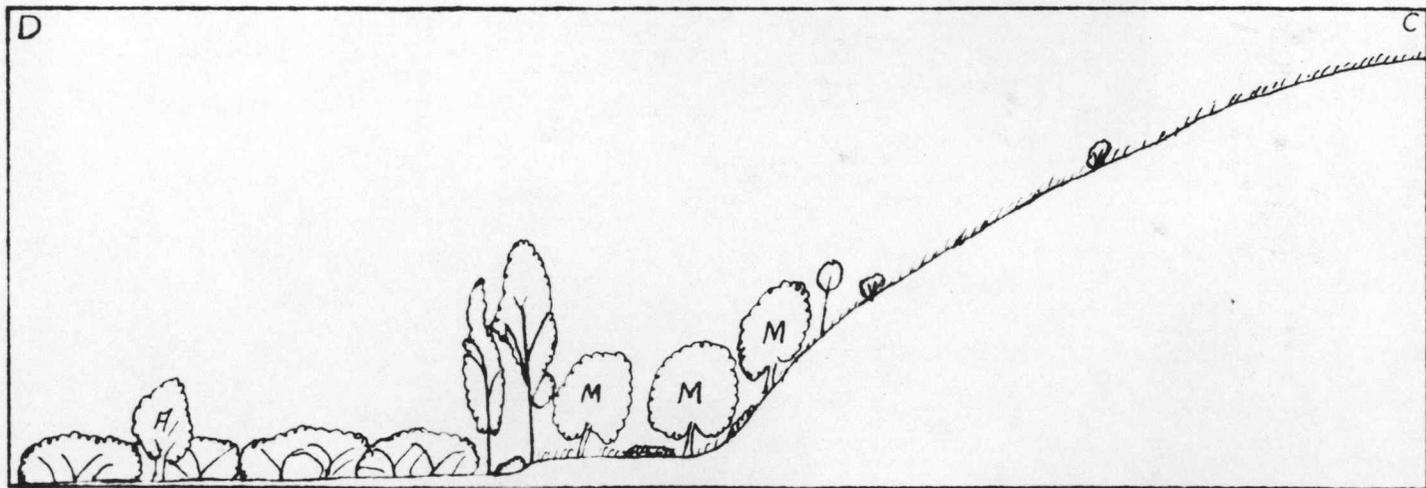


Fig 9.

$\frac{3}{4}$ in = 50ft.

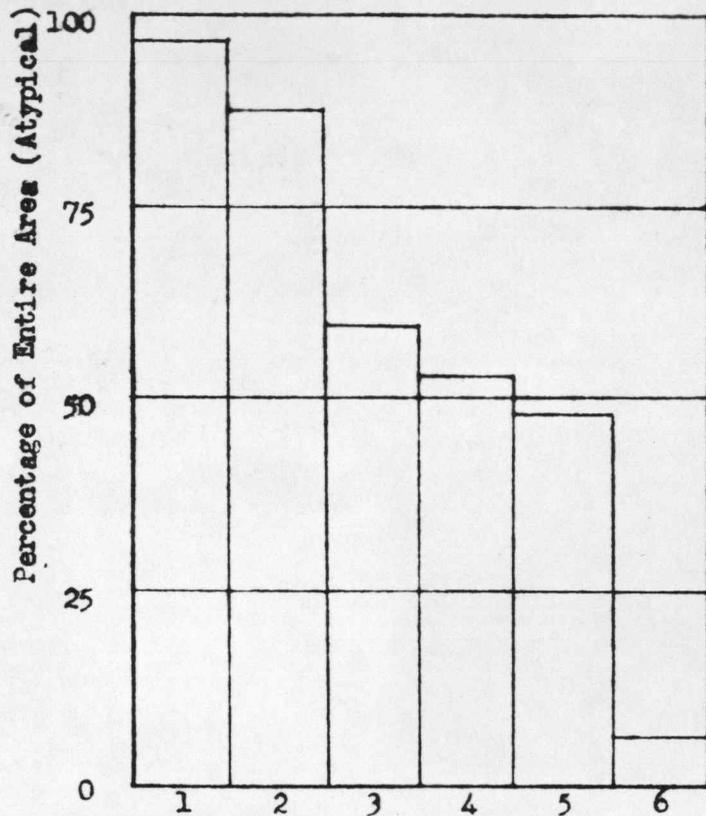


Fig. 10. Cover Types.

The numbers along the bottom indicate cover types as follows; 1- Debris, 2- Herbs, 3- Trees, 4- Fungus and Lichen, 5- Shrubs, 6- Moss.

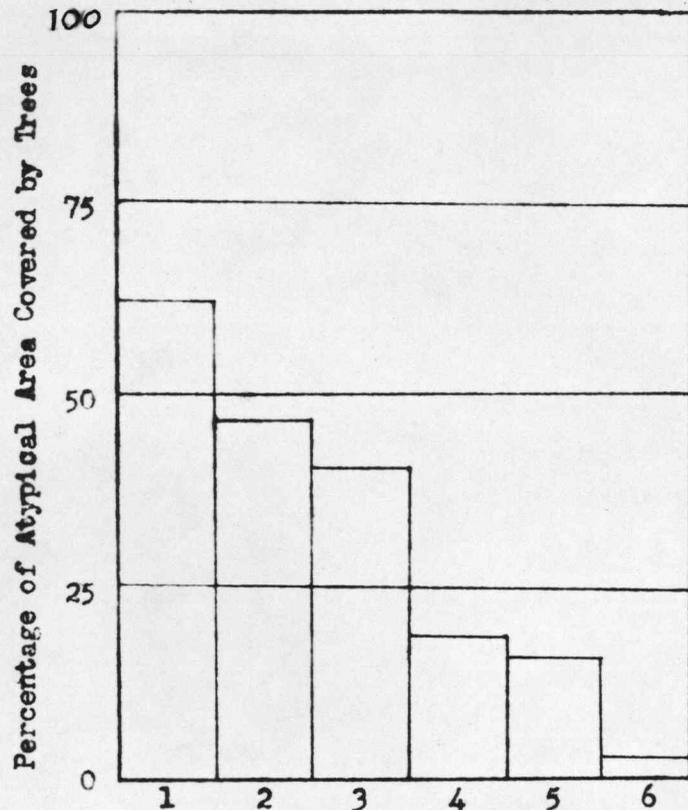


Fig. 11. Trees .

The numbers along the bottom indicate the kinds of trees as follows: 1- Oak, 2- Maple, 3- Willow, 4- Alder, 5- Ash, 6- All others.

out for comparison with the typical oak woods. Figs. 8 and 9 are cross sectional diagrams through Fig. 7 at the points A-B and C-D. On Fig. 7 note that the main growths of trees are rather distinct from each other, being grouped somewhat in zones of their water requirements.

The growth in the flat of this section is extremely dense, especially along the row of alders, where there is a thick tangle of blackberry vines, ninebark, and willows. Also at the west end of the area there is a dense tangle of willows, ninebark, vines, sedges, and shield fern. Ash trees are concentrated in the narrow strip between the two very wet sections. For approximate percentages of cover types, and percentages of trees on this atypical area see Figs. 10 and 11. Note that in Fig. 11 the percentages of trees total more than 100 because of overlapping of different kinds.

Figs. 12-17 show various locations within the atypical area.

Plant Aspection

Aestival:

At this season all trees and shrubs are in full leaf. Such hot weather herbs as St. John's Wort, Canada thistle, wild carrot, moth mullein, self-heal, giant hedge nettle, curly dock, and shield fern are at their height. Lichens, mosses, and fungus are quite dry and lifeless.



Fig. 12. Growth on north margin of thicket at west-center end of atypical area.



Fig. 13. View looking south-east from, figure 12.



Fig. 14. Alders near east end
of atypical area.



Fig. 15. Dense alder-willow
growth near west end
of alder belt.



Fig. 16. Water hole at west
end of alder belt.



Fig. 17. Interior of oak-maple
woodland of atypical
area.

Autumnal:

Grasses are now all dead, leaves are fast dropping from trees and shrubs; herbs of all sorts are wilting and drying. The last of the blackberries are drying on the vines.

Hiemal:

Trees and shrubs are now entirely leafless; sedges, vines, leaves, and herbs form a mat over the ground of the area. The entire hill takes on a dark, drab, dead appearance. In late winter the mat of dead vegetation begins to form humus, and the mosses, lichens, and fungus begin to show signs of growth.

Prevernal:

Early in February the buds are just starting to make their appearance on the willows and oaks, but remain immature for some time yet. Mosses, fungus, and lichens are at their peak. In the latter part of the month the herbs begin to show above the surface of the ground, and the maple buds show up quite well. Fringe cups are now in young leaf.

By the first week in March the willows are in flower, and the leaves are coming out on the blackberries and roses. In the third and fourth weeks of March the fawn lilies and trillium are at their height; the entire hill is now green with herbs of various sorts. At the end of March and the first of April the open slopes are yellow with

field buttercups, and the maples are in full bloom and starting to become leafy. The alder tops are also green with young leaves.

In mid-April the hill is covered with spring queen and spring beauty, and there is a lot of shooting star, wild strawberry, yellow violet, indian pink, camas, flag, and ragged starflower.

Vernal:

Near the end of April the fawn lily and trillium are just about gone. Fringe cups are in bloom, ferns are growing fast, and the oaks have leafed out enough to give a light green tinge to the wooded parts of the hill.

During the first and second weeks in May the oaks and all other trees come to full leaf, bracken fern is getting quite thick on the west and south slopes, indian pinks make their appearance in the atypical area, and pussy's ears are fairly common all over the hill.

Miner's lettuce, candy flower, and field larkspur are in full bloom by the start of the third week in May, and flag is beginning to die on the crest of the hill. The close of the month sees five finger, death camas, and blue-eyed grass at their best. Sedges and wild celery are starting to bloom, shield fern and bracken are reaching maturity, and St. John's Wort is beginning to come up on the slopes of the hill.

III

AMPHIBIA AND REPTILES

Few in both species and individuals, the amphibia and reptiles are much more noticeable in the atypical area of the hill. Here the amphibians congregate for breeding and most all of their activities; Triturus granulosus was never found beyond the bounds of the atypical niche.

Seclusive in their habits, these animals were seen little during the course of normal wanderings about the hill but could be discovered when an effort was made to locate them. Only the two species of amphibia and five species of reptiles listed in Table 5 were found on the area.

Table 5. Amphibia and reptiles of the area.

Amphibia	
Oregon newt	<u>Triturus granulosus granulosus</u> (Skilton)
Pacific tree frog	<u>Hyla regilla</u> (Baird & Girard)
Reptiles	
Pacific blue-bellied lizard	<u>Sceloporus undulatus occidentalis</u> (Baird & Girard)
Western alligator lizard	<u>Gerrhonotus multi-carinatus scincicauda</u> (Skilton)
Western yellow-bellied racer	<u>Coluber constrictor morman</u> (Baird & Girard)
Coast gopher snake	<u>Pituophis catenifer catenifer</u> (Blainville)
Puget garter snake	<u>Thamnophis ordinoides ordinoides</u> (Baird & Girard)

Amphibia

Triturus granulosus granulosus (Skilton)

Oregon newt

Triturus was first noticed in the atypical area on the tenth of October, 1942, the day following the first heavy rain of the season. At this time the animals were quite abundant, mainly females with some males, all heading away from the water of the west end of this area. On the tenth and eleventh the main body of the population of this location appeared to be on the move, and all were crawling over debris, etc. as fast as they could. For the rest of October and the first week of November there were only a few of the animals seen, and these did not seem to be in such a hurry to travel. At no time were any seen more than forty to fifty feet from the nearest water.

During this general movement of the Triturus, time was taken to follow several individuals to see just where they might be headed for. In all cases the salamanders eventually crawled into crevices and holes in the ground or under the larger branches and logs that were strewn about over the ground. On the following days attempts were made to locate the animals uphill farther than any had been previously seen, but without success.

For the last three weeks in November, all of December, and January no newts could be found except in one instance

on the first day of January. This animal, a female, was crawling sluggishly over leaves and other debris in the center of the sippy location in which the Triturus were first seen. The next animals seen were three females crawling among debris on the fifth of February. All appeared as though the eggs were developing within them. From this time until field observations were brought to a close at the end of May no more Triturus were seen out of water.

Males were found in water in the middle of February, and females showed up with them by the end of February and were in the act of mating at this time. First evidence of egg laying was on the fifth of March, when a female was observed depositing eggs on a thick clump of water moss (Fig. 18). After the first week of March the number of both males and females increased to a peak in the last week of the month, when upwards of fifteen females and nearly as many males could be found in an area of about ten or twelve square feet in which water buttercup was quite thick. On the stems and leaves of this plant the females were laying single eggs rather thickly. No clusters of eggs were ever found, but eggs were laid closer together on the very thick water moss than on the water buttercup.

By the first week in April egg laying activities all but ceased, and the numbers of animals rapidly diminished until only scattered individuals could be found. Condi-



Fig. 18. Triturus eggs attached to water moss.



Fig. 19. Favorite habitat of blue-bellied lizard.

tions remained this way until observations were ended. No copulatory actions were noted after the first week in April, but three females were located in a pool in the eastern part of this atypical area laying eggs up to the last day of May; at this time one female contained such an amount of eggs that it seemed she had not as yet laid any.

Some of the embryos were well formed by the second week of April and broke out of their gelatinous casings shortly after. Larvae were still in the process of hatching by the end of May; search revealed a few still in egg casings and myriads of them, ranging from one-half to one inch in length, swimming among the dense growth of water plants.

It might be noted that from early May to the end of this month the skins of Triturus became quite rough and granular, even though the animals had not yet left the water. This proved to be the case in both males and females. Also the large tail fins which characterize the males during the breeding season had become very much reduced, and in a few instances the tails were only slightly larger than those of the females observed at the same time.

Hyla regilla (Baird & Girard)

Pacific tree frog

Hyla was first noted among the willows of the atypical area near the end of September and was found only here

and among the oak-maple growths until late in November. Rains and general lowering of temperatures seemed to induce the frog to move uphill into the oaks of the typical area as well as the atypical area. It remained in this scattered status until the breeding season in February and March, when it moved more into the willow growths again.

Supposedly a frog favoring locations near or on the ground (Wright), it was not uncommon during the winter months to hear numerous Hyla croaking from very near the tops of the oaks.

Reptiles

Sceloporus undulatus occidentalis (Baird & Girard)

Pacific blue-bellied lizard

The blue-bellied or fence lizard is the commonest reptile on the hill, being noticeably more abundant in the atypical area than in the typical. Having a liking for logs and fallen branches for its normal habitat, this lizard was often seen on a pile of alder logs (Fig. 19) near the east end of the atypical area.

Fence lizards are present throughout the summer and through the month of October. At the start of much cooler weather at the end of this month the lizards find places to hibernate and do not make their appearance again until early the following April. At this time they may be seen dur-

ing the warmer hours of the day sunning themselves on the highest point of a log or branch.

Gerrhonotus multi-carinatus scincicauda (Skilton)

Western alligator lizard

Not nearly as often seen as Sceloporus, the alligator lizard seems to prefer the brush and oaks more than anything else. It disappears in the fall and reappears in the spring at about the same time as the blue-bellied lizard. One individual was found in the late fall in a small burrow, apparently of its own making, under a moderate-sized oak limb half-way up the hill. This animal was decidedly sluggish and made little effort to escape, just crawled to the end of its burrow and curled up.

Coluber constrictor mormon (Baird & Girard)

Western yellow-bellied racer

More frequently seen among grass and small brush of the open slopes, this snake is very seldom seen in the atypical area at all. Fast of action, it is not uncommon to have an individual disappear into a hole or small crack in the ground before you have time to overtake it.

Pituophis catenifer catenifer (Blainville)

Coast gopher snake

The least common of any reptile on this area, the go-

pher snake, like the racer, prefers the more open sections.

Thamnophis ordinoides ordinoides (Baird & Girard)

Puget garter snake

Confined primarily to the atypical area, this was the most frequently seen and the most numerous of the snakes, being second only to Sceloporus among the reptiles.

During the summer months Thamnophis was very common among blackberry vines and other thick brushy vegetation. The sound of the snake slithering among leaves, vines, etc. could often be heard when no animal could be seen at all.

No garter snakes were seen after the end of October, 1942, but in early April, 1943, they again made their appearance. Among those that showed up in the early spring were quite a few young snakes still in their first year of existence.

IV

BIRDS

Most apparent and numerous of any of the animals on the area were the birds. Changing from season to season in the species making up the population, and also changing in activities, the birds could easily be made the sole problem for study on such an area as this. Because of the relatively short period of time spent on birds, only generalities may be given concerning their habits. In Table 6 appears the entire list of birds, in seasonal groups, seen on the area. The order and scientific names are the same as given by Gabrielson and Jewett in their Birds of Oregon.

Table 6. Birds of the entire area, by seasonal groups.

Permanent Residents (common throughout the year)	
Western Red-tailed Hawk	<u>Buteo borealis calurus</u> Cassin
Oregon Ruffed Grouse	<u>Bonasa umbellus sabini</u> (Douglas)
Ring-necked Pheasant	<u>Phasianus colchicus torquatus</u> Gmelin
Harris's Woodpecker	<u>Dryobates villosus harri-</u> <u>si</u> (Audubon)
Gairdner's Woodpecker	<u>Dryobates pubescens</u> <u>gairdneri</u> (Audubon)
Western Crow	<u>Corvus brachyrhynchos hes-</u> <u>peris</u> Ridgway
Oregon Chickadee	<u>Penthestes atricapellus</u> <u>occidentalis</u> (Baird)

Table 6. Continued.

<u>Permanent Residents (continued)</u>	
Slender-billed Nuthatch	<u>Sitta carolinensis aculeata</u> Cassin
California Creeper	<u>Certhis familiaris occidentalis</u> Ridgway
Seattle Wren	<u>Thryomanes bewicki calophonus</u> Oberholser
Northwestern Robin	<u>Turdus migratorius caurinus</u> (Grinnell)
Western Bluebird	<u>Sialia mexicana occidentalis</u> Townsend
Audubon's Warbler	<u>Dendroica auduboni auduboni</u> (Townsend)
Western Meadowlark	<u>Sturnella neglecta</u> Audubon
Oregon Towhee	<u>Pipilo maculatus oregonus</u> Bell
Song Sparrow	<u>Melospiza melodia</u>
<u>Winter Residents</u> (common in autumn and winter)	
Northwestern Flicker	<u>Colaptes cafer cafer</u> (Gmelin)
Northern Red-breasted Sapsucker	<u>Sphyrapicus varius ruber</u> (Gmelin)
Chestnut-backed Chickadee	<u>Penthestes rufescens rufescens</u> (Townsend)
Western Winter Wren	<u>Nannus hiemalis pacificus</u> (Baird)
Pacific Varied Thrush	<u>Ixorens naevius naevius</u> (Gmelin)
Western Golden-crowned Kinglet	<u>Regulus satrapa olivaceus</u> Baird
Ruby-crowned Kinglet	<u>Corthylio calendula</u>
Junco	<u>Junco oreganus</u>
<u>Summer Residents</u> (common in spring and summer)	
Turkey Vulture	<u>Cathartes aura septentrionalis</u> Wied
Band-tailed Pigeon	<u>Columba fasciata fasciata</u> Say
Western Mourning Dove	<u>Zenaidura macroura marginella</u> (Woodhouse)
Rufous Hummingbird	<u>Selasphorus rufus</u> (Gmelin)
Western Wood Pewee	<u>Myiochanes richardsoni richardsoni</u> (Swainson)

Table 6. Continued.

<u>Summer Residents (continued)</u>	
Olive-sided Flycatcher	<u>Nuttalornis mesoleucus</u> (Lichtenstein)
Violet-green Swallow	<u>Tachycineta thalassina le-</u> <u>pida</u> Mearns
Coast Jay	<u>Cyanocitta stelleri car-</u> <u>bonacea</u> Grinnell
Cassin's Vireo	<u>Vireo solitarius cassini</u> Xantus
Western Warbling Vireo	<u>Vireo gilvus swainsoni</u> Baird
Lutescent Warbler	<u>Vermivora celata lutes-</u> <u>cens</u> (Ridgway)
Black-throated Gray Warbler	<u>Dendroica nigrescens</u>
Yellow Warbler	<u>Dendroica aestiva</u>
Golden Pileolated Warbler	<u>Wilsonia pusilla chryse-</u> <u>ola</u> Lawrence
Lazuli Bunting	<u>Passerina amoena</u> (Say)
Western Chipping Sparrow	<u>Spizella passerina ari-</u> <u>zonae</u> Coues
Golden-crowned Sparrow	<u>Zonotrichia coronata</u> (Pal- las)
Lincoln's Sparrow	<u>Melospiza lincolni lin-</u> <u>colni</u> (Audubon)
<u>Occasional Visitors</u> (those seen infrequently at any time of the year)	
Sharp-shinned Hawk	<u>Accipiter velox</u> (Wilson)
Cooper's Hawk	<u>Accipiter cooperi</u> (Bona- parte)
Sparrow Hawk	<u>Falco sparverius spar-</u> <u>verius</u> (Linnaeus)
Wilson's Snipe	<u>Capella delicata</u> (Ord)
Vaux's Swift	<u>Chaetura vauxi</u> (Townsend)
Lewis's Woodpecker	<u>Asyndesmus lewis</u> Gray
Western Flycatcher	<u>Empidonax difficilis</u> <u>difficilis</u> Baird
Tree Swallow	<u>Iridoprocne bicolor</u> (Vieillot)
Long-tailed Jay	<u>Aphelocoma californica</u> <u>immanis</u> Grinnell
Hermit Thrush	<u>Hylocichla guttata</u>
Hutton's Vireo	<u>Vireo huttoni huttoni</u> Cassin
Pacific Yellow-throat	<u>Geothlypis trichas arize-</u> <u>la</u> Oberholser

Table 6. Continued.

<u>Occasional Visitors (continued)</u>	
Long-tailed Chat	<u>Icteria virens longicauda</u> Lawrence
Western Tanager	<u>Piranga ludoviciana</u> (Wilson)
Western Evening Grosbeak	<u>Hesperiphona vespertina brooksii</u> Grinnell
California Purple Finch	<u>Carpodacus purpureus californicus</u> Baird
Northern Pine Siskin	<u>Spinus pinus pinus</u> (Wilson)
Green-backed Goldfinch	<u>Spinus psaltria hesperophilus</u> (Oberholser)
Oregon Vesper Sparrow	<u>Poecetes gramineus affinis</u> (Miller)
Puget Sound Sparrow	<u>Zonotrichia leucophrys pugetensis</u> Grinnell
Fox Sparrow	<u>Passerella iliaca</u>

Distribution of Birds

With the exception of a very few, the birds listed in Table 6 were found in both the typical and atypical areas. Species that were common throughout could usually be found more frequently in the atypical area than in the typical. Here in the atypical, the different types of thick vegetation tended to concentrate the birds in a small space; offering better protection and more available food, this atypical area attracted the birds from the entire hill at sometime or other during the period in which they were present at all. Permanent residents of the study area could be found in this area when it was not possible to find them in any other place.

Of the sixty-three species of birds noted, only five

were never seen in the atypical and only seven were never seen in the typical area. Those birds that were never seen in the atypical area were the Lewis's Woodpecker, Vaux's Swift, Tree Swallow, Lincoln's Sparrow, and the White-crowned Sparrow. Those never seen in the typical area were the Wilson's Snipe, Western Flycatcher, Long-tailed Jay, Pacific Yellow-throat, Long-tailed Chat, Northern Pine Siskin, and the Green-backed Goldfinch.

Such brush loving birds as the Winter Wren, Seattle Wren, Song Sparrow, and Oregon Towhee were extremely abundant in the atypical area. These species would seldom be seen very far from the lush growth of this area, and hardly a day would pass without all of them being recorded within a restricted section here. At the beginning of the breeding season the Golden-crowned Sparrows also became very abundant in this section; walking through the fern and brush would cause them to fly from all sides to places of safety.

Bird Movements

On the whole the bird movements are quite varied and complex, depending to a large extent on the characteristics of the different species. An overall statement as to the manner in which the bird population moves about the area would be open to many questions, but it has been noticed that certain generalities may be drawn about this ac-

tivity.

Taking the area as a unit, it has been found that most all birds tend to follow the growths of trees in their normal daily movements. This, then, leads to an overall north-south direction in daily wanderings. Also there is an amount of east-west travel near the south margin of the hill, for here the thick groves of oak run together in this direction. In the atypical area the daily movement is entirely east-west through this bench-land growth. Perhaps the most noticeable exception to these generalities would be the movements of the Evening Grosbeaks. These birds move erratically about the area in closely packed flocks, with no regard to any specific direction.

Group movements:

As the birds move about the area, they seem to prefer moving in association with other birds. Definite groupings of different species occur quite frequently. One of the outstanding associations is that of the chickadees and kinglets. Almost always these two species will travel together, and often they will be joined by various warblers, some juncos, and vireos. Occasionally seen with this more or less closely-formed group will be a few wrens and Gairdner's woodpeckers straggling along behind or to one side of the main body of birds. This sort of assortment forms a relatively slow-moving flock.

One of the more rapid-moving combinations is made up of Audubon's warblers and bluebirds. Sometimes with this grouping will be found a few black-throated gray warblers. The bluebirds also have a liking for the robins and varied thrush; and when this sort of an organization is noted, the warblers have become the dissociated members of the movement. These are the more apparent arrangements of the birds, but other more loosely knit groups may also occasionally be seen. These may consist of almost any of the birds such as sparrows, wrens, towhees, kinglets, etc., but usually this sort of grouping does not hold together as long or as compactly as those mentioned above.

Individual movements:

Noticeable for their independence are such birds as the hawks, grouse, pheasant, creepers, mourning doves, band-tailed pigeons, flycatchers, jays, Lincoln's sparrows, and particularly the hermit thrush. Others that are a little less individualistic are the wrens, towhees, and nuthatches. All of these species move about the area at their own discretion, wandering within more narrow limits than the majority of birds and travelling through other groupings without heeding them in any way except for alarm calls in case of some approaching danger.

Effect of Climatic Factors on Movements

Wind:

As pointed out by Johnston (1943), wind is one of the largest factors influencing local movements of birds. As would be expected, activity is greatly reduced at times of moderately strong winds and almost completely curtailed in very heavy winds.

On this particular area the birds always sought the heaviest wooded sections when there was much wind blowing. These sections are most abundant on the mid-southern and lower southern margins of the hill, and the number of birds present here was always greater during windy days than mild days, when they would be more scattered about the hill. If a breeze would come up during a period of observation, it was noted that the avian population moved away from the wind until they came to a wind break of vegetation. Here they would quiet down until the breeze abated.

At times when exceptionally strong winds came up, the birds would very shortly cease almost all activity and seek shelter among the foliage of trees and bushes.

Rain:

Rain also has a decided quieting effect on the avifauna of the area. As rain would become heavy, the birds would suddenly become very quiet and inactive; but if the rain should let up for just a few minutes, activity would again continue. Also, as with wind, the effect was

to cause the animals to seek the densest growths of vegetation.

Temperature:

Less noticeable than wind or rain was the effect of changes in temperature. Change in temperature had little effect until it became quite extreme in one direction or the other; then the birds would take to places of shelter in either case.

In the summer, effects of temperature were brought out by the quiet intervals in activity during the hottest hours of the day. The first period was in the mid-morning, and the second period was in the early to mid-afternoon. At these times the woods sounded as if no animal life was present, and the slightest sound made by an outsider seemed out of place entirely. During the hottest days the mid-day activity of obtaining food was quite short, and it seemed that the birds would hunt cool places just as soon as they had secured enough food to satisfy them until evening.

Seasonal Changes in the Bird Population

Table 6 gives a fair idea of the birds present during the different times of the year, but it does not show the fluctuations that take place in the numbers of birds present at these seasons. From late autumn to late winter there is little fluctuation except in such cases as the

chestnut-backed chickadee when there will be a great influx for one or two months and then a decided decrease as they move on to other areas. Late in the summer the number of individuals in the entire population is quite high, and then again in the spring there is another increase of even greater proportions. These are most likely caused by the starting of the autumn and spring migrations of the summer and winter residents. In the early spring there is an increase in the numbers of warblers and vireos, and within two or three weeks the numbers will have greatly decreased. Then a little later in the spring these birds will increase again and remain fairly constant. As indicated by Williams (1936), this is probably due to the movement of the birds through the area on their way to more northerly breeding grounds in the early spring and then the arrival of those which will settle in this area a short time later. This is true not only of the warblers and vireos, but also of some of the sparrows, flycatchers, and the coast jay.

Seasonal Changes in Levels

It is common knowledge that different species of birds prefer to spend most of their time and carry on their normal activities at fairly well-defined vertical levels in the vegetation. On this study area it was found that this distribution of birds into certain ver-

tical levels tends to disappear after the leaves fall from the trees and other vegetation. No longer did the birds show a definite preference for these levels, but they moved through the area at all levels. Particularly was this true where there was a heavy layer of brush, etc. under the trees--as in the atypical area.

In the rather open woods the birds still showed some liking for the crowns of the trees, but elsewhere they had no regard for their former levels maintained while vegetation was in foliage. This sort of change in vertical levels of course did not show up among those species commonly found on or near the ground.

V

MAMMALS

Table seven is a list of the mammals noted on the area during the time of this study. With the exceptions of the sheep and horse, the order of listing and the scientific names are as given in The Mammals and Life Zones of Oregon by Vernon Bailey.

Although quite numerous, most of the mammals are not often seen because of their varied habits and general timidity. Since there are not many species of mammals in the list, each one will be discussed separately. All mammals except the horse occur in both the typical and atypical areas.

Odocoileus columbianus columbianus (Richardson)

Columbian black-tailed deer

Deer were first noted on the fourth of October in the west end of the atypical area. On this foggy morning two young does and one young buck--a spike--were seen eating leaves from willows. All three ran uphill after they discovered my presence about fifty feet from them. On the twenty-third of the month the head and neck of the spike were found covered with debris at the base of an oak about 400 feet north-east of the first location. There were no more signs of their presence until the first week in Janu-

Table 7. Mammals of the area.

Columbian black-tailed deer	<u>Odocoileus columbianus columbianus</u> (Richardson)
California jack rabbit	<u>Lepus californicus californicus</u> Gray
Douglas's ground squirrel	<u>Citellus douglasii</u> (Richardson)
Oregon flying squirrel	<u>Glaucomys sabrinus oregonensis</u> (Bachman)
Dusky-footed wood rat	<u>Neotoma fuscipes fuscipes</u> (Cooper Ms.) Baird
Ruddy deer mouse	<u>Peromyscus maniculatus rubidus</u> Osgood
Camas pocket gopher	<u>Thomomys bulbivorus</u> (Richardson)
Cascade red fox	<u>Vulpes fulvus cascaden-sis</u> Merriam
Pacific marten	<u>Martes caurina caurina</u> (Merriam)
California skunk	<u>Mephitis occidentalis occidentalis</u> Baird
Northwestern raccoon	<u>Procyon lotor pacifica</u> Merriam
Townsend's mole	<u>Scapanus townsendii</u> (Bachman)
Shrew	<u>Sorex</u> (sp)
Domestic sheep	<u>Ovis aries</u>
Domestic horse	<u>Equus caballus</u>

ary, when fresh tracks were found all over the hill. On the twenty-ninth of January another doe was seen as she ran west along the mid-slope of the hill, jumped a fence, and disappeared over the next ridge. Although tracks were abundant the rest of the winter, the deer were seldom seen but were sometimes heard racing away through the woods. With the coming of spring not even tracks were found with any degree of frequency.

These animals seemed to prefer this oak hill on the cool and foggy days of the winter. Every time they were scared out of the area they would head for the north slope of the hill and toward the firs beyond. Apparently they enjoyed browsing on the variety of shrubs and trees found in the atypical area and on the falling acorns of the oak woods. Evidently they had a liking for willow bark also, for in the spring it was noticed that several young willows had the bark peeled off and that teeth marks were present.

Lepus californicus californicus Gray

California jack rabbit

Only one record for the jack rabbit was obtained. This was on March the third when an adult rabbit ran from the willows at the south-center of the atypical area. It immediately went through the fence and headed downhill as fast as it could go.

Citellus douglasii (Richardson)

Douglas's ground squirrel

Abundant over the entire area, this squirrel prefers the lower slopes bounding the meadows. The most active period for these animals was in the late summer and early fall, at which time they could always be seen running about the hill and standing guard by their burrows. They were extremely fond of apples, and every day three or four of them could be scared from a particular tree at the south-east edge of the atypical area.

By the end of September and in early October the squirrels had all started their period of hibernation and were entirely absent from the area until the very end of February. At this time an occasional one was seen on the lower slopes. By the middle of March they were back in fair numbers and kept on the increase until the study was ended.

Glaucomys sabrinus oregonensis (Bachman)

Oregon flying squirrel

A male flying squirrel was caught in a live trap for mice on the twenty-fifth of August. When turned loose he climbed about twelve or fifteen feet up a small oak, jumped to another oak, and after making one more jump climbed down the trunk and tried to hide in the leaves and small brush. He was not at all well adapted to the

ground; he moved slowly and clumsily, and with much effort.

It was odd that a squirrel of this kind should have been caught in this situation, for not only was the trap on the ground, but it was in the open bed of a small creek. The mixture of molasses, peanut butter, and grain must have been very appealing to the animal.

Another squirrel was chased out of a large oak tree near the top of the hill on the twenty-fifth of October. This one went to the uppermost branches of the tree and then sailed about twenty feet, from point of take-off to point of landing, into another large oak which was nearby.

Neotoma fuscipes fuscipes (Cooper Ms.) Baird

Dusky-footed wood rat

There were five wood rat nests scattered among the dense willow growths of the atypical area. Live traps set near them showed that at least three were occupied last autumn. Except in the growths of vegetation along creeks on the lowest slopes of the hill, the nests were found only in the atypical area. Fig. 20 shows a typical nest built among the willows.

Active throughout the year, these rats exhibit a tendency to become a great deal less active in the mid-winter months.



Fig. 20. Wood rat's nest in
willow thicket.

Peromyscus maniculatus rubidus Osgood

Ruddy deer mouse

These mice (Figs. 21 and 22) prefer the margins of the soggy parts of the atypical area. Trapping from the first of August to the end of November revealed very few in the oak woods, and those that were trapped there were found along the creeks. All dens of these animals were found as burrows at the bases of growing trees, in ground covered with brush, or under logs. When released from traps, some of these mice proved to be very good climbers; they would run up the trunks of trees and onto limbs as skillfully as wood rats.

Home range:

Since this atypical area offered favorable conditions for such work, it was decided to study something of the home ranges of the mice in such a setting. Live traps, constructed from tin cans and ordinary snap traps, were set around the dense growths of willow, etc. in the atypical area and up into the oaks at each end of this area; see Figure 23 for locations. Trapping was carried on from the first of August until the end of November, the traps being set daily during the months of August and September and on week-ends thereafter. A total of thirty-seven animals were kept track of, and these were numbered by toe clipping (Fig. 24). Distances traveled were measured in a straight line from one trap to another.



Fig. 21. Deer mouse, note contrast in pelage of dorsal and ventral surfaces.



Fig. 22. Deer mouse in natural setting. Notice the blending of the mouse's coloration with the surroundings.

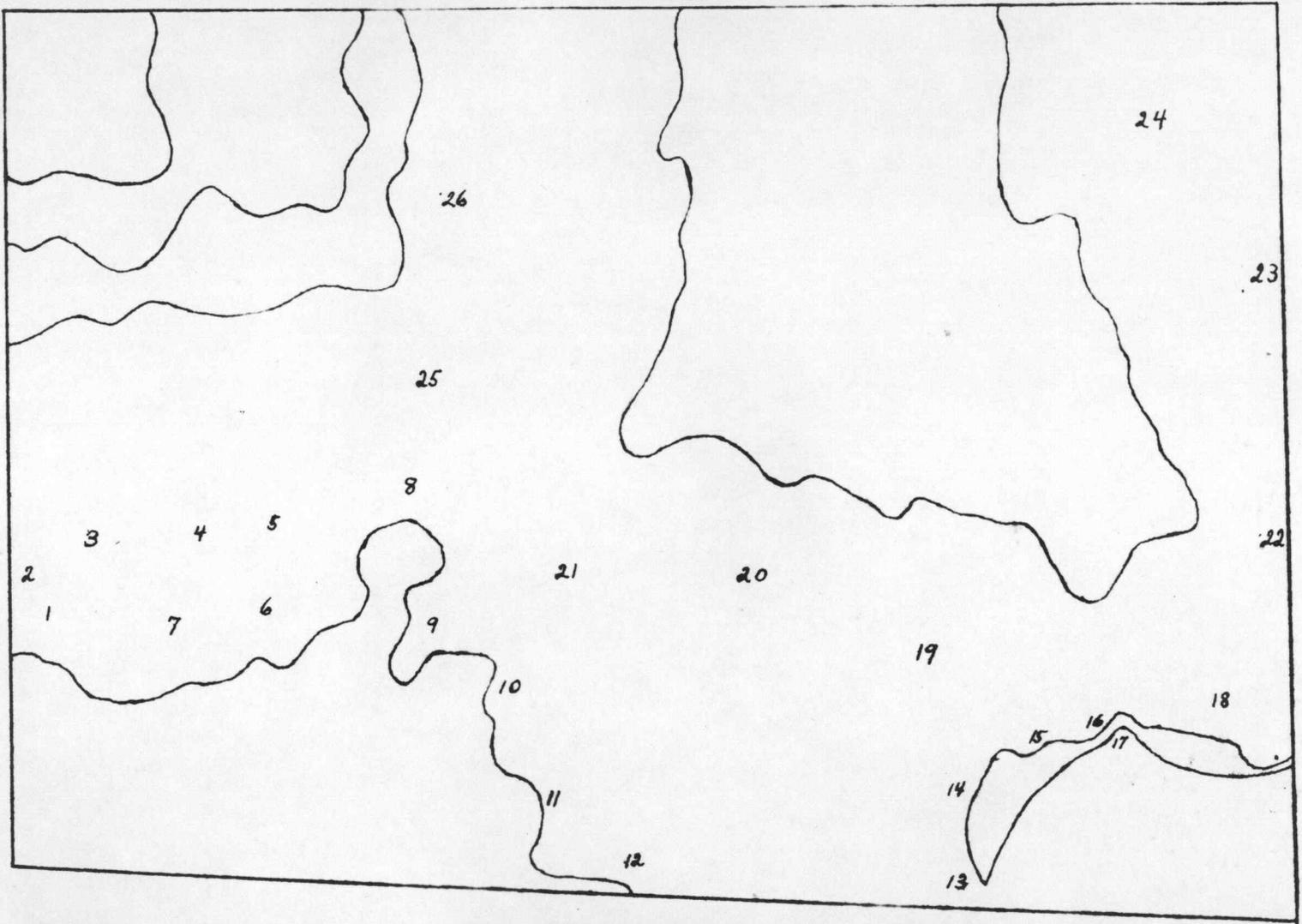
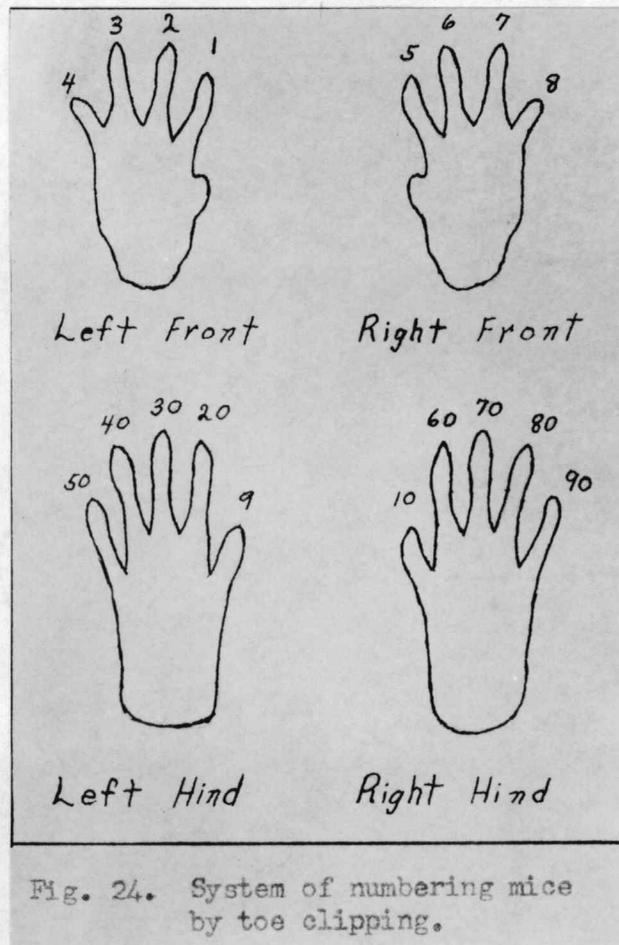


Fig. 23. Trap locations.

$\frac{7}{8}$ in. = 100 ft.



It was found by Blair (1942) that deer mice cover at the most a home range of 2.31 acres or (from his figure) a straight line distance of about 360 feet. His studies were made in a hardwood forest in Michigan. Here in the oak and willow growths it was found that these animals traveled a distance of 470 feet at the most and an overall average of 75.9 feet, based on eighty-one trappings of the eleven mice most frequently caught. The average is much smaller than the farthest distances, for sometimes the animals would be taken for two or more times in the same trap, thereby reducing the average. The average distance for females was 84.6 feet, and the average for the males was 70.8 feet. Table 8 gives a summary of the data on the eleven mice most frequently trapped.

Although there was overlapping of ranges among these mice, it was found that some animals would not tolerate others from another family range. On occasions when mice were carried from one location to another and liberated in the presence of a foreign animal, a fight almost always resulted. The contestants would become so engrossed in fighting that a person could walk about them and even grab their tails without their running off.

Trapping was stopped at the end of November because by now the weather had become quite cool and wet. The mice had become less active and did not travel nearly as far as in the summer and autumn. All their activities in-

Table 8. Data on eleven mice most frequently caught.

Number	Least distance (in feet)	Greatest distance (in feet)	Ave. distance (in feet)
Males			
2	0	225	87.5
9	55	55	55.0
12	0	185	24.5
17	0	185	88.0
19	0	60	38.3
20	0	195	60.5
21	0	350	142.3
7	7.85	179.3	70.8
Females			
5	0	190	126.0
7	0	100	44.4
10	0	470	138.0
24	0	30	30.0
4	0	197.5	84.5
Total ave.	5	185.9	75.9

dicated that they stayed in their dens as much as possible during the coldest and wettest months of the year. Those that were at all active were the very young adults of the population. A small amount of trapping this May resulted in no retaking of any marked animal and would seem to indicate that the mice live for only about a year in the natural situation.

Thomomys bulbivorus (Richardson)

Camas pocket gopher

Here is a mammal that is very abundant all over the entire hill. The only decided preference it shows is for the open grassland between the groves of trees. It is active throughout the year at both day and night hours. Fresh mounds can be found abundantly every morning (Fig. 25), and occasionally on warm sunny days the animal can be seen pushing dirt and wastes out of a freshly dug burrow.

With the coming of winter the gophers gradually burrow less on the lower slopes and more on the higher slopes where the ground is not quite so soggy. During the coldest and wettest months of winter gophers do very little extensive burrowing, but are content to remain rather inactive. Very much activity would be out of the question, for the water collects in the burrows and eventually forms shallow subterranean creeks that open into the surface creeks on the hill and the water holes in the atypical area.

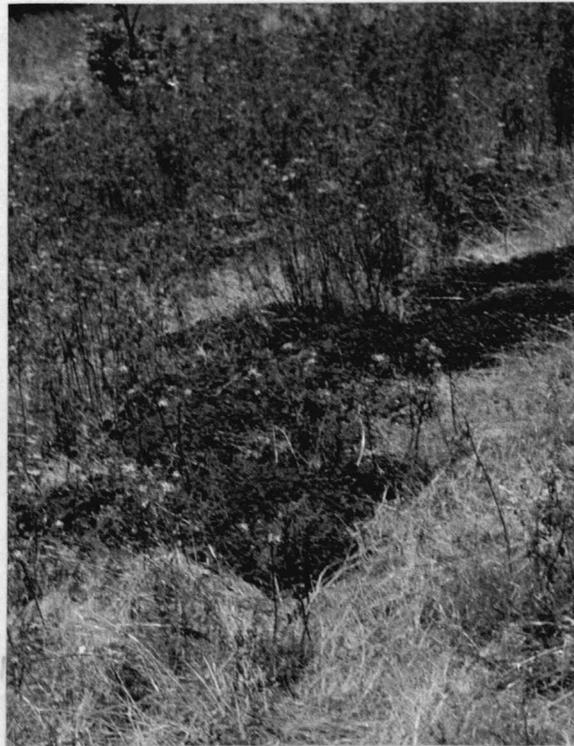


Fig. 25. Gopher mounds.

Gopher mounds provide the initial starting points for the various herbs in the spring. Here on these mounds spring flowers can be found growing quite well before any can be found on the hard-packed dirt surrounding them. By the end of autumn almost all of the space in the open sections has been plowed by the diggings of gophers and moles as they move up and down the slopes of the hill.

Vulpes fulvus cascadensis Merriam

Cascade red fox

Though rarely seen, there is at least one family of red foxes on the area as indicated by numerous droppings, tracks, and three dens. First positive proof of the animals' presence was secured in the spring (May) immediately prior to the beginning of this study. At this time a friend and I located a fox den (Fig. 26) in a thicket of a dense growth of poison oak, a short distance to the north of the west end of willow growths of the atypical area. Pups could be heard inside the den, and upon opening it we found a total of seven fox pups about five weeks of age. Two of them, a male and a female, had died of suffocation in an attempt to get into the extreme back end of the burrow while it was being excavated. Of the seven, four were females and three were males. Figure 27 shows one of the pups.

There is some doubt as to whether these foxes are of



Fig. 26. Fox den under poison oak.



Fig. 27. Fox pup, about five weeks old.

the true Cascade variety or are products of a group of eastern red foxes that were liberated in the Willamette Valley some years ago. After comparing the descriptions and habits of the two varieties, it seems possible that the particular individuals on this area may be the result of interbreeding of the two forms.

In general these foxes are of the Cascade coloration, yet they are not straw-colored enough to fit this form perfectly. The habit of coming down so close to the valley floor and the fact that they dig an extensive burrow--unlike the Cascade fox--would indicate that they were of the eastern variety.

In and about the den were found parts of numerous Douglas's ground squirrels, a turkey wing and leg, rabbit legs, and some bird feathers. Hamilton (1933) finds that foxes of New York and New England consume very few squirrels (2.9%), but here the ground squirrels made up the major portion of the meat eaten by the foxes; probably because the den was located near a slope of extensive squirrel diggings.

Adult animals were seen during the winter and in the early spring, and numerous tracks were found when the ground was covered with snow. Then, in the third week of May of this year, a fox pup was seen sitting at the entrance to another den under a maple tree about 400 yards to the east and slightly south of the first den. Upon inves-

tigation it was discovered that there were three openings to the burrow, each about seven feet apart. North of this den about seventy-five feet was the opening to still another much smaller burrow. Scattered about these two dens were the remains of ground squirrels, gophers, and chickens.

Martes caurina caurina (Merriam)

Pacific marten

Probably an occasional visitor to the area, the marten was seen the first time, on November fifteenth, running along low willow limbs and alder logs at the west end of the atypical area. After being discovered, it soon beat a hasty retreat into the densest growth handy and disappeared from view. The next indication of the animal was a clear set of tracks in the snow which led to a den in the base of a large oak tree near the top center of the hill. Inside the opening, from which emanated a strong musky odor, were the remains of a varied thrush. This was on the twenty-ninth of January, and the next time a marten was seen was on the fifteenth of March. This time the animal was in the south-center of the willow growths of the atypical area and headed out to the north of it. The specimen in this case appeared to be somewhat smaller than the first one seen and was much lighter in color, almost a yellow-brown.

Mephitis occidentalis occidentalis Baird

California skunk

When the study was first begun, a piece of skin and the front foot of a striped skunk were found near an old maple log in the atypical area. For the rest of the summer and autumn the only indication of skunk was the odor at various places on the hill and a burrow that was of about the dimensions of a skunk's. Not until the first day of April was an actual animal seen. While wandering about near the top and east of center of the hill, I came upon a bent-over oak that contained a hollow trunk (Fig. 28). Stooping over to investigate, I put my face into the long opening and found myself looking into the face of a large striped skunk. After a bit of coaxing and probing, the animal finally came out of the hollow trunk and ran down the gully, up the next rise, and down the other side to a burrow. During the entire chase there were only three times when the irked animal took the defensive posture, (Fig. 29) and no attempt was made at using the effective weapon it possessed. Only a moderate amount of odor was noticed during the action.

Procyon lotor pacifica Merriam

Northwestern raccoon

No raccoon was ever seen on the study area during the



Fig. 28. Temporary skunk den.



Fig. 29. Striped skunk taking defensive stand.

entire ten months spent observing. But in the winter there were abundant tracks in the mud and snow in the typical and particularly the atypical areas. Tracks along the creeks were noted until the end of May, when observations were stopped. Attempts at locating raccoon dens were of no avail, and it may be that these animals are frequent visitors to the area from the thick growths of conifers and brush to the north of the area.

Scapanus townsendii (Bachman)

Townsend's mole

Like the gopher, the moles are quite widespread through both typical and atypical areas. But unlike the gopher the mole prefers the somewhat damper locations. The mounds of the mole are most numerous in the late winter and early spring of the year. At these times they can be seen everywhere scattered over the moist ground. As with the gopher, the mole moves toward the top of the hill after the ground becomes quite wet. As the upper slopes of the hill start to get dry in the spring and early summer, the mole workings become fewer in number here and increase considerably in number in the damp and soggy parts of the atypical area. It was from one of the tunnels in this soggy ground that a mole was trapped for identification purposes (Fig. 30).

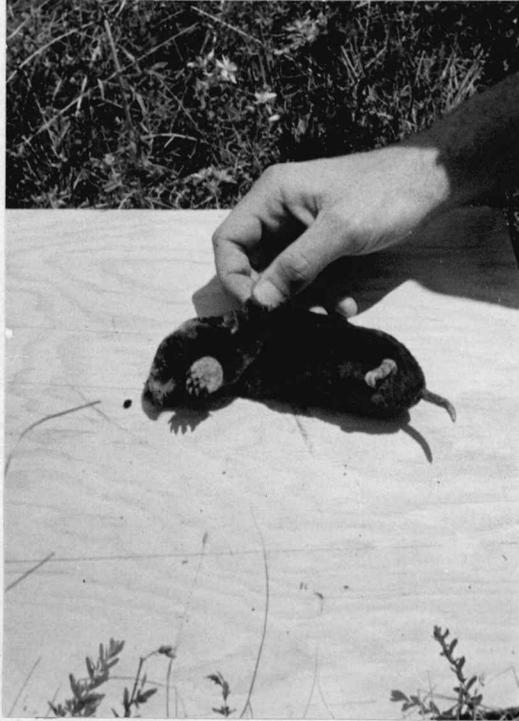


Fig. 30. Townsend's mole.

Sorex (species)

Shrew

In all locations the small runways and holes of the shrew were seen throughout the year, but all attempts to capture one for positive identification were fruitless. From the fleeting views of several of them as they scurried about through the grass and a short look at one that a boy had in a bottle it may be assumed that they are either Palmer's or Trowbridge's shrews.

Ovis aries

Domestic sheep

One of the greatest factors affecting the plant life of the area is the grazing of the flock of sheep on the hill. In all there are about one-hundred to one-hundred and fifty sheep being grazed on the various parts of the hill during the entire year.

From late fall to early spring the sheep are kept on the western end of the hill, and from early spring to fall they are kept on the central and east portions of the hill. Undoubtedly the constant trampling of the grass and soil and the removal of much vegetation affects the small mammalian and reptilian populations of the area. Burrows of animals are trampled closed, hiding places are torn up and destroyed, and in general the cover is altered as soon as the sheep are put into one of the areas. When the sheep

were run onto the center section this spring, the grass was eighteen to twenty-four inches high, and within five or six days the grass was eaten and trampled down to about eight to twelve inches in height.

Equus caballus

Domestic horse

There are only six horses on the area, and they are confined to the lower slopes of the hill. The farthest up the hill they are able to get is to the fence at the south boundary of the atypical area. Even with so few horses grazing in the fields, there is a very noticeable difference in the height and type of grasses and other herbs between the section where the animals are kept and the sections where they cannot go. On the horses' side of the fence the grass is extremely short and there are practically no flowers of any sort, while on the other side of the fence the grass is tall and there are many and varied kinds of wild flowers.

VI

SUMMARY AND CONCLUSIONS

Ten months, from August, 1942, to May, 1943, were spent studying the effects on plants and vertebrate animals caused by the one factor of water collecting on a benchland in the midst of a typical oak woodland.

A listing of the dominant plants of both areas shows that water greatly alters the woodland by giving suitable conditions for the influx of many forms not usually found in an oak woodland. Among the trees and shrubs there are thick growths of willow, alder, ash, maple, ninebark, and hawthorn. Among the herbs the sedges, hedge nettle, geranium, water buttercup, miner's lettuce, etc. are extremely abundant. Such a change in the vegetation introduces a very different type of habitat for the animals.

The climate is given considerable consideration and the physiography, geology, and drainage are also discussed.

Two forms of amphibia and five of reptiles were noted. Triturus granulatus is the only amphibian found in the atypical area that is not found in the typical, and all of the reptiles are found in both areas. Some phases of the life history of Triturus were investigated.

Of the sixty-three species of birds recorded, only seven were noted in the atypical area that were never no-

ted in the typical, and there were five species that were recorded only in the typical area. It was noted that birds were inclined to concentrate in the atypical area and remain more dispersed in the typical. Bird movements and factors affecting movements were studied in some detail.

Of the fifteen mammals on the area only the horses were never noted in the atypical area, and this was so because they were fenced in the lower meadows. The only mammal studied closely was the ruddy deer mouse. Home range was found to be a little larger than was previously thought to be the case, the animals ranging over an average distance of about 80 feet in a straight line and an extreme distance of 470 feet.

From all observations it may be concluded that such an atypical setting in the oak woodland serves to concentrate the animals that are already present and occasionally cause the influx of a species foreign to the region. It offers an abundance of food in a small space and also affords very good protection in most instances.

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