AN ABSTRACT OF THE THESIS OF

Carl Robert Eklund for the M.S. in Fish & Game Mgt.
(Name) (Degree) (Major)

Date Thesis presented September 1937

Title Ecological and Mortality Factors Affecting the Nesting Stage of the Chinese Pheasant, Phasianus torquatus, Gmelin, in the Willamette Valley, Oregon

Redacted for Privacy

Abstract Approved:
(Major Professor)

Recession of the pheasant population in the Willamette Valley is a problem of major importance to the game manager. In order to determine the factors affecting the Chinese pheasant in the Willamette Valley, two phases of their life history were intensely studied in the spring and summer of 1937. These were the mortality and ecological factors affecting this bird during the nesting season.

Study was made of 145 nests distributed in Benton, Linn, and Polk counties, Oregon. Boy Scouts, 4-H Club members, farmers, and College farm employees cooperated on the project, in conjunction with the Oregon Research Unit. Each nest was observed sufficiently to determine its finality, whether successful, destroyed by predators or biotic operations, or other causes.

The significance of this study pointed out the following facts:

1. More nests were destroyed than actually completed.

2. Greatest nest mortality was found in habitats outside of cultivated fields.

3. Skunks are the only animal predators which may merit control during nesting seasons.

4. Temperature and humidity are probably not limiting factors.

5. Rainfall is an important variable effective factor in mortality to juvenile pheasants, but probably does not cause nest abandonment except with flooding.

6. Shade is probably not a limiting factor in nest distribution.

7. Type of soil is a basic factor in nest distribution.

8. Preference not shown for hilly or level ground within the same habitat.

9. Edges of fields not always preferred for nesting.

10. Water and graveled roads are not limiting factors in nest distribution.

11. Flooding in the early stage of the nesting season probably does not result in abandonment of the area, but does cause later nesting.

12. Farmlands, preferably cultivated lands, are best suited for pheasant nesting, while timber and large wood lots are limiting factors in nest distribution.

13. Normal agricultural operations are not limiting factors to pheasant nesting.

Successful hatches occurred in 44.83 per cent or 65 nests; 55.12 per cent or 80 nests were either destroyed or abandoned. The following factors contributed to nest mortality:

Haying - 42 nests or 28.96%
Nearby disturbance - 8 nests or 5.52%
Skunk - 8 nests or 5.52%
Unknown - 5 nests or 3.44%
Eggs taken from nest by man - 4 nests or 2.76%
Plowing - 3 nests or 2.07%
Flooding - 2 nests or 1.38%
Quail - 2 nests or 1.38%
Crow - 2 nests or 1.38%
Turkey buzzard - 1 nest or .69% (circumstantial evidence)
Turkey - 1 nest or .69%
Cow - 1 nest or .69%
Small carnivore - 1 nest or .69%
(based on 145 nests)

Ninety-five nests were found in hay and grain fields--42 or 44.2% of these were destroyed by haying. Fifty nests were found outside of the hay and grain field habitat--35 or 70% of these were destroyed by causes other than haying and cultivation. Three additional nests were destroyed through plowing.

The following ecological factors affected nest distribution:

Hayfield - 90 nests or 62.10%
Fencerow - 12 nests or 7.27%
Roadside - 11 nests or 7.59%
Unused field - 8 nests or 5.51%
Orchards - 7 nests or 4.82%
Pastures - 5 nests or 3.44%
Grainfield - 5 nests or 3.44%
Deciduous wood lot - 3 nests or 2.07%
Railroad - 2 nests or 1.38%
Ditch bank - 2 nests or 1.38%

27 nests or 18.6% located on hilly land.
118 nests or 81.3% located on level land.
15 nests located on land subject to flooding.
15 nests or 9.33% completely shaded.
122 nests or 84% partially shaded.
8 nests or 5.51% had no shade.
7 hens killed by mower while setting on nests.
10 hens crippled by mower while setting on nests.

ECOLOGICAL AND MORTALITY FACTORS AFFECTING THE NESTING STAGE OF THE CHINESE PHEASANT, *Phasianus torquatus* Gmelin, IN THE WILLAMETTE VALLEY, OREGON

by

CARL ROBERT EKLUND

A THESIS

submitted to the

OREGON STATE COLLEGE

in partial fulfillment of
the requirements for the
degree of

MASTER OF SCIENCE

September 1937

APPROVED:

Redacted for Privacy

Professor of Fish and Game Management

In Charge of Major and Department

Redacted for Privacy

Chairman of School Graduate Committee

Redacted for Privacy

Chairman of College Graduate Council

ACKNOWLEDGMENTS

The author is especially indebted to Professor R. E. Dimick, Department of Fish and Game Management, for his criticisms, suggestions, and hearty cooperation, and to Mr. Arthur S. Einarsen, Oregon Research Unit, United States Biological Survey, who has made it possible for the writer to carry on these studies.

Funds and facilities for this investigation were provided by the Oregon Research Unit, a cooperative undertaking of the American Wildlife Institute, Oregon State Game Commission, Oregon State Agricultural Experiment Station, and the United States Biological Survey.

Professor W. E. Lawrence, Botany Department, is deserving of special thanks for his interest and suggestions.

The writer also wishes to thank the farmers, 4-H Club members, and college farm employees who cooperated in conducting these investigations.

TABLE OF CONTENTS

	Page
INTRODUCTION	1
NEST MORTALITY	3
Nest Destruction and Abandonment	4
Factors Causing Nest Losses	5
CLIMATIC ECOLOGICAL FACTORS	11
Temperature	11
Rainfall	12
Humidity	14
Exposure to Sun or Shade	14
EDAPHIC ECOLOGICAL FACTORS	15
Nests in Relation to Soil Types	15
PHYSIOGRAPHIC ECOLOGICAL FACTORS	17
Nests in Relation to Land Topography	17
Nests in Relation to Edges of Fields	18
Nests in Relation to Escape Cover	19
Nearness to Water	21
Nests in Relation to Graveled Roads	21
Nests Subjected to Spring Floods	23
Nest Distribution	24
BIOTIC ECOLOGICAL FACTORS	26
Plant Growth	26
Agricultural Work	28
CONCLUSION	34
BIBLIOGRAPHY	41

LIST OF TABLES

TABLE		Page
1.	Giving Tabulation of Nests Observed	5
2.	Showing Percentage of Nest Destruction Based on 80 Losses out of 145 Nests	9
3.	Showing Losses of Nests and the Cause Based on 80 Losses out of 145 Nests	10
4.	Giving Number of Nests Having Complete, Partial, and No Shade	15
5.	Giving Number of Nests Found on Various Soil Types in Benton and Linn Counties Based on 141 Nests	17
6.	Giving Location of Pheasant Nests in Relation to Edges	20
7.	Showing Nest Distance to Water	22
8.	Giving Nest Distances to Graveled Roads Either Automobile or Railroad	23
9.	Nest Distribution Showing Number and Per Cent Successful and Unsuccessful	26
10.	Giving Kinds of Nest Cover and the Number and Percentage of Nests in Each Type	28
11.	Showing Individual History of Each Nest Observed	30-33

LIST OF FIGURES

FIGURE	Page
1. Eggs Sucked by Skunk	36
2. Skunk Caught Robbing Nest Number 82	36
3-5. Flooded Fields of Observation Area During April 1937 Floods	37
6-8. Normal Condition of Fields Shown on Page 37, in August 1937	38
9. Habitat of Nest Number 2	39
10. Eggs and Cover of Nest Number 2	39
11. Hen Returned to Nest After Removal of Cover	40
12. Site of Nest Number 5 Abandoned Because of Flood	40

ECOLOGICAL AND MORTALITY FACTORS AFFECTING THE NESTING STAGE OF THE CHINESE PHEASANT, *Phasianus torquatus* Gmelin, IN THE WILLAMETTE VALLEY, OREGON

INTRODUCTION

The investigation to determine the effect of ecological and mortality factors on the nesting stage of the Chinese pheasant in the Willamette Valley, Oregon, was carried on in conjunction with small game bird studies conducted by the Oregon Wildlife Research Unit. Conclusions were based on nest observations in Benton, Linn, and Polk counties, Oregon, from April through August, 1937.

The type of land on which the investigation was carried on is mainly farm land, in the humid transition life zone. Most of the farm land was planted to hay and grain, and much of it consisted of orchards. The farms of the area are interspersed by deciduous and coniferous growths, mainly along the river bottoms. The study in Benton county did not extend into the foothills of the coast mountain range.

Conservationists have recognized the gradual recession of the pheasant population in the Willamette Valley for approximately the past twenty years, and it has created a considerable problem to the student of game management. Many theories have been advanced as to the probable cause of this recession. Excessive hunting, disease, predators, and "clean farming" are brought forth as some of the possible causes. Others think that possibly the genuine Chinese ring-necked, _Phasianus torquatus_ Gmelin, which was introduced into the United States from Asia, has been crossed with the true English pheasant, _Phasianus colchicus_ Linnaeus, to such an extent that a less fertile strain has been developed. The English pheasant originally came from Asia Minor, and it too has been liberally introduced into the United States until it is doubtful whether many birds exist in the wild that are an absolute true strain of either species. _Phasianus torquatus_ Gmelin was the species originally introduced into Oregon by Judge Denny in 1881.

This work is not an attempt to solve the whole problem but rather a step in determining whether ecological and mortality nesting conditions are important limiting factors in the recession of the pheasant population. The solution lies in scientific research. Similar work, in addition to other phases of the problem, should be carried on over a period of several years.

Previous nest mortality studies have been carried on by English (3), 1932, in southern Michigan, in conjunction with the Williamston Game Management project, and by Leopold (7), 1936, in southern Wisconsin. The latter's investigations were made only on hayfield nests. Obviously their conclusions could not be applied to the Willamette

Valley because of the varying ecological conditions existing in Oregon as compared with Michigan and Wisconsin. Varying factors such as temperature, greater rainfall, and farm practices could all tend to cause a difference in production. Therefore, in this type of study, investigations are necessary for every distinct geographical location.

The Oregon Wildlife Research Unit inaugurated a cooperative arrangement with Boy Scouts and 4-H Clubs in Benton county, in which each boy or girl was given fifty cents for every game bird nest reported. In addition to these, many nests were located by contacting the farmers in Benton, Linn, and Polk counties, Oregon. Actual observation was made of every nest, except in cases where they were totally destroyed.

NEST MORTALITY

Natural reproduction is the only practical method of building up the pheasant population for sustained hunting. Artificially reared birds are frequently necessary to restock depleted areas, but the biggest supply must come from reproduction in the wild. Thus, we realize that nest mortality becomes an important problem, and if practical means can be devised whereby nest losses can be reduced, the natural reproduction will be aided considerably. Nest and juvenile mortality might easily be the most important critical periods in the life history of the pheasant. The nest mortality study was based on observations of 145 nests, and of these the hen actually began setting on 114 nests. The remaining 31 were either abandoned or destroyed before the hen began setting. The 114 nests averaged 10.45 eggs per clutch. The largest clutch contained 22 eggs and the smallest only 3. Hens were observed setting on 12 nests in August, and this may indicate a second brood is reared in the same season, although these may have been renests from previously destroyed nests. No data were gathered as to authenticity of second broods, and future work should be done on this problem.

Nest Destruction and Abandonment

Successful hatches occurred with 65 nests, from which a total of 641 pheasants were hatched for an average of 9.86 chicks per hatched out nest. A nest was considered successful if any of the eggs hatched out and the hen took the brood away from the nest. Unsuccessful nests numbered 80 or 55.17 per cent of the total. English's (3) two year study of 193 nests in Michigan showed a 65.2 per cent mortality, while Leopold's (7) 1936 observations in Wisconsin revealed a 57 per cent mortality on 42 hayfield nests. Heavy June rains in the Willamette Valley delayed mowing for almost two weeks, and this allowed many nests to hatch out which might otherwise have been destroyed by mowing.

Table 1 - Giving Tabulation of Nests Observed

Number of nests	145
Successful nests:	
Number	65
Per cent	44.83
Unsuccessful nests:	
Number	80
Per cent	55.17

Factors Causing Nest Losses

Haying was the greatest single factor in nesting losses, with the destruction of 45 nests. These were either destroyed by the mower, stepped on by horses, or smashed with a tractor, combine, or binding machine. From observation of nests, it appeared that the majority were destroyed while the hen was still setting. Seven hens were killed in attempting to get away from the machinery, and 10 were crippled, such as having one leg cut off or a wing cut. This shows a 15.5 per cent fatality, and 22.2 per cent crippling loss of nesting females in hay and grain fields. Only 5 nests out of the 45 were returned to by the hen after removal of cover by mowing, and 4 of these were brought to successful hatches (Figure 11).

The validity of nest mortality studies might be questioned upon the grounds that a normal study is not obtained, because hay and grain field nests are easiest to find--other, and perhaps more numerous nests are in habitats too difficult to find. Although haying was the greatest single factor in nest mortality, the surprising fact in this study was that the heaviest percentage of losses was found in nests outside of hay and grain fields as a result of a combination of factors not including mowing. Cultivation and mowing of hay and grain fields resulted in 45 losses or 47.5 per cent mortality out of 95 nests found in these habitats. The remaining 50 nests which were outside of the hay and grain fields suffered 35 losses or a 70 per cent mortality. These mortality figures were undoubtedly influenced, in part, by late cuttings resulting from heavy June rains, and conditions observed may not represent a normal loss from farm activities.

Nearby disturbances caused abandonment of 8 nests. One of these nests (Figure 9) was 8 feet from a railroad track, 35 feet from a Corvallis residential house, and directly back of the college tennis courts. Moving trains, people walking near the nest, and a cow grazing nearby probably caused abandonment on the 18th day of setting. Workers in fields adjoining fencerows and roadsides caused nest abandonment in several cases.

Skunks destroyed a surprisingly large number of nests. Losses of 8 pheasant and many quail nests were credited to this otherwise beneficial animal. Twenty-four pheasant and quail nests were found on the C. L. Logsdon farm north of Corvallis, and 9 of this number were destroyed by skunks. In two of the cases, the skunks were caught in steel traps at the nests (Figure 2). These nests were under frequent observation and when several eggs were found sucked, a trap was set, and the skunk caught as it returned the following night to finish the remaining eggs. A den with 4 young skunks was found 30 feet from the site of a previously destroyed nest, on the Guerber property north of Corvallis, Oregon. (Nest number 82, Table 11). The skunk has a rather characteristic manner of sucking an egg by breaking a hole in the shell at the side or end (Figure 1). With the case of a smaller and thinner quail's egg, the shell is sometimes crushed.

Man took the eggs from 4 nests before the hatch was completed. State Game Farm employees took 2 of these nests for the purpose of obtaining wild birds for new breeding stock. Eggs were taken from another nest and set under a bantam hen, and in the case of the fourth nest the eggs were eaten by man.

Plowing destroyed 3 nests, and flooding was the cause of 2 nests being abandoned (Figure 12). Quail, laying eggs in 2 pheasant nests, accounted for their abandonment. In one of these, the pheasant hen had laid 10 eggs and the Bobwhite quail had followed with 5, after which the nest was abandoned. In the case of the second nest only 1 pheasant egg was laid, followed by 12 Bobwhite quail eggs, after which the nest was destroyed by mowing.

Crows do not seem to be as important a factor in nest mortality in the Willamette Valley as in other sections of the country. This is probably due to fewer numbers present during the nesting season of the pheasant. One nest loss was definitely attributed to a crow, in that the bird was seen pecking at the egg after having removed it from the nest and brought it to the top of an alfalfa shock. (Nest number 73, Table 11). Turkey buzzards may be a more important factor than the crow in nest losses in this section. Many of these vultures were observed cruising over the fields. Only one nest loss was attributed to this bird (nest number 114, Table 11), but the writer believes that the percentage of loss is probably greater than was found. In this one instance the hen was setting on an entirely exposed nest in an unused field. Turkey buzzards were attracted nearby to this site by dead sheep, on the afternoon previous to the destruction of the nest. The birds were seen hovering over the nest, and the morning following, the eggs were found eaten. The hen evidently had not been harmed. This was not absolutely conclusive evidence, but everything pointed to this bird as being the probable predator.

A small mammal killed a hen while the bird was setting on her nest (nest number 10, Table 11). The bird had been released by the State Game Commission, and bore band number 16403 on its leg. All but the legs and feathers had been eaten. Small teeth marks were found in the legs, and the predator may have been a cat, weasel, or small dog. The eggs were not eaten, which would eliminate the skunk as a possible predator.

Turkeys disturbed one setting hen until she abandoned her nest. Another nest was destroyed when stepped on by a cow. Cause of abandonment of 5 nests was unknown.

Table 2 - Showing Percentage of Nest Destruction Based on 80 Losses out of 145 Nests

Causes	Per cent
Haying	28.96
Nearby disturbances	5.52
Skunk	5.52
Eggs taken from nest by man	2.76
Plowing	2.07
Flooding	1.38
Quail	1.38
Crow	1.38
Turkey buzzard	.69
Turkey	.69
Cow	.69
Small canine	.69
Unknown	3.44
Total	55.17
Total undestroyed	44.83
	100.00

Table 3 - Showing Losses of Nests and the Cause
Based on 80 Losses out of 145 Nests

Causes of loss	Number of nests not successful	Per cent of nests not successful
Man:		
Haying (includes threshing)	42	28.96
Nearby disturbances	8	5.52
Eggs taken by man	4	2.76
Plowing	3	2.07
Predator:		
Skunk	8	5.52
Crow	2	1.38
Small canine (dog, weasel, or cat)	1	.69
Turkey buzzard	1	.69
Miscellaneous:		
Flooding	2	1.38
Quail	2	1.38
Turkey	1	.69
Cow	1	.69
Unknown	5	3.44
Total	80	55.17
Total undestroyed nests	65	44.83
Total number nests	145	100.00

Leopold (7) found a 57 per cent mortality on 42 nests, and English (3) showed a 35.2 per cent loss on 193 nests (2 years) as a result of haying.

Burning has often been credited as being an important decimating factor in nesting success. Rigid state fire laws, in Oregon, practically prohibit burning during the nesting season of the Chinese pheasant, with the result that not a single loss could be attributed to this cause. Very little burning was done by the farmers in the Willamette Valley at this time, and interviews with state highway maintenance crews disclosed the fact they also had done little roadside burning. In these few cases of burning, there were no nest losses to their knowledge. Another interesting fact was that the two men employed by the state highway department for the purpose of mowing grass and weeds along the main highways in Benton, Linn, and Polk counties cut over only one pheasant nest. In this instance the hen went back to the nest and successfully completed the hatch (nest number 26, Table 11).

CLIMATIC ECOLOGICAL FACTORS

Temperature

Some work has been done on meteorological factors as affecting pheasant hatchability. English (3) reported that in Michigan a domestic hen setting on 26 pheasant eggs was exposed to temperatures ranging from 21° to 76° Fahrenheit. Fourteen of the eggs were fertile and 13 of these hatched. This would indicate that rather extreme variances in air temperatures do not have an effect on the hatchability. This investigator carried on an experiment in which 500 eggs were divided into 16 lots and exposed for 15 days to temperatures of 10°, 16°, 31°, 68°, and 85° Fahrenheit. Three hundred and sixty of these eggs hatched, and 85 of the eggs were infertile. This also indicates that temperature on eggs, before incubation, played a minor role in hatchability.

Temperature in the Willamette Valley during the 1937 nesting season was slightly above normal. Readings at the Corvallis Weather Bureau during the period of these studies showed a mean temperature of 58.0° Fahrenheit, a departure of +2.6° from normal. The highest recording was 94° Fahrenheit, and the lowest was 40°. June had a high of 94°, with the lowest recording at 46° Fahrenheit. The monthly mean temperature for June was 64°, a departure of +3.2° from normal. July showed a high temperature of 90° and a low at 48° Fahrenheit. August had a high of 93° and a low at 43° Fahrenheit. June 2 showed the greatest daily range of temperature with a maximum of 92° and a minimum of 51° Fahrenheit.

Rainfall

Undoubtedly one of the greatest factors in mortality to pheasant chicks is the effects of rainfall. Theories have been advanced, claiming heavy precipitations favor good game crops (4), but field observations in the Willamette Valley do not bear this out. Juvenile birds require a high protein food content, such as is supplied by insects. Dalke (1) found that in Michigan 87.3 per cent of the food of one week old pheasant chicks consisted of insects. Research work in Oregon (2) has shown that grasshoppers (Orthoptera) are a main item of food for adult pheasants in the summer. Generally speaking the grasshopper increases in numbers with dry weather and development is retarded by cold spring rains. Heavy rains would therefore hold down the supply and cause insects to become less active, which would make them less available to the pheasant chick for food.

This past spring and summer were not normal ones for rainfall, in that April showed an increase of +4.76 inches of rainfall from normal, in the Western Division of the state, when 8.71 inches fell. This caused many floods on farm and pasture lands in the Willamette Valley, and probably delayed the time of successful nesting on these areas.

May was moderately dry. The Corvallis Weather Bureau showed a total of 3.22 inches of rainfall for this section.

June was the wettest since records were begun in 1890 (11). About two and two-thirds times the normal amount of rainfall, for June, fell during this month. The monthly average for the Western Division was 5.54 inches, a departure of +3.70 inches from normal. The Corvallis station registered 5.56 inches. Most of this fell during a fourteen day period from the June 9 to the 23. Inasmuch as this came during a period of heavy nesting, it may have caused some nest abandonment, in addition to a heavy mortality to the chicks through chilling and reduction of available food. Nest abandonment from rains, other than through flooding, is probably slight, however.

July and August were both very dry months. Only 0.16 inches of rainfall fell during July, and August showed only traces of moisture.

Humidity

Experiments were not carried on to determine relative humidity in the nests of pheasants in the wild, due to the lack of equipment and possibility of nest abandonment. In the artificial incubators at the Oregon State Game Farm, near Corvallis, a relative humidity of 50 per cent is used constantly. This sometimes increases to 100 per cent when the chicks begin hatching. Humidity records at the local weather bureau show an average relative humidity of 52.4 per cent for May, 55.6 per cent for June, and 48.3 per cent during July. Ground humidity during these periods would vary somewhat from these figures, but this was never determined. Assuming the relative humidity used in artificial incubation is somewhat near correct, we might conclude that humidity did not affect nesting in the Willamette Valley this past summer.

Exposure to Sun or Shade

It is difficult to tell exactly the part which sun and shade play in the selection of nesting sites. Eighty-four per cent of the 145 nests were partially shaded, but the selection of the site was probably due to the type of cover, and the shade was incidental. A combination of sun, shade, and good cover is probably the ideal habitat. Five nests were found at the bases of tree trunks having diameters varying from 10 to 15 inches, and four of these nests were on the west side of the trunks. The fifth was on the south side of the trunk. This may indicate the hen favors the sun somewhat. Entire exposure to sun was found in the cases of eight nests and only two of these were successfully hatched. Fifteen nests were entirely shaded at all hours of the day and seven of these were successful hatches.

Table 4 - Giving Number of Nests Having Complete, Partial, and No Shade

Completely shaded:	
Number of nests	15
Per cent	10.34
Partially shaded:	
Number of nests	122
Per cent	84.14
No shade:	
Number of nests	8
Per cent	5.52

EDAPHIC ECOLOGICAL FACTORS

Nests in Relation to Soil Types

Soil of 14 different types supported 91 nests in Benton county (8). Fifty nests were found on eleven soil types in Linn county (9). Willamette silt loam supported 29 nests in Benton county, and these were located in 20 different vegetative habitats, i.e., oats and vetch, alfalfa, clover, orchard grass, weeds, thistle, rye, wheat, and various other combinations. A big percentage of the soil in Benton county is Willamette silt loam and Dayton silt loam. In Linn county 19 nests were located on the gravelly subsoil phase of Dayton silt loam. Seventy-five per cent of the soil 12 miles east of the Willamette river in Linn county is of this type (9).

The Glaciation Hypothesis (6) has been mentioned as a possible limiting factor in the confinement of pheasants to certain soils. Under the hypothesis the thought was advanced that certain plants were limited to soil types, or the soil itself contained a substance such as lime or gravel, necessary to the welfare and breeding vigor of the bird. Different soils undoubtedly favor distinct floras, and with a rich soil such as Willamette silt loam, a better crop is produced than on most other soil types within this area, hence more food for the pheasants with the resultant increase in carrying capacity. The greatest variable effective factor to nest habitats is the type of vegetative cover, which in some instances may be the result of soil types and conditions. Many poor soils are suitable only for growing timber, and as timber is not the habitat of the pheasant the soil would be the basic limiting factor. Type of soil therefore would be a primary ecological factor in nest distribution.

Table 5 - Giving Number of Nests Found on Various Soil Types in Benton and Linn Counties Based on 141 Nests

	No. nests Benton Co.	No. nests Linn Co.
1. Willamette silt loam	29	8
2. Gravelly-subsoil phase of Dayton silt loam	--	19
3. Amity silty clay loam	18	--
4. Wapito silty clay loam	10	--
5. Carlton silty clay loam	8	--
6. Dayton silty clay loam	8	--
7. Friable phase of Melbourne clay loam	7	--
8. Amity silt loam	--	6
9. Dayton silt loam	--	5
10. Chehalis silty clay loam	1	4
11. Cove clay	2	2
12. Chehalis silt loam	--	3
13. Whiteson silty clay loam	2	--
14. Melbourne silty clay loam	2	--
15. Heavy phase of Chehalis silty clay loam	1	--
16. Grand Ronde silty clay loam	1	--
17. Olympic clay loam	1	--
18. Shallow phase of Olympic clay	1	--
19. Newberg sandy loam	--	1
20. Clackamas gravelly loam	--	1
21. Camas gravelly loam	--	1
Total	91	50

PHYSIOGRAPHIC ECOLOGICAL FACTORS

Nests in Relation to Land Topography

In the correlation of nest habitats to hilly and level land, it was found that 118 or 81.3 per cent of the nests were located on level ground, and 27 or 18.6 per cent of the nests were on hilly ground. The major proportion of farming land in the Willamette Valley area studied would be classed as level, and the ratio of nests to hilly and level land would correspond somewhat the same as the ratio of hilly to level land. Here again the site is probably chosen because of the cover type. It is generally recognized that pheasants show a partiality for swales, in that better protection is usually afforded by the provision of escape runways. In this survey, a swale was not classed as hilly, provided the surrounding ground was level. It was suspected that one hen changed the site of a previously flooded nest (Figure 12, nest number 5, Table 11) to that of higher and somewhat hillier ground (nest number 4, Table 11), but this was not definitely proven.

Nests in Relation to Edges of Fields

A study of nests in relation to distances to edges of fields is a difficult one because fields vary so greatly in size. Nests 75 feet from the edge of a large field would seem close in comparison with a small field in which the same distance might put the nest in the very center of the field. In order to get an accurate correlation, the fields would have to be all of the same size. Studying the same fields over a period of years might give some good information in relation to preference for edges. In this report, fences, roads, and natural boundaries such as creeks or changes in vegetative cover were considered as a field's edge.

Seventy-five nests were found within 100 feet of edges, 42 nests were 100 feet or over from the field's edge, and 25 were not classified according to edges, in that they were found in fencerows, ditch banks, or on railroad or roadside right-of-ways. A comparatively heavy nest concentration was found on the J. H. Swank property, east of Tangent, Oregon, in Linn county. In this case 11 nests were found in a 200-acre field, and the majority of these were in the center of the field well over 100 feet from the edges.

These records indicate the improbability of pheasants, in the Willamette Valley, preferring the edge or near edge of a field for nesting. Again the important factor is probably the cover protecting the hen from natural enemies, providing there is an ample food supply such as would be furnished by clover and grain fields. There may be an attraction for edges if the field itself is lacking in food because edges of fields usually support dense growths of weeds, wild berries, and seed and fruit producing bushes, if the farming has not been too "clean".

<u>Nests in Relation to Escape Cover</u>

Opinions may vary as to what is considered excellent, good, fair, and poor escape cover, in that it is more or less an arbitrary matter. Dense brush, and grassy, weedy, or brushy fencerows and swales were considered as excellent escape cover provided the nest was located in or within a few feet of such an area. A good stand of alfalfa, clover, wheat, or any other cultivated crop was considered in this study as good escape cover. Nests in open places having thin vegetative growth and not accessible to good cover affords little chance for escape from predators such as hawks and owls, and this was generally considered fair or poor escape cover. Using these generalizations concerning cover as a basis for the 145 nests observed, it was determined that 8 nests had poor escape cover. Only one was successful, whereas 13 successful hatches resulted from the 21 nests having excellent escape cover.

Table 6 - Giving Location of Pheasant Nests in Relation to Edges

Distances of nest, in feet, to edges	Number of nests
0	25
1-10	7
11-20	14
21-30	12
31-40	14
41-50	7
51-60	7
61-70	1
71-80	11
81-90	4
91-100	1
101-125	17
126-150	3
151-200	7
201-300	6
Over 300	9
Total	145

Nearness to Water

This ecological study of nest location in relation to nearness to water indicated that pheasant nesting sites are not limited to the close proximity of water. The daily cruising radius of the pheasant is estimated at from one-eighth to one-half mile (5) and 42 of the 145 nests were located one-half mile or over from the nearest water supply. Feces droppings of a setting hen are often found within 50 feet of the nest and this might indicate the daily cruising range of the setting hen is below the normal average. This offers more conclusive evidence that drinking water is not required. Succulent foods and dew probably supply a sufficient water content.

In the course of this study, data were also collected on quail nesting, and this material served to offer an excellent contrast between the two groups of game birds. The Bobwhite and Valley quail, the former an exotic to the Willamette Valley, limited their nests in a closer proximity to water, whereas in the case of the pheasant over 50 per cent of the nests were found a quarter of a mile or over from water.

Nests in Relation to Graveled Roads

Gallinaceous birds require a small amount of grit or other hard substances in the crop, as an aid in grinding hard seeds and other food particles. Some records show the ratio of grit eaten to grain is 50:50. (6) This is probably more than is actually required for proper food digestion, but it does stress the importance of grit. Relationships between graveled roads and game bird population densities have been worked out to show a bird increase with the presence of graveled roads (5). Mortality to birds from automobiles on the highways may be caused by their desire for grit. From observations made in the three Willamette Valley counties studied, it is the writer's belief that the majority of the soils present carry sufficient grit so that pheasants do not have to rely on graveled roads. When pheasants were more abundant in these sections, than at present, there were fewer roads. Thirty-one per cent of the nests found were over a quarter mile from graveled roads.

Table 7 - Showing Nest Distance to Water

Distance in feet	Number of nests
0-50	7
51-100	8
101-200	6
201-300	3
301-500	12
500-$\frac{1}{4}$ mile	35
$\frac{1}{4}$ - $\frac{1}{2}$ mile	32
$\frac{1}{2}$ - 3/4 mile	22
3/4 mile and over	20
Total	145

Table 8 - Giving Nest Distances to Graveled Roads Either Automobile or Railroad

Distance in feet	Number of nests	Per cent
1-25	20	13.8
26-50	9	6.2
51-100	12	8.3
101-200	13	9.0
201-500	24	16.5
501-$\frac{1}{4}$ mile	22	15.2
$\frac{1}{4}$ - $\frac{1}{2}$ mile	17	11.7
$\frac{1}{2}$ mile or over	28	19.3
Total	145	100.0

Nests Subjected to Spring Floods

Land subject to flooding probably results in a less dense nest capacity than ground not subject to flooding, provided the floods come at the beginning of the nesting season. Floods frequently occur in April, in the areas studied, and as this is at the beginning of the nesting season, the birds may have a tendency to locate on ground not inundated, if the waters do not recede in a short time. Fifteen nests were found on land subject to flooding and two of these were abandoned because of the water (Figure 12). The remaining 13 nests were constructed after the water had receded.

April flooding of the Oregon Wildlife Research Unit's observation area east of Corvallis undoubtedly caused a later nesting season than would otherwise have been the case, but from bird counts made before and during the nesting season, it is doubtful whether flooding caused any of the pheasants to abandon the area. Observers located four nests and three more were reported as having been found on this area, but what percentage of the total number this represents is unknown. An unsuccessful attempt was made to flush setting hens off their nests, in a previously flooded 10 acre red clover field on the observation area, six weeks after the April flood waters had receded. This was at a time supposedly to be in the height of the nesting period. The method of flushing employed was to drag a 35 foot rope over the top of the clover, as close to the ground as was possible without injuring the vegetation. Had there been hens setting at this time it was believed that they would have flushed off their nests. A college farm employee, mowing in this same field on August 3, killed a hen and 7 one day old chicks near their nest. A successful hatch was also found in this same field. The lateness of these two nests may have been caused by the April flooding of this land.

Nest Distribution

Hay fields were the most favored nesting habitat of the pheasant, for 90 nests were observed in these places. This habitat provides good food and cover, and constitutes the largest percentage of any other single habitat in the Willamette Valley areas studied. Grain fields provide equally good cover, and better food conditions, but the best grain growth comes at a later date in the nesting season, with the result that most of the nests in this type of cover are probably renests.

Fence rows, roadsides, orchards, and unused fields accounted for 38 nests, while 10 nests were found in pastures, ditch banks, and deciduous wood lots. Wood lots are not favored as well as one might expect, and the three nests that were located in these places were closely adjacent to fields. Only 1.37 per cent of the nests were found along railroad right-of-ways but this is probably not a true percentage, for rank grass, weeds, and berry growths along railroad grades make particularly good nesting sites which are very difficult to find. The second nest found in this study, although unsuccessful, was only eight feet from a rail, so apparently the hens are not much disturbed by passing trains (Figures 9 and 10).

The percentage of successful nests in each separate habitat is rather interesting, in that when sufficient data can be gathered, it may give a reliable prediction as to nest successes. Only the hay field nests are of sufficient numbers to give a reliable cross section for this season, but with additional studies, a good cross section could be built up for each type of habitat. Hay fields showed a success percentage of 45.55 on 90 nests, and in this connection it is interesting to note that English (3), in

Michigan, found a success percentage of 44, based on 86 hay field nests. Nest success in fence rows, in the Willamette Valley, showed a percentage of 33, while roadside nests were 36 per cent successful. Pastures and orchards showed the highest success with 60 per cent and 57 per cent respectively. These, however, were based on only 12 nests.

Table 9 - Nest Distribution Showing Number and Per Cent Successful and Unsuccessful

Type of habitat	No. of nests	Per cent	No. successful	Per cent successful	No. unsuccessful	Per cent unsuccessful
Hay field	90	62.10	41	45.55	49	54.44
Fence row	12	8.27	4	33.33	8	66.66
Roadside	11	7.59	4	36.36	7	63.63
Unused field	8	5.51	4	50.00	4	50.00
Orchard	7	4.82	4	57.14	3	42.85
Pasture	5	3.44	3	60.00	2	40.00
Grain field	5	3.44	2	40.00	3	60.00
Deciduous wood lot	3	2.07	1	33.33	2	66.66
Railroad	2	1.38	1	50.00	1	50.00
Ditch bank	2	1.38	1	50.00	1	50.00
Totals	145	100.00	65		80	

BIOTIC ECOLOGICAL FACTORS

Plant Growth

Inadequate food and cover are recognized as two of the most important limiting factors in the propagation of upland game birds. Plant growth in the Willamette Valley might be considered almost ideal in this respect. Farming is not yet as "clean" as is done on many farms in the eastern states, and the cultivated crops are still bordered by comparatively wide fence rows of weeds, grass, and brush. These together with swales and brushy wood lots make an ideal vegetative habitat for the pheasant.

Nests were found in 26 different types of vegetative cover such as oats, vetch, clover, rye, wheat, cheat, wild grasses, weeds, and various combinations of all these. Alsike clover was the most favored cover, for 22 nests were found in this type of vegetation. A combination of oats and vetch came next with 17 nests, followed by 16 nests in a combination of grass and weeds such as orchard grass, mesquite, tarweed, dock, thistle, goldenrod, wild carrot, dog fennel, plaintain, and lupine. Red clover provided cover for 13 nests, and 12 were found in alfalfa. All of the cultivated crops provide good food and cover, and were it not for mowing at critical periods of nesting, the percentage of nest successes would have been much higher.

Table 10 - Giving Kinds of Nest Cover and the Number and Percentage of Nests in Each Type

Type of cover	Number of nests	Per cent
Alsike clover	22	15.17
Oats and vetch	17	11.72
Grass and weeds	16	11.03
Red clover	13	8.97
Alfalfa	12	8.28
Grass	10	6.90
Grass and bushes	9	6.21
Grass and vetch	6	4.14
Berry vines	5	3.44
Grass and ferns	5	3.44
Australian peas	4	2.76
Wheat	4	2.76
Rye	3	2.07
Cheat	3	2.07
Oats	3	2.07
Vetch and clover	3	2.07
Stubble and thistle	2	1.38
Vetch and rye	2	1.38
Trees and poison oak	2	1.38
Red clover and vetch	1	.69
Red and alsike clover	1	.69
Dead branches	1	.69
Clover and timothy	1	.69
Total	145	100.00

Agricultural Work

The pheasant is classed as farm game, and as such is one of the best. It is a product of the farm, and its tolerance for man and his activities is sometimes amazing. Locations of some nests remind one of the "purloined letter", in that they are often found in the most unthought of places. Apparently the hens are not often disturbed by passing automobiles, trains, or people, as several nests were found in the very front yards of houses, between the buildings and railroad or highway (nests numbers 21 and 14, Table 11). Nearby farming operations will seldom flush a setting hen even after the nest has been discovered, and for this reason many are injured by mowers because of the female's reluctance to leave the nest. As stated before, however, once their cover is removed, only a small percentage go back to the nest (Figure 11).

Table 11 - Showing Individual History of Each Nest Observed

								Mortality of Nests													Ecological Factors												
No.	No. of Eggs	♀ Setting	Hatch-successful	Nest-abandoned	Date of Hatch	Date of Abandonment	Chicks Hatched	Haying	Plowing	Human Disturbance	Skunk	Crow	Turkey Buzzard	Turkey	Cow	Quail	Eggs Taken by Man	Small Carnivore	Unknown	Flooding	Hayfield	Grainfield	Fence-row	R.R.	Pasture	Ditch Bank	Orchard	Deciduous Wood Lot	Roadside	Unused Field	Distance to Water (ft.)	Distance to Road (ft.)	Distance to Edge
1	16	X	X		5/17/37		14																							X	90	90	90
2	17	X		X		5/14/37	0			X														X							40	0	35
3	13	X	X		5/19/37		13																							X	175	450	40
4	13	X		X		5/18/37	0			X													X								90	50	0
5	R			X		?	0													X					X						25	105	105
6	15	X	X		5/22/37		14																X								50	1500	0
7	6	X		X		5/14/37	0			X																			X		1760	3	0
8	11	X	X		6/5/37		11														X										1320	20	20
9	10 [illegible]			X		5/23/37	0									X													X		2640	25	0
10	10	X		X		5/26/37	0											X											X		1000	8	0
11	13	X	X		6/1/37		13																X								1320	7	0
12	13	X		X		5/29/37	0												X						X						1320	1000	0
13	8	X	X		6/5/37		8																							X	25	2640	7
14	11	X		X		6/4/37	0	X													X										1320	450	250
15	6	X	X		6/4/37		6																		X						50	25	4
16	10	X		X		6/14/37	0	X													X										2640	35	35
17	6	X		X		6/3/37	0		X																		X				1000	100	75
18	13	X		X		6/4/37	0		X																		X				1000	100	80
19	10	X	X		6/6/37		8														X										1200	50	50
20	11	X	X		6/6/37		11														X										1320	350	350
21	10	X	X		6/6/37		10																					X			350	1000	20
22	10	X		X		5/27/37	0										X											X			1320	2640	35
23	12	X	X		6/3/37		12																				X				750	75	75
24	14	X	X		6/1/37		13																				X				600	75	75
25	14	X	X		5/20/37		14																				X				1200	80	80
26	21	X		X		5/19/37	0										X												X		60	8	0
27	13	X	X		6/8/37		13																						X		1320	5	0
28	10	X		X		5/17/37	0				X												X								1050	0	0
29	8	X		X		5/19/37	0			X																				X	150	23	23
30	7	X		X		6/12/37	0			X																			X		1400	8	0
31	17	X	X		6/4/37		17																						X		1320	5	0
32	15	X		X		6/14/37	0	X													X										1400	210	90
33	8	X		X		6/14/37	0	X													X										2640	750	60
34	11	X	X		6/14/37		11														X										400	75	75
35	11	X		X		6/4/37	0	X													X										750	20	20
36	10	X	X		6/6/37		10														X										1050	60	60
37	8	X		X		5/30/37	0				X												X								120	210	0
38	7			X		6/23/37	0	X													X										600	600	105
39	10	X	X		6/20/37		10														X										900	675	180
40	10	X	X		6/4/37		10														X										1100	1050	210
41	[illegible]			X		6/10/37	0									X					X										2640	105	105
42	7			X		6/3/37	0							X									X								75	1200	240

NO.	No. of Eggs	? Setting	Hatch-successful	Nest-abandoned	Date of Hatch	Date of Abandonment	Chicks Hatched	Mortality of Nests: Haying	Plowing	[illegible]	Skunk	Crow	Turkey Buzzard	Turkey	Cow	Quail	Eggs taken by man	Small carnivore	Unknown	Flooding	Ecological Factors: Hayfield	Grainfield	Fence-row	R.R.	Pasture	Ditch Bank	Orchard	Deciduous Woods	Roadside	Unused Field	Distance to Water	Distance to Road	Distance to Edge
43	7	X		X		6/24/37	0	X													X										900	105	90
44	14			X		5/16/37	0												X				X								1050	135	0
45	9	X	X		5/13/37		8																							X	75	2640	10
46	6			X		6/20/37	0				X												X								270	2100	0
47	9	X	X		6/20/37		9																X								1050	1050	0
48	1			X		5/14/37	0													X					X						105	1650	105
49	7			X		7/20/37	0				X															X					1050	2640	900
50	12			X		5/20/37	0										X				X										375	2640	120
51	3			X		6/30/37	0			X																			X		1350	12	0
52	9	X		X		6/30/37	0	X													X										375	225	105
53	11	X		X		7/2/37	0	X													X										4000	450	120
54	9	?		X		7/1/37	0				X												X								450	2640	0
55	10	X	X		6/14/37		10																		X						60	1050	30
56	13	X	X		6/20/37		13														X										4000	450	450
57	11	X	X		7/5/37		11														X										750	330	330
58	10	X		X		7/5/37	0							X							X										450	1275	105
59	9	X		X		7/6/37	0	X													X										1050	1200	45
60	10	X		X		7/6/37	0	X													X										2640	45	45
61	18	X		X		7/6/37	0	X													X										2640	55	50
62	11	X	X		6/11/37		10														X										1760	2640	6
63	9	X	X		6/25/37		3														X										1320	2640	5
64	13	X	X		5/24/37		13																			X					3	13	2
65	10	X		X		7/6/37	0	X													X										1320	1320	20
66	10	X		X		7/6/37	0	X													X										1320	1320	45
67	12	X		X		7/6/37	0	X													X										1050	1320	110
68	8	X	X		7/6/37		7														X										1320	2640	45
69	12	X		X		7/10/37	0	X													X										900	4000	35
70	11	X		X		7/10/37	0	X													X						X				1320	18	18
71	9	X	X		7/5/37		7																								2640	130	–
72	10	X	X		7/10/37		9														X										2640	75	75
73	9	?		X		7/16/37	0					X									X										4000	2640	135
74	10	X		X		7/1/37	0	X													X										4000	2640	35
75	6			X		7/8/37	0	X													X										4000	2640	25
76	10	X	X		7/21/37		10														X										4000	1320	35
77	10	X		X		7/3/37	0	X													X										2640	1760	70
78	9	X	X		7/3/37		9														X										2640	1760	75
79	10	X	X		7/13/37		10														X										330	600	15
80	1			X		7/6/37	0					X									X										1450	450	125
81	2			X		7/10/37	0	X													X										2640	1320	40
82	8	?		X		7/20/37	0				X										X										750	1650	30
83	11	X	X			7/13/37	11														X										1500	1500	55
84	12	X	X			7/9/37	11														X										1800	1800	120

MORTALITY OF NESTS

NO	No. of eggs	Setting	Hatch successful	Nest abandoned	Date of hatch	Date of abandonment	Chicks hatched	Haying	Plowing	[illegible]	Skunk	Crow	[illegible]	Turkey	Cow	Quail	Eggs taken by man	Small carnivore	Unknown	Flooding	Hayfield	Grainfield	Fence-row	R.R.	Pasture	Ditch bank	Orchard	[illegible]	Roadside	[illegible]	Distance to water	Distance to road	Distance to edge
85	11	X	X		7/14/57		11														X										1350	1000	55
86	12	X	X		7/14/57		12																		X						60	1500	20
87	10	X	X		9/6/57		8																						X		660	7	0
88	10	X		X		7/16/57	0	X													X										450	500	35
89	13	X		X		6/24/57	0	X													X										300	1320	125
90	7			X		5/30/58	0		X												X										450	1320	175
91	9	X		X		7/16/57	0	X													X										900	900	15
92	8	X	X		7/14/57		8														X										900	750	25
93	9	X		X		7/10/57	0	X													X										2640	40	40
94	9	X	X		7/13/57		9														X										1760	120	120
95	5	X	X		7/14/57		2														X										900	750	25
96	8			X		7/3/57	0			X																	X				105	4000	9
97	7			X		7/6/57	0	X													X										1200	4000	35
98	9	X	X		7/12/57		9														X										2640	2640	375
99	9	X	X		7/12/57		7														X										900	450	75
100	7			X		7/10/57	0										X												X		360	6	0
101	7	X	X		7/8/57		7														X										2640	330	330
102	11	X	X		7/11/57		11														X										4000	675	35
103	8	X	X		7/10/57		6														X										1320	115	25
104	3			X		6/20/57	0	X													X										300	50	35
105	11	X	X			7/12/57	9														X										2640	180	120
106	15	X	X		6/28/57		15																	X							20	0	0
107	10	X		X		6/12/57	0	X													X										5000	180	35
108	11	X		X		7/16/57	0	X													X										2640	135	135
109	10	X	X		7/16/57		10														X										2640	35	35
110	18	X	X		6/16/57		18														X										600	600	450
111	7	X		X		7/20/57	0	X													X										1760	1760	18
112	9	X		X		6/14/57	0	X													X										2640	35	35
113	7	X		X		7/19/57	0	X													X										1760	360	25
114	10	X		X		9/6/57	0						X																	X	750	450	30
115	10	X	X		7/24/57		10														X										4000	360	360
116	6			X		7/21/57	0	X													X										450	210	35
117	8			X		7/20/57	0	X													X										2640	450	210
118	10	X	X		7/21/57		10														X										600	160	160
119	11	X		X		7/21/58	0	X													X										5000	660	160
120	11	X	X		7/29/57		10															X									900	2640	550
121	9	X		X		7/28/57	0	X													X										600	1200	120
122	7	X		X		9/3/57	0	X														X									1500	180	150
123	10	X	X		9/3/57		10														X										2640	135	12
124	8	X		X		7/27/57	0	X														X									750	480	35
125	12	X	X		6/29/57		12														X										4000	360	360
126	10	X	X		8/15/57		10																						X		1320	15	0

NO.	No. of Eggs	Setting	Hatch successful	Nest abandoned	Date of hatch	Date of abandonment	Chicks hatched	Mortality of Nests: Haying	Plowing	[illegible]	Skunk	Crow	Turkey buzzard	Turkey	Cow	Quail	Eggs taken by man	Small carnivore	Unknown	Flooding	Ecological Factors: Hayfield	[illegible]	Fence row	R.R.	Pasture	Ditch bank	Orchard	[illegible]	Weed field	Road side	Distance to water	Distance to road	Distance to edge
127	11	X		X		9/2/37	0	X														X									900	105	105
128	8	?		X		9/10/37	0				X																		X		75	2640	14
129	13	X	X		9/2/37		12														X										2640	330	60
130	8	X	X		9/4/37		8															X									2640	210	80
131	11	X		X		9/4/37	0	X													X										2640	40	15
132	8	X	X		9/9/37		7																X								120	2640	0
133	3	X	X		9/6/37		1														X										1500	900	180
134	6			X		9/6/37	0	X													X										1600	2640	45
135	10	X	X		9/6/37		8														X										4000	4000	80
136	3			X		?	0												X		X										4000	4000	30
137	9	X	X		9/7/37		8														X										4000	4000	60
138	8	X		X		9/8/37	0	X													X										4000	4000	270
139	7	?		X		9/10/37	0				X												X								4000	4000	0
140	4			X		9/10/37	0			X																			X		2640	60	30
141	6	X	X		9/10/37		5														X										4000	450	15
142	12	X	X		9/12/37		11														X										4000	300	100
143	10	?		X		9/14/37	0												X		X										4000	4000	20
144	3			X		9/14/37	0												X		X										4000	4000	290
145	8	X	X		9/14/37		8														X										4000	4000	90
Total		114	65	80			641	42	3	8	8	2	1	1	1	2	4	1	5	2	90	5	11	2	6	2	7	3	8	11			
			44.78%	55.12%				28.96%	2.06%	5.51%	5.51%	1.37%	.69%	.69%	.69%	1.37%	2.75%	.69%	3.44%	1.37%	62.1%	3.44%	7.57%	1.37%	4.13%	1.37%	4.82%	2.06%	5.51%	7.57%			

CONCLUSION

The limited study made this year cannot provide data sufficiently conclusive for the formation of definite game management policies, as concerns the pheasant in the Willamette Valley. Certain of the results, however, offer indications as to the ultimate conclusions. The following conclusions on the mortality and ecological factors affecting the nesting stage of the Chinese pheasant in the Willamette Valley, Oregon, are based only on the 1937 study.

1. Mowing is the greatest single factor in nest destruction.

2. Hay fields are the favored habitat for nesting. In spite of the fact that mowing is the greatest single limiting factor in nest mortality, more nests are abandoned or destroyed outside of the hay fields, as a result of a combination of other factors.

3. Heavy populations of skunks cause considerable nest destruction, and there probably should be some control of this species on small game management areas.

4. Predators, other than skunks, do not cause sufficient nest mortality to necessitate their control.

5. Rainfall is one of the greatest variable effective factors in mortality to pheasant chicks, but it is doubtful whether it causes nest abandonment, except in case of flooding.

6. Humidity is probably not a limiting factor.

7. Shade is not a limiting factor. Partial shade was found in the majority of nests, but it was probably incidental to the protective cover.

8. Type of soil is a basic factor in nest distribution in that the soil is a limiting factor to vegetative growth.

9. Preference is not shown for hilly or level ground, provided the type of cover is similar.

10. Edges of fields are not always preferred to the centers.

11. Drinking water is not a limiting factor in nest distribution.

12. Graveled roads are not a limiting factor in nest distribution.

13. Flooding in the early stage of the nesting season probably does not result in abandonment of the area.

14. Farm lands, preferably cultivated lands, are best suited for pheasant nesting.

15. Timber and extensive wood lots are of minor importance as nesting areas.

16. Hay, grain, wild grasses, brush, and weed fields are favored habitats for nesting.

17. Normal agricultural operations are not limiting factors to pheasant nesting.

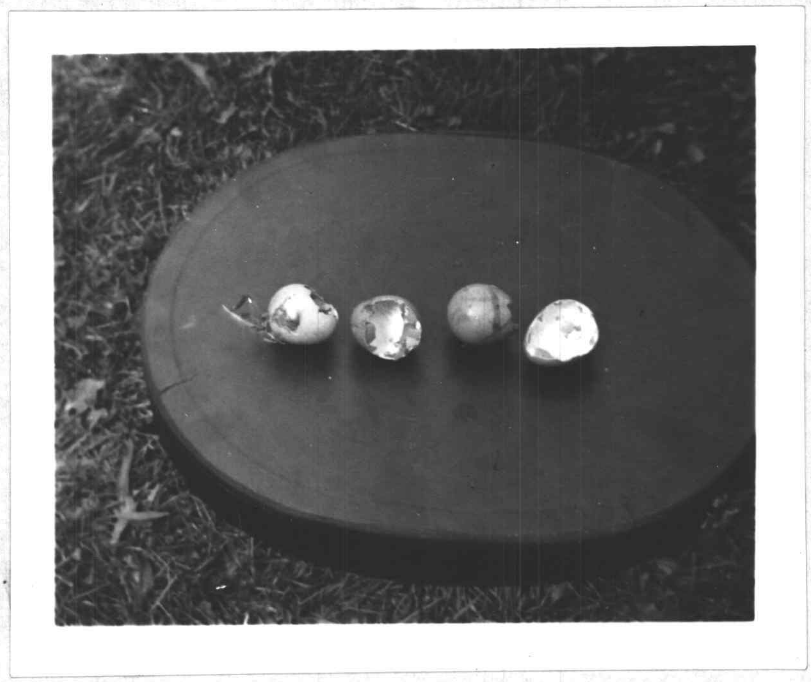

Figure 1 - Eggs Sucked by Skunk

Figure 2 - Skunk Caught Robbing Nest Number 82

Figure 3

Figure 4

Figure 5

Flooded Fields of Observation Area
During April 1937 Floods

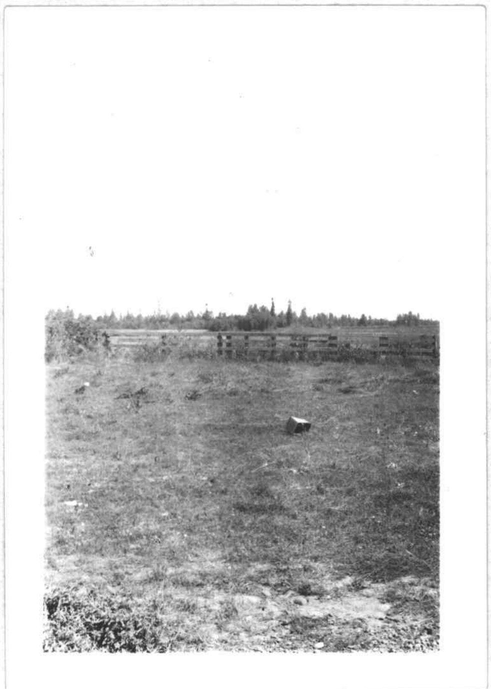

Figure 6

Figure 7

Figure 8

Normal Condition of Fields
Shown on Page 37, in August 1937

Figure 9 - Habitat of Nest Number 2

Figure 10 - Eggs and Cover of Nest Number 2

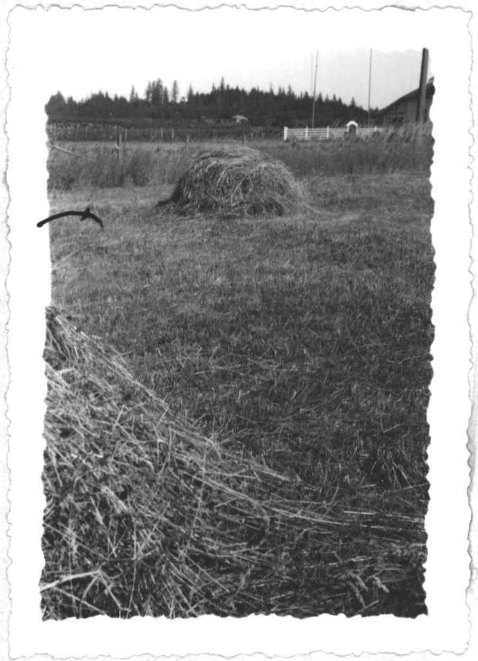

Figure 11 - Hen Returned to Nest
After Removal of Cover

Figure 12 - Site of Nest Number 5
Abandoned Because of Flood

BIBLIOGRAPHY

1. Dalke, Dr. Paul D. Food of young pheasants in Michigan. American Game, May-June 1935.

2. Department of Entomology. Food habits of the Chinese pheasant in Oregon. Unpublished manuscript, Oregon State College, Corvallis, Oregon.

3. English, P. F. Causes of pheasant mortality in Michigan. Unpublished Ph.D. thesis, University of Michigan, Ann Arbor, Michigan, 1934.

4. Gerstell, Richard. Precipitation in relation to game crops. American Wildlife, March-April 1936, p. 22, 26-28.

5. Leopold, Aldo. Game management. Charles Scribner's Sons, New York, 1933, p. 76.

6. Leopold, Aldo. Game survey of the north-central states. American Game Association, Washington, D. C., 1931, p. 67-68, 125.

7. Leopold, Aldo. 1936 pheasant nesting studies. Wilson Bulletin, 49(2):91-95, June 1937.

8. Carpenter, E. J. and Torgerson, E. F. Soil survey of Benton county, Oregon. United States Department of Agriculture, Bureau of Soils, Washington, D. C. Advance sheets, field operations of soils, 1920.

9. Kocher, Carpenter, Harper, Torgerson, and Stephenson. Soil survey of Linn county, Oregon. United States Department of Agriculture, Bureau of Chemistry and Soils, No. 25, Series 1924, 1924.

10. Trelease, S. F. and Yule, E. S. Preparation of scientific and technical papers. Third edition. The Williams and Wilkins Co., Baltimore, 1936.

11. Wells, E. L. Climatological data. United States Department of Agriculture, Weather Bureau, Oregon section, 33(5):25-29, and 33(6):31-35, May-June 1937.