

AN ABSTRACT OF THE THESIS OF

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Title Ring-Necked Pheasant Studies on Protection Island
in the Strait of Juan de Fuca, Washington

Abstract Approved: [REDACTED]

(Major Professor)

An observational study of Ring-necked pheasants, Phasianus colchicus torquatus Gmelin, on Protection Island in the Strait of Juan de Fuca, Jefferson County, Washington was conducted from September 21, 1938 to August 31, 1939.

This 400 acre island, located about two miles off shore, is an excellent study area, not under wire, comparable in many respects to average pheasant range. The climate is temperate with an average annual rainfall of 13.39 inches.

The particular purpose of the study was to establish bases for effective management practices and to consider the effects of the relationships between Ring-necked pheasants and agriculture as practiced on the island.

In May, 1937, two male and eight female pheasants were liberated. At least two of the females died before they could have completed nesting. From the off-spring of this nucleus there remained thirty-five birds in 1938 and about one hundred birds in 1939. In October, 1939, 430 birds were tallied in the fall inventory. The 1939 increase may be said to be approximately 321 per cent of the 1938 population. A drive census method of inventory corroborated by later observation was used to determine the numbers of birds.

Pheasants normally roosted in areas of medium cover except during the mating and nesting seasons when few birds roosted at all for long periods in one spot as is customary. Roosting returned to normal in August.

Slightly over fifteen per cent of the 1938 population was found dead due to predation or accidents. Only 2.81 per cent of the 1939 increase was found dead due to

these same causes during the last four months of the study.

Two feral, male house cats were resident on the island. They were responsible for 41.17 per cent of the known causes of loss of pheasants. Other predators known to have been on the island at some time were the common, rapid flying hawks and Short-eared and Dusky Horned Owls. A tractor was responsible for the deaths of some young birds.

Male pheasants began to crow in early March but did not extensively display until nearly April. Although no matings were observed until April 15 some had undoubtedly been consummated prior to that date.

Sixty per cent of the observations on feeding pheasants were in grain fields which comprised about thirty per cent of the total area of the island.

The more important food items in the order of their occurrence in crops and gizzards were miscellaneous vegetation, composed principally of grass and grain chaff, vetch, wheat, bindweed, insects and yellow mustard. Other items believed to be of importance, but not measureable, were potato, lily, wild onion and Spring Gold.

Pheasants learn, or are at least aware of, the difference between new and old grain sprouts. They prefer new sprouts and take wheat much more frequently than barley. Because of this it seems likely that a light seeding of these grains, following the original planting by two weeks, will serve to divert the attention of the birds until the original planting is beyond the desirable stage for pheasants.

In the six-tenths of an acre of wheat where pheasants were known to have fed heavily sixty-four per cent of normal sprout growth remained. Elsewhere in the wheat it may be said that pheasants contributed to the development of the stand of grain by causing the young sprouts to "stool out" more than usual.

At no time were pheasants ever seen utilizing free drinking water from any source. Apparently pheasants, on Protection Island at least, are completely capable of sustaining life on succulence and dew alone, as far as water is concerned.

RING-NECKED PHEASANT STUDIES ON
PROTECTION ISLAND IN THE
STRAIT OF JUAN DE FUCA
WASHINGTON

by

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A THESIS

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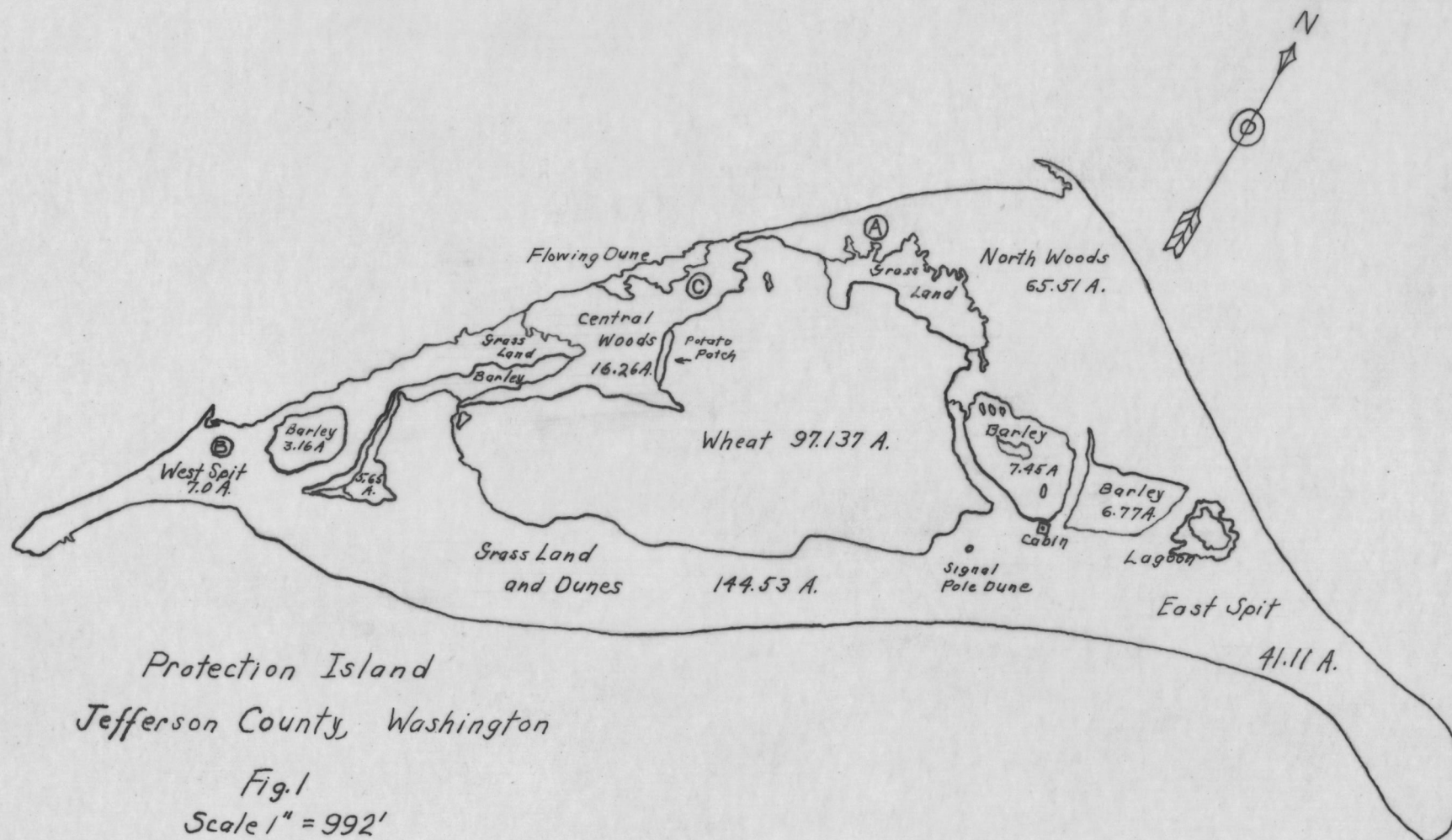
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Protection Island

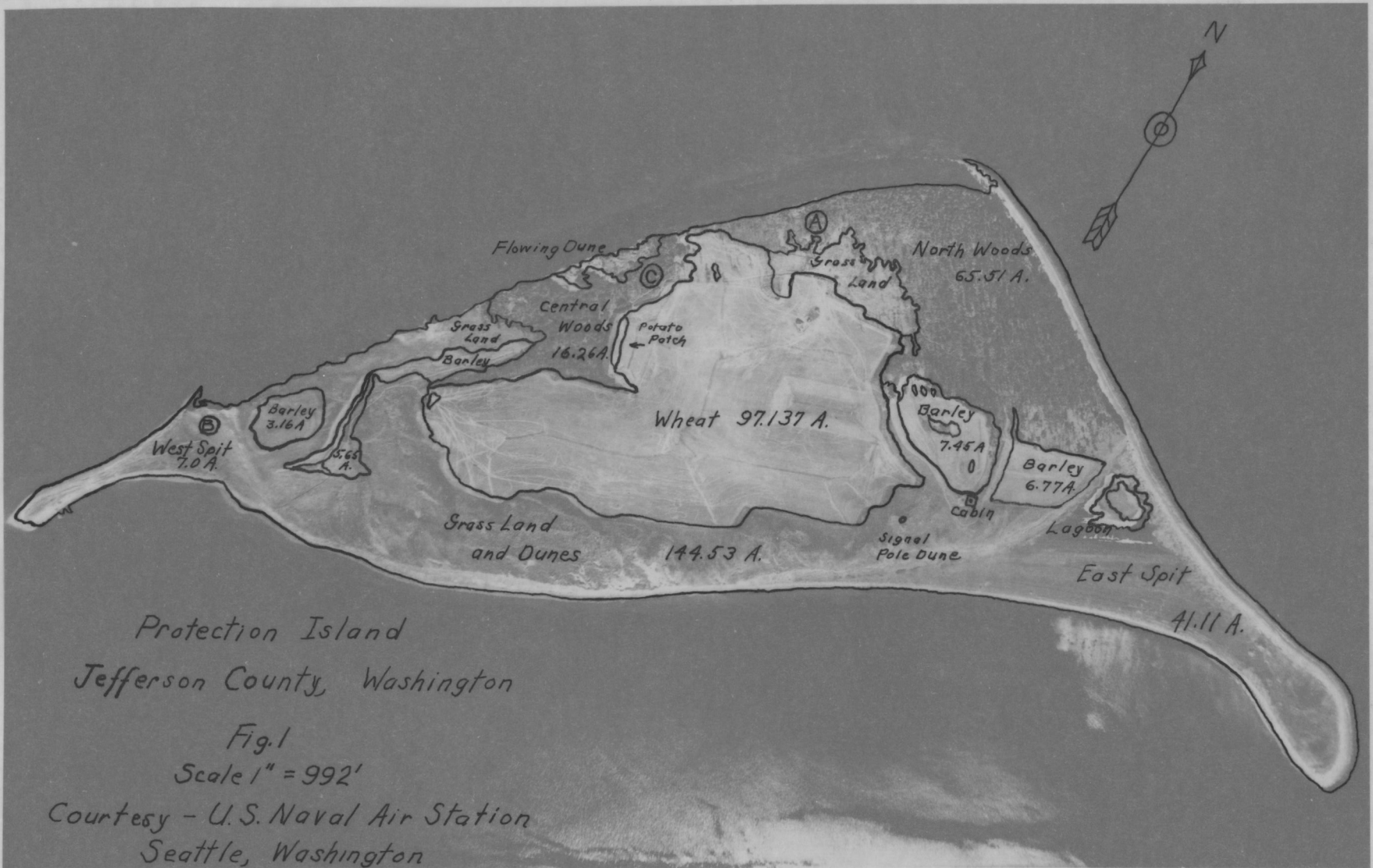
Jefferson County, Washington

Fig. 1

Scale 1" = 992'

Courtesy - U.S. Naval Air Station
Seattle, Washington





RING-NECKED PHEASANT STUDIES ON PROTECTION ISLAND
IN THE STRAIT OF JUAN DE FUCA WASHINGTON

INTRODUCTION

An observational study of Ring-necked pheasants, Phasianus colchicus torquatus Gmelin, on Protection Island in the Strait of Juan de Fuca, Jefferson County, Washington was conducted from September 21, 1938 to August 31, 1939. The main purpose of the work was to determine life history facts in regard to the following birds:

Ring-necked pheasant Phasianus colchicus torquatus Gmel.
Valley Quail Lophortyx californica vallicola (Ridgway)
Oregon Ruffed Grouse Bonasa umbellus sabini (Douglas)
Sooty Grouse Dendragapus fuliginosus fuliginosus (Ridg)

The work was financed by the Oregon Cooperative Wildlife Research Unit* and was under the direction of Mr. Arthur S. Einarsen, Associate Biologist, United States Bureau of Biological Survey.

Since only the pheasants were present on the island at the inception of the study, most of the work was done with that bird. There was no intention of making a complete life history study and accordingly the paper is limited in its scope.

* Cooperators include: United States Bureau of Biological Survey, Oregon State College, Oregon State Game Commission, Washington State Department of Game, and the American Wildlife Institute.

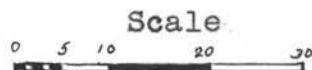
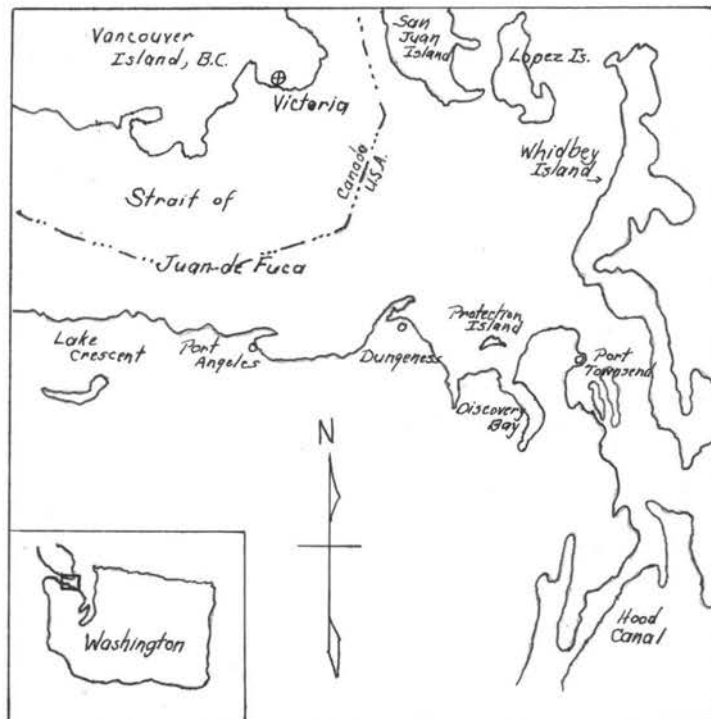
The island, (Figs. 1,3 & 4) located about two miles off shore, with approximately 200 feet elevation, is an ideal situation for studying the birds over a period of years. At sea level the nearest point of mainland is 1.83 miles distant while at average elevation the nearest point is 2.34 miles.

Infiltration of, or loss of birds due to their wandering is eliminated by the natural barrier of water. Inventory of the stock is accomplished with comparative ease and this renders possible a knowledge of pheasant numbers at all times. Since the majority of predators are known and easily watched, they may be controlled if necessary in order to maintain normal or average conditions of predator abundance. In general it may be said that the presence of the common predators adds materially to the value of the study. Most of the tillable portions of the island are devoted to the production of cereal crops. The area is comparable in many respects to average pheasant range. Thus it may be seen that Protection Island offers a nearly ideal site for study with an admirable degree of control possible.

OBJECTIVES

The Protection Island Study is a long time project designed to acquire sufficient data to set up definite standards of measurement for:

Fig. 3



Sketch Map Showing the
Location of Protection Island

- a. Determining increases or decreases of upland game birds under natural conditions.
- b. Establishing worthwhile game management practices permitting increasing returns of small game.
- c. Establishing the comparative effectiveness of artificially and naturally reared game birds.

The particular purpose of the effort expended on this study was to consider the effects of and the relationships between Ring-necked pheasants and agriculture as it was practiced on the island. The work in this direction was of course limited by the impracticability of taking birds for crop and gizzard analyses and attempting to study them under natural conditions at the same time. The plan to overcome this difficulty, by analyzing weekly collections of scats from nocturnal roosting sites, had to be discontinued due to lack of time. A comprehensive analysis of pheasant droppings from Protection Island will be conducted when a sufficient number have been collected. The crops and gizzards of birds found dead due to accident or predation have been used to good advantage in this connection.

This paper has been prepared with the hope that the information presented will be of value to all workers in the field of wildlife research and with the hope that the observations may be applied by managers of game birds. If the statements and observations made do nothing more than to further the realization that a given species does not of necessity behave in the same manner in different lo-

calities it will have been worthwhile.

DESCRIPTION

LOCATION OF STUDY AREA

Protection Island is located in the Strait of Juan de Fuca, 1.83 miles from the nearest point of mainland, near the mouth of Puget Sound, in Jefferson County, Washington. (Figs. 3 & 4) The name of this island, which has been likened by world travelers to Pitcairn Island in the South Pacific Ocean and to German Helgoland in the North Sea, is derived from its position as a sort of breakwater at the mouth of Discovery Bay. Here skippers of small craft have rested in security during storms ever since Captain Vancouver first wrote extensively in his journal about the region. (Fig. 2)

PHYSIOGRAPHIC FEATURES

The area of this island of sedimentary and glacial origin is approximately four hundred acres.* The one hundred and twenty acres of level to gently rolling table land is suitable for and used for agriculture. There are about eighty acres of woodland in two parts, of fifteen and sixty-five acres respectively, composed principally of the following:

* For more detail turn to Fig. 1 and Table II, page 46.



Fig. 2
A log raft tow at mouth of
Discovery Bay waits in the
shelter of Protection Island
for a northwest storm to subside



Fig. 4
Protection Island
viewed from Cape George

Dominant

- Douglas Fir . Pseudotsuga taxifolia (Poir.) Britt.
Vine Maple . Acer circinatum Pursh.
Tree Willow . Salix hookeriana Barratt
Wild Cherry . Prunus emarginata (Dougl.) Walp.
 var. erecta Piper
Madrone Arbutus Menziesii Pursh.

Under Story

- | | |
|--------------------------|---|
| Roses | <u>Rosa</u> spp. |
| Ocean Spray | <u>Holodiscus discolor</u> (Pursh.) M. |
| Gooseberry, Coast Black. | <u>Ribes divaricatum</u> Douglas |
| Currant, Red-flowering . | <u>Ribes sanguineum</u> Pursh. |
| Snowberry | <u>Symphoricarpus alba</u> (L.) Blake |
| Cherry, Western Choke .. | <u>Prunus demissa</u> (Nutt.) Dietr. |
| Elderberry, Blue | <u>Sambucus glauca</u> Nutt. |
| Bracken Fern | <u>Pteridium aquilinum pubescens</u>
Underw. |

The latter group serves as ground cover and in many spots is so thick as to exclude much light from the floor of the wooded areas.

At the west end of the island is a sand spit comprising approximately seven acres while on the east end is a spit of about forty acres. (Figs. 1, 5 & 6) These two long, narrow fingers of land extending in a southwesterly and easterly direction respectively are only slightly above high tide level and are sometimes washed by salt water during winter storms. The latter spit contains a salt marsh and a small lagoon, which during migration periods is used to considerable degree by ducks and to some extent by geese. (Fig. 1) The remainder of the island is composed of grassland and sand dunes, of about one hundred and fifty acres in extent. These areas, for the most part, are along the south side of the island but a small dune area exists on the north side and is growing larger with



Fig. 5
East spit of
Protection Island



Fig. 6
West spit of
Protection Island

astonishing rapidity. (Figs. 1, 7 & 9)

CLIMATE

The climate is temperate with a low, average annual rainfall. Nearby Port Townsend, with an average annual rainfall of 19.54 inches, had 18.25 inches in 1939 as compared with 12.50 inches for Protection Island during the same period. This low precipitation figure is easily understood when it is realized that the island is only a few miles east of the Olympic range of mountains which cause most of the westerly rains to fall before reaching the vicinity of the study area.

In connection with rainfall and available moisture the presence of a small, native cactus, Opuntia polyacantha borealis Coult., on the east spit is of interest. The very presence of the plant is eloquent testimony to the fact that moisture is low but is probably even more indicative of a condition of physiological dryness caused by salts deposited in the soil during the ocean overflow periods of severe storms. (Fig. 8)

LOCATION OF CABIN

Continual residence with Mrs. Newcomb was maintained on the island for the entire period, leaving only for intervals of a few hours to secure supplies. The cabin (Figs. 1 & 12) was situated on the eastern end of the a-



Fig. 7

Flowing dune on
north side of island



Fig. 8

Native cactus
Opuntia polyacantha borealis
on east spit



Fig. 9

Showing south dunes
where pheasants normally
roosted. Looking east



Fig. 10

Central wooded section
where pheasants roosted
during snow in
early February

rea on practically the highest point of ground. The primary consideration in determining its location was that by far the greatest area of ground could be seen at one time from this particular spot. That the location was well chosen may be illustrated by the fact that frequently, numerous simultaneous observations on birds in various sections of the island were made from the interior of the cabin with the aid of binoculars. Such opportunities would have been wasted at any other location. There is little doubt but that the chance to observe birds behavior and mannerisms from such seclusion as the cabin afforded revealed many items of value and interest that would otherwise have escaped attention.

ECONOMIC DATA

OWNERSHIP AND TENANCY

Protection Island is owned by Mr. William E. Grimshaw of Seattle, Washington. The island has been in possession of his family for nearly fifty years. Farming operations of one sort or another have been conducted there for at least seventy years. At one time turkeys were commercially raised in large numbers and to this day the remains of some of the old nesting boxes may be found covered by dense tangles of brush in the wooded sections of the island.

Mr. Grimshaw has never directly farmed the island himself but has instead leased the land for that purpose to men living in the vicinity. The present lessee, Mr. Harry

F. Purnell, has farmed the island since 1936. The first two years he devoted his efforts to raising seed crops such as spinach, peas and vetch. Adverse weather conditions including high winds rendered his attempts in this direction ineffectual and accordingly Purnell has turned to the production of cereal crops. During 1938 and 1939 he raised about ninety-seven acres of wheat or 80.82 per cent of his total acreage and about twenty-three acres of 19.18 per cent of the tilled land was devoted to barley.

PAST HISTORY

Strangely or not, depending upon one's point of view, there is considerable variance of recorded data concerning the early liberation of pheasants on Protection Island, not to mention the even greater variety of opinions expressed by the older residents in the region. To illustrate the discrepancies printed, Henry Rief, Superintendant of the King County Game Farm at Seattle, Washington was quoted in 1916 by E.A. Quarles in American Pheasant Breeding and Shooting (5:63) as follows:

"You probably know that of the Chinese birds first brought to the Pacific Coast by Judge O.N. Denny, the majority were liberated in Oregon. Some, however, were placed on Protection Island in Puget Sound. No further consideration was given these birds till some years later when a few sportsmen began shooting them."

According to William T. Shaw (1908) in his booklet entitled The China or Denny Pheasant in Oregon with Notes on the Native Grouse of the Pacific Northwest. (6:14,15) Sil-

ver and Copper pheasants were liberated in approximately 1882 on Protection Island in the Columbia River. Apparently Mr. Shaw was in error as to the location of Protection Island.

In 1889, fifty years before the inception of the present study, a young couple named Mr. and Mrs. W.H. Brown were stationed on Protection Island to watch for smugglers. At that time Mr. Brown estimated the pheasant population to be about 8,000 birds. At the present rate of increase and figuring on a later drop in the rate of reproduction the pheasants will reach that number in about seven years. On the basis of the foregoing statements it may be seen that pheasants were present on the island at least by 1882.

After reaching tremendous numbers the pheasants died off due to relentless hunting or blackhead disease, Histomonas meleagridis, transmitted from the turkeys raised on the island. Pheasants did not reappear until May, 1937 when H.F. Purnell, the present farmer-lessee, through the cooperation of the Washington State Department of Game liberated two male and eight female Ring-necked pheasants on the slope above the east spit. (Fig. 14) They did not spread far, but nested almost immediately. At least two of the females died before they could have completed nesting, but some broods were successfully reared. The next spring, according to Purnell, there were about thirty-five birds entering the breeding season.

METHODS OF PROCEDURE AND OBSERVATION

NESTING SEASON (1938)

During the first few weeks of the study much time was devoted to becoming thoroughly familiar with every portion of the island. While following this procedure, special effort was made to discover pheasant nests of the previous season. Although there is no way of knowing if all nests were found, it is believed that most of them were, for the sixteen discovered tallied well with Purnell's statement of about thirty-five birds in the spring, since the sex ratio was approximately equal. The nests were in open locations mostly in the edges of Beach grass, sometimes referred to as Holland grass, Ammophila arenaria (L.) Link., and under small, sparse rose bushes. Only one was found in the wooded sections and that was near the pasture's edge. A number of the nests were placed along the foot of the bank just above the east spit. (Fig. 14) All nests found were marked in the field with light colored stakes and numbered consecutively for ease in later reference.

Nests were listed and described as to location, number of eggs,* number of eggs hatched, number of eggs fertile but not hatched and number of eggs infertile.

* A minimum count is given. That is, only definitely known individual eggs are listed. The total number of eggs deposited was probably slightly higher.

There were remains of ninety-one eggs found.

Nine of the seventeen which failed to hatch were infertile. Of these nine, six were in one nest and three in another. The figures based on nests found in 1938 indicate a fertility of 83.57 per cent.* There was a successful hatch of 81.4 per cent as compared with only 46.62 per cent in the Willamette Valley, Oregon, but in 1937 the successful hatch in the Valley was as high as 94.9 per cent.

INVENTORY (1938)

One of the primary steps in conducting the study was taken on November 10, 1938 when a drive census was carried out, using five men for the task. The spits and steep banks were driven the previous evening after the birds had ceased moving about. On the morning of the tenth the five men walking abreast at equal intervals, in a line slightly bowed in the middle, again covered the area driven the previous night as a check on ranging propensities.** The men then continued along the north side of the island through the wooded section, traveling from east to west. Evaporated milk cans with pebbles were used as noise makers to aid in flushing birds out of the woods and across the field to the south side which is composed principally of grass-covered dunes. After thoroughly beating the brush on the

* For a graphic and tabular display of 1938 nesting data and nesting cover turn to Table III, page 47.

** No birds were flushed.

north side of the island the dune area was covered, with the men traveling in the opposite direction. The fields were newly planted, thereby affording no cover for the birds between the dunes and woodland. Thus it was possible, after flushing the birds from the north side of the island, to travel the length of the south side counting only birds that flew behind the "drivers" or toward the center of the island. Although the topography was comparatively ideal for conducting an inventory by this method the weather was decidedly adverse to the undertaking, being a mixture of hail, snow, sleet and rain; rendering the birds difficult to flush. A total of seventy-six known individuals were tallied; thirty-three males and forty-three females.

DAILY CHECK AND OBSERVATION

In connection with the inventory a record was kept of all pheasants seen from September 21, 1938 to March 25, 1939. Totals of males and females were listed for morning and afternoon. This was done because it was noted early in the study, on certain apparently exceptional days, that the birds congregated in large flocks. At such times, practically all pheasants on the island could be seen at one time. For example, on November 13, 1938, fifty-nine females were seen. On January 27, 1939, fifty-three males were tallied. These instances were the maximum records. The birds were seen in groups in sections of the island,



Fig. 11

Typical pheasant
roosting cover on
south dunes



Fig. 12

Cabin on
Protection Island

sufficiently detached to preclude any duplications. The foregoing observations give a reliable basis for the statement that approximately one hundred and ten birds were resident on Protection Island on January 1, 1939, with the sex ratio nearly equal.

In addition to the previously described information, careful observations were maintained by patrolling the area with particular emphasis given to roosting, feeding, kills and predators, crowing, mating and broods. A discussion of each of these topics follows.

ROOSTING

Due to the limited area and the small number of pheasants, it was a relatively simple matter to keep track of the roosting habits of the birds.

For the most part, pheasants roosted in clumps of bracken and Beach grass along the north side of the south dunes. (Figs. 9 & 11) This was the common practice except during the mating and nesting seasons and shall be considered normal although occasional roosting sites were observed throughout the year in rose clumps at the middle of the east spit and some along the base of the south bank of the island. Roosting on the east spit was rare and practiced with no apparent rhyme nor reason. Other occasional roosting sites were found in scattered clumps of grass north and east of the cabin and at edges of the woods.

The first of the outstanding departures from normal roosting procedure came on November 10, 1938 at a time of snow and sleet which drove the birds to the cover of thick tangles of roses and red-flowering currant along the north side of the island. (Fig. 1,A) This lasted only two days.

The second variance from normal came on January 19, 1939, when forty roosting sites were found in a slight depression at the foot of the steep west bank of the island. The grasses there could have afforded little cover to the birds but the depression itself must have been sufficient protection against all winds. A few of the roosting signs were several days old but the majority were recent deposits when found. Two days following this discovery, careful scrutiny revealed that only one bird had since used the area for roosting. The above fact was easily determined since the roosting sites were expunged after being found. The area was used only rarely by a few birds during the ensuing month, apparently at times of highest wind. (Fig. 1,B)

The third radical departure from normal roosting procedure came on February 6, 1939 when, after a three inch fall of snow, the birds forsook their former habits and took to the trees as though snow was a common occurrence in their lives. At that time it was impossible to find more than a few droppings anywhere until, with the disappearance of the snow five days later, many stools were found under the

horizontal branches of Vine Maple and Douglas Fir trees, mostly in the central wooded section. (Fig. 1) At this period droppings, other than those beneath the trees, were difficult to find and all were much smaller than usual. There was no other evidence of any difficulty on the part of the birds to adequately provide for themselves nor was there any predation observed.

By the middle of January, birds began to select more open roosting sites. Rather than getting under grass clumps the birds selected the comparatively slight protection of the skimpy branches of gumweed or some plant of similar density or very light stands of grass and bracken fern. Roosting continued to be practiced in the same general areas.

In early February, the pheasants began to spread out from the general areas previously mentioned, progressively utilizing more open sites for their nocturnal roosting. Rare instances were noted of roosting in bare, open spots at the edge of the north side of the island.

To return to the period following the snowfall in early February, evidence indicating that the birds experienced difficulty in adjusting themselves to the return of former conditions was noticed. Numbers of the pheasants failed to resume roosting on the south dunes immediately, but instead congregated in the small dune area on the north side of the island adjacent to the central wooded area

where so many birds roosted during the period of snow.

(Fig. 1,C & Fig. 10) The most interesting part of this new move was that all such roosting sites were infinitely better hidden and deeper in the thick tangle of Beach grass than were any of the sites found previously or since. In late February and early March, after two or three weeks of comparatively rare roosting on the south side of the island, with none at all on the signal pole dune near the cabin, (Fig. 1) there was a marked return to those roosting sites. A few birds continued to roost in the dunes on the north side of the island.

By the middle of March the birds became independent, so to speak, and roosting was scattered all over the island, including the grain fields. Many roosts found in the fields were more than one hundred yards from the edges and the grain was only about six inches high. Roosting sites were apparently temporary affairs, containing only a few stools, indicating that the birds were extremely restless and were moving about much of the time.

From April until the last of June, night-long roosting sites were rarely found, indicating that nocturnal roosting during this period was practiced chiefly by unmated birds. There seems to be no satisfactory method of substantiating such a theory but the fact that it is a departure from normal behavior during the mating and nesting season certainly lends support to the idea that there is indi-

vidual abnormality or variation among the birds.

At the end of June there commenced a gradual resumption of normal nocturnal roosting. Judging from the size and contents of the stools first indicating such behavior it was evident that the young birds, often accompanied by an adult hen, were the first to practice group roosting after the nesting season. Here again is a position admitting of circumstantial evidence, for the majority of adults may have been roosting in the grain fields at this time. Since it was not deemed ethical to go wandering through the ripening grain, such a possibility was not given full consideration until harvest time when the evidence was more difficult to interpret.

During July and August the grain was harvested by combine. Practically all effort during this period was devoted to studying the ground for evidence of nesting, roosting and predation by riding behind the header on the combine. It was observed that considerable roosting was still being practiced in the fields but was confined almost entirely to areas which were choked and matted with volunteer vetch and more especially with bindweed.*

After completion of the harvest, roosting as almost entirely confined to the slopes of the dune areas. In short, roosting had returned to normal.

* Vicia spp. and Polygonum Convolvulus respectively

KILLS, PREDATORS AND ACCIDENTS

Throughout the twelve months of the study, seventeen definite adult kills were found. Using the figure arrived at early in the study, of approximately one hundred and ten resident birds, it may be stated that an adult kill of 15.45 per cent resulted.

In four months, May through August, nine definite young bird deaths were noted. The total increase of birds for the year was roughly three hundred and twenty individuals. This kill of chicks or young birds represents 2.81 per cent of the increase, for the last four months of the study year. The reader must not assume that 2.81 per cent is one third of the annual chick loss, for the decimation rate rises sharply in September during the hawk migration. In addition, probably only a few of the actual kills of chicks were found since small birds are more completely consumed by predators and their carcasses are much more difficult to see. John S. Morse, the resident caretaker of the island during 1939 and 1940 indicates in his reports that at least two predatory hawks resided on the island all winter, whereas none were known to be permanent winter residents the previous year.

Nine of the adults killed were males and eight were females. The sex of the young birds was not determined since most of them were badly mangled by the predators.

TABLE I - CAUSES FOR PHEASANT LOSS
November 1938 - September 1939

	Cat		Hawk		Owl*		Unknown		Accident#		Totals	
	M	F	M	F	M	F	M	F	M	F	M	F
Adults	2	5	1				5	3	1		9	8
Young	3		1		2		1		2		9	

There were two feral, male house cats resident on the island. They had been there for several years. Their presence added much to the value of the study, for cats are a common decimating factor on wildlife areas in all farming regions. Individually, the cats were probably the most successful of the predators.

Other predators present on the island at some time were:

Marsh Hawk Circus hudsonius (L.)
 Western Pigeon Hawk Falco columbianus bendirei Swann.
 Duck Hawk Falco peregrinus anatum (Bonaparte)
 Western Goshawk.... Astur atricapillus striatulus Ridgway
 Sharp-shinned Hawk. Accipiter velox velox (Wilson)
 Cooper's Hawk Accipiter cooperi (Bonaparte)
 Short-eared Owl ... Asio flammeus flammeus (Pontoppidan)
 Dusky Horned Owl**. Bubo virginianus saturatus (Ridgway)

Purnell's tractor was responsible for the deaths of the young birds listed as accidental in Table I and was probably responsible for other deaths not recorded. The young birds became confused at the approach of the tractor and squatted down in the grain as is their natural inclination when danger threatens, thus becoming inconspicuous.

* See Fig. 15 for typical owl kill.

One male flew into a fence. Tractor ran over young.

** This bird was frequently heard but never seen.



Fig. 15

Typical owl kill
Young female pheasant
found August 17, 1939



Fig. 16

Typical pheasant
feeding on potatoes
July 29, 1939

CROWING, DISPLAY AND MATING

Breeding plumage was strongly evident by the middle of January but other indications of the awakening of sexual activity were slow in reaching any magnitude despite the fact that display procedure was observed as early as January 9. Apparently the male in question was premature to a marked degree, for the hen he was trying to attract tried desperately to avoid him. This procedure was next observed on February 18 and on March 2. Occasional, rather feeble attempts at crowing and one sporadic attempt at fighting were noted during the first two months of the year.

The first real lusty crowing began on the twelfth of March. The following remarks are adapted from the field diary on that date:

One male pheasant was seen on a Beach grass dune below the water tank at eleven o'clock in the morning. A male at the south side of the central wooded section crowed vigorously at the same time. Immediately another male on the north side of the same wooded section began crowing. Soon the three birds were engaged in vocal competition.

For about two weeks crowing was conducted during the middle of the day, but it was not long before the first streak of dawn was ushered in with the strident tones and vigorous wing flappings of exuberant male pheasants.

The procedure followed on March 31 is typical of

the pre-mating season. Excerpts from the field diary on that and other dates will illustrate:

"Males called continuously during the afternoon despite showers. One male in particular was vociferously aggressive and chased several other males from the barley field northeast of the cabin. Following this action he herded a group of four females around that field making all possible overtures and display, apparently without effect. The performance lasted from two o'clock until four forty-five o'clock in the afternoon, after which other males came out in the field and crowing continued.

"On April 1, crowing continued unabated. One male and five females spent most of the morning in the barley field northwest of the cabin. A male and four females spent an hour and a half in the late afternoon in the barley field northeast of the cabin. The male sauntered around his "harem", displayed by spreading his wings, fanning his tail, tilting it from side to side and running back and forth with his body held close to the ground. These actions were interspersed at regular intervals with crowing and wing-flappings. The ear tufts on this bird appeared more conspicuous than usual. Crowing continued until well after dark.

"The first matings were observed on April 15 but undoubtedly some matings had been consummated prior to that date, for a premature egg was found on the fourteenth and another on the eighteenth. Each was dropped in the open on the south dunes."

The foregoing illustrations are typical of the procedure followed by pheasants from January to June with activity continually rising in crescendo until the last of April and then gradually diminishing.

At the peak of the pre-nesting season, on April 19, there was a partial eclipse of the sun. The main effect of the eclipse was strongly in evidence for three hours and to a lesser extent for two additional hours. From a half hour before sunrise the birds had been calling as loud-

ly as at any time during the year but before the advancing shadows of the moon had become detectable by human senses the pheasants became strangely quiet. This was shortly before eight o'clock and the birds did not resume their courtship behavior until nearly noon. During those four hours occasional blasting or other detonations were heard. These caused most of the birds to set up a frightened, nervous cackling which quickly subsided. In this connection it might be well to add that almost any time a sharp report was heard, such as those caused by a practice bomb striking the water, thunder or gunnery practice, it nearly always caused the birds, males and females alike, to cackle as though badly frightened. In many instances the birds showed evidence of having felt the detonations before they had become apparent to human systems. Sometimes the majority of the birds started calling at the same time in response to the stimulus while on other occasions first one bird would give the frightened call which would then be taken up by the others, progressively. At times even the back-firing of the diesel-powered tractor would cause alarm to spread among the birds, while at other times they appeared not to notice it at all.

FOOD HABITS AND WATER REQUIREMENTS

OBSERVATION

A careful perusal of the daily field notes taken during the year reveals some interesting items for consideration. Of 718 recorded observations of pheasants feeding in various types of cover or on certain types of plants, 414 were in either wheat or barley fields. That is, 57.6 per cent of all recorded observations were made in the grain fields or in 30.48 per cent of the total area. Of course such a figure should not be taken as an indication of the type of food consumed.* The point given emphasis by these figures is that the birds spend a much greater portion of their time in the grain fields than the amount of grain consumed by them tends to indicate.** Were there no cover of grain for them, they would undoubtedly spend much of their time in natural grass cover if it was available, as indicated by the next figure in Table V, which shows that the birds spend approximately eleven per cent of their time under the protection of Beach grass, not including time devoted to roosting.

In explanation of the discrepancy between frequency of occurrence of the birds in a given type of feeding cover and consumption of that type of food, one must realize

* For a complete breakdown of these observation turn to Table V, page 49.

** See Crop and Gizzard Analysis, Table VI, pages 50-53.

that many varieties of food may be found by the birds in such cover as a wheat field where bindweed, vetch, yellow mustard, wild radish, volunteer potatoes and peas, red-maids, Moss campion, insects and countless other foods occur in abundance.

At the beginning of the study the fields were covered with masses of dried yellow mustard, vetch and peas. The peas which had been planted as a seed crop failed to develop, due to lack of moisture, but they supplied excellent food for the pheasants. One bird killed by a dog, just before the study began, had its crop full of peas.

On June 12, 1939, pheasants were observed feeding on volunteer peas in nearly all of the grain fields. The following day the fields were carefully examined. The evidence found indicated that the birds had been feeding on this item for about a week. The birds seemed to take peas from only those pods that were on or near the ground. The pods were pecked through on one side and usually split open regardless of the extent to which the pods had dried. Invariably one pea remained in each pod, a fact which is probably only a curious coincidence.

H.F. Purnell planted a few rows of potatoes around the edges of the large field in the center of the island. In the fertile soil and mild climate the potatoes, like most everything else, volunteered. The birds were not long in discovering that the new underground stems could be

easily dug up in the light soil. Apparently, as soon as the taste for this delicacy was developed, the birds systematically covered the areas where the potatoes were found. The truth would not be severely violated by the statement that practically every volunteer potato along the edges of the wheat field was dug up by the pheasants. Most of the potatoes had only a few pecks in them. Close to the northeast edge of the central wooded section Purnell planted several rows of new potatoes. These too were sampled at great length and were apparently preferred to the volunteers for considerable portions were removed from the products of these solonaceous plants. (Fig. 16) The principal damage accorded the potatoes by pheasants is not due to the actual feeding on them but rather to the uncovering of the underground portions, exposing them to the action of sunlight so that they turn green.

Another feeding procedure that seems of particular interest is that concerned with the tremendous effort expended by pheasants in beds of many members of the lily and parsley families. (Figs. 17 & 18) In some areas on the island members of the Liliaceae and Umbelliferae grew in profusion. The birds appeared to be most interested in the Cluster lilies, wild onion and Spring Gold. The bulbs of the lilies mentioned are not as deeply seated in the earth and are found in lighter soils than are the other bulbs on Protection Island. Whether the birds fed on the bulbs or



Fig. 17

Showing where wild onions
had been completely dug
out by pheasants.
July 29, 1939



Fig. 18

Showing where Spring Gold
had been dug out by
pheasants on east spit.
July 25, 1939

on some insects harbored there was not determined. At any rate these plants should be investigated as important items in the diet at certain periods of the year when available.

The most important food item needing consideration are wheat and barley, not because they are essential to the well being of the birds, but because those grains or the young plants are sometimes consumed in large quantities, thus constituting a potential problem to the man who raises cereal crops for a livelihood.

Purnell's hired man planted wheat in the fall during two separate periods. Naturally the grain sprouted during corresponding periods. Another item in the planting process that made possible some observations was the fact that in two or three strips the seed drill came out of gear. Consequently no seed was deposited in those strips until after the original sprouting, when the condition was noticed and rectified by a later drilling.

Before the middle of November, evidence of the birds feeding along the edges of the wheat field was noticed. There were some signs of feeding as far as two hundred and fifty feet from the edges, but these were scattered and apparently hurried. Most of the wheat sprouts appeared to be too deep and firmly rooted to be pulled up and some of those sprouts that were uprooted were not eaten.

It seemed that at first the birds did not recognize the newly sprouted grain as food. This fact is entire-

ly in keeping with several studies pointing out that many animals must often learn or be taught to accept new foods in their diet, as recorded by Bogardus, A.H. (1), Errington, P.L. (2), Gorsuch, D.M. (3), and Stoddard, H.L. (7). A considerable period of time intervened between the appearance of sprouted grain and evidence of its being utilized by the birds. At first only the tops were taken, then the bleached portion at the base of the sprout. Finally the birds dug down and consumed the grain, but this was done in a comparatively few instances where some areas had been planted late and there was little disintegration of the kernel. In some places where the seed drill had gone over previously planted ground one could easily see where the pheasants had followed the path of the second seeding, digging up the very new sprouts and entirely ignoring the older ones.

After the birds learned that new sprouts meant full seeds they dug for those seeds until they had been so fully utilized by the plant that they offered little, if any, food value. Then the pheasants reversed their methods and again fed on the sprouts when no new seedlings were available. Apparently the anti-fungus treatment of a light soaking in formaldehyde to which each seed was subjected before planting was of no consequence to the birds which fed upon them. The outstanding point of this whole topic is that pheasants learn or are at least aware of the dif-

ference between new sprouts and old ones. Possibly, in the event of considerable pheasant damage to newly sprouting grain, a light seeding in a separate field or around the edges of the field being damaged would serve to divert the attention of the birds until the original planting was beyond the desirable stage for the pheasants. A diversion seeding should be made two or three weeks following the first seeding, since it is the younger sprouts that attract the birds.

Feeding on barley sprouts was comparatively rare and confined largely to the portions of those fields where the earth had been packed down firmly by the tractor. The choice thus exercised by the birds may be explained by the fact that the more solid ground offered easier footing for the birds than the broken clumps left by a disc, or what is perhaps more likely the seeds are not so deeply planted in the firm soil. The light, sandy loam under-soil offers easy digging even when the surface is packed down.

In connection with feeding habits it was of interest and significance to observe that nearly all cat droppings examined on the island during July and August contained feathers and barley or wheat fragments. Of course not all of the feathers were those of pheasants, but many were, thus giving additional emphasis to the contention that considerable grain is utilized by these birds.*

* Largely waste grain.

One other point concerning the feeding on cereal grains needing clarification is, how much of the feeding on the grain crop is actual damage and how much grain consumed is waste? General observations strongly indicate that at least in cases where the population is at the level found on Protection Island during the year of this study, most of the grain taken by pheasants is of the latter category. The birds were frequently seen pecking at heads of wheat which had been broken down by men walking through the field or by heavy storms. Since the grain, averaging 42 inches tall, would not otherwise have been readily available to the birds, and since no deliberate attempts on the part of the pheasants to break the stalks was ever seen, it may be assumed that such an act is rarely, if ever, committed. After the harvesting season considerable quantities of waste grain become available and are used. The tall stubble remaining after the harvest enables the birds to travel all through the fields with comparative ease and safety. (Figs. 19 & 20)

MEASUREMENTS

FEEDING IN GRAIN

In order to ascertain the pheasant damage to grain sprouts, if any, a variation of the sample plot method of study was used to secure the desired information. A



Fig. 19

H.F. Purnell,
six feet tall, showing
height of wheat stubble,
August 17, 1939



Fig. 20

Mrs. Newcomb,
five feet tall, showing
height of barley stubble,
August 6, 1939

square, rigid wooden frame was constructed with inside dimensions of one foot. (Fig. 13) With this implement the average number of sprouts per square foot in each field was determined. At first, numerous random samples were made in order to discover what percentage of the fields should be sampled and also to find out how constant the measurements were. The samples checked within approximately one sprout per square foot of each other which was considered sufficiently accurate for the purpose in mind. A total of 710 counts were made by systematically covering each field and making a square foot count at regular intervals. Barley fields received 310 counts and the wheat field received 400 counts. The large area of the wheat field in one block permitted of a smaller percentage of samples with no commensurate loss in accuracy. The procedure outlined above revealed an average of 17.91 sprouts per square foot in the barley fields and 17.33 sprouts per square foot in the wheat. One of the barley fields was planted much more heavily than any of the others which accordingly raises the average figure for barley sprouts unproportionately.

After securing the average number of sprouts per square foot in each field, locations where pheasants were known to feed heavily were delineated and the areas determined. The average number of sprouts per square foot in these areas were determined by further sampling.

In the barley field the count revealed 9.76



Fig. 13

Square wooden frame
used to measure number
of grain sprouts



Fig. 14

Showing east bluff
where pheasants were liberated
in May, 1937 and where many
1938 nests were found

sprouts per square foot in that portion where pheasants were known to have fed heavily. Since comparatively little feeding was done in the barley as a whole, these figures will be dropped from further discussion. In the wheat field the average sprout count revealed 11.10 sprouts per square foot in the area where the birds had fed heavily. In 27,000 square feet, or 0.6201 acres of wheat land, which is only 0.638 per cent of the total area planted to wheat, 64.05 per cent of normal sprout growth remained. Elsewhere in the field, where feeding was light, circumstantial evidence indicated that the birds contributed to the development of the stand of grain by causing the young sprouts to "stool out" more than was normally expected. A similar conclusion was independently reached by Mr. Purnell. Undoubtedly this supposition could be easily demonstrated or disproven as the case might be.

CROP AND GIZZARD ANALYSES

Since it would obviously defeat the purpose of the study as a whole to take birds for crop and gizzard analysis, this phase of the work was dependent upon the recovery of these organs from birds found dead due to predation, disease or accident.

One or both organs were recovered from thirteen birds, yielding a total of seven crops and eleven gizzards. Such a small number of samples serves only to indicate the

trend in food utilization by pheasants on Protection Island. Five samples, or 27.77 per cent of the total, were taken during the first three months of the year. Only one sample, or 5.56 per cent, was recovered during the second three months. Eleven samples, or 61.11 per cent, were found during July, August and September. The last quarter of the year produced only one sample, or 5.56 per cent of the total. The high increase in mortality during late summer comes when the birds are moulting and at the beginning of the hawk migration.*

The figures in Tables VII and VIII representing miscellaneous vegetation may seem unduly high. In most cases this category is composed of grass and grain chaff which is of comparatively little value as food to the birds and passes through the intestinal tract practically unchanged in physical appearance. This fact may be easily comprehended when the miscellaneous vegetation is compared to the contents of a dried dropping.

Mr. Arthur S. Einarsen, under whom the study as a whole was conducted, is of the opinion that Ring-necked pheasants are capable of existing entirely on leafy vegetation. The high percentage of such material occurring in so

* The figures indicating recoveries of crops and gizzards can not be compared with kills found on the island since in many cases different birds are represented. Frequently a kill yielded neither crop nor gizzard.

A complete breakdown of the contents of crops and gizzards will be found in Table VI, pages 50-53.

few stomachs lends support to this contention. Undoubtedly the birds prefer greater variety than such a diet would provide, but experiments should be conducted to determine the possibility of pheasants existing under those conditions.

WATER

The only free, fresh water obtainable by pheasants on the island was from pools following hard showers or from the cattle drinking trough. At no time were the birds ever seen utilizing these two sources. Nor were the pheasants ever seen at the edge of the ocean or the brackish lagoon attempting to drink. Apparently pheasants on Protection Island are completely capable of sustaining life on succulence and dew alone, as far as water is concerned.

Wight (8:224,5) says: "The accessibility to water does not seem to be a factor of importance in the choice of the nest site. During the excessive heat of late July and early August, 1930 ... pheasant flocks were in some instances found close to water and at times were actually in the water although they were not seen drinking."

Leopold (4:292) says: "This evidence as to pheasants is somewhat contradictory. Probably the ring-necks are like grouse; they can nest on dew and succulence, but in late summer tend to seek water either out of choice or necessity. Optimum pheasant range should doubtless offer frequent drinking water."*

There is no doubt but that evidence in connection with water requirements of pheasants is contradictory.

* *Italics mine.*

Following the nesting season on Protection Island there is a continual drop in available moisture. During August there were several days without a trace of dew at any time and numerous days when dew was barely noticeable. If, after the present study is finished, another could be started with comparable conditions except for the presence of watering places, it would perhaps be possible to determine if optimum pheasant range should necessarily supply frequent drinking water as Leopold has suggested. The question on that point is raised for, as the discussion under one of the following headings will indicate, reproduction of pheasants has so far been wholly satisfactory.

NESTING (1939)

The first nest of the 1939 nesting season was found on May 5. Twelve of the fourteen eggs it contained hatched on May 13. The other two eggs or their remains could not be found. In order not to adversely affect the hatch no effort was made to find nests until after the nesting season. The grain fields were carefully inspected from behind the header on the combine during the harvest and it is believed that nearly all nests which were in the grain fields were found. Unfortunately, it was necessary to leave the island before the harvest was completed and this method of nest hunting was not continued in the remaining grain which was about 15 per cent of the total

stand of wheat. Twelve nests were found but one was completely destroyed by the tractor before the egg remains were counted.

Of the ninety-six eggs found in eleven nests, 62, or 64.58 per cent hatched, 12.50 per cent were fertile but failed to hatch, 5.21 per cent were known to be infertile and 17.71 per cent were classified as unknown. Fertility was at least as high as 77.08 per cent. A cat killed one female on the nest and destroyed the eggs but did not feed on them. One nest containing fifteen eggs was deserted for some unknown reason and the fertility was not determinable. These last two items help explain the discrepancy between the 1938 and 1939 nesting seasons. The average number of eggs per nest in 1939 was 8.73.

Fifty per cent of the 1939 nests were found in barley fields, 33.33 per cent in wheat fields and 16.66 per cent were found under cover of bracken and grass.*

BROODS

Of forty-four broods of young birds observed from May 14 to August 3 the average number was 6.93 individuals. This figure does not include lone chicks which were frequently seen during the above mentioned period. One of the interesting points in connection with the brood count was

* For a graphic and tabular display of 1939 nesting data and nesting cover turn to Table IV, page 48.

that during the last two weeks, most of the groups seen contained two or three times as many birds as the average and the members of the broods were usually of separate age classes. This fact indicates that broods break up due to predation or the carelessness of the parent hen and the "orphan" or "foundling" chicks become attached to other groups.

INVENTORY (1939)

On October 13, six men with a dog conducted a drive census on the island in an attempt to determine the increase of birds. The procedure followed was identical to the inventory taken the previous year with the exception of the use of a dog and an additional man. The weather was excellent, as opposed to the rain, hail and sleet of November 10, 1938. (Pagell) Two hundred and twenty male pheasants, one hundred and eighty females and thirty of undetermined sex were flushed and tallied for a total of four hundred and thirty birds. On a basis of the seventy-six birds tallied the previous year the increase would appear to be 565.8 per cent. Were it to be assumed that the two censuses were equally effective that figure could stand, but since a dog and an additional man were used and the weather was much more conducive to reasonably accurate censusing on October 13, 1939, the corrected 1938 figure of approximately one hundred and ten birds minus a kill of

eight birds prior to the nesting season should be used to determine the relative increase. On the basis of one hundred and two birds entering the 1939 nesting season it may be said that there was an increase in the pheasant population on Protection Island in 1939 of roughly 321.0 per cent.

SURVIVAL

Since there was a potential increase of approximately 480 birds represented by fifty-five nests containing an average of 8.73 eggs, the measured increase of 329 birds in October indicates a survival of about sixty-six per cent resulted. This high survival is probably due to the limited amount of moisture during the nesting and brooding seasons and also to the relative freedom from predators and mechanical menaces such as highway traffic and telephone wires enjoyed by the birds on Protection Island.

SUMMARY AND CONCLUSIONS

SUMMARY

1. The study of Ring-necked pheasants on Protection Island, Jefferson County, Washington was made possible by the Oregon Cooperative Wildlife Research Unit, under the direction of Mr. Arthur S. Einarsen, Associate Biologist, United States Bureau of Biological Survey.

2. Protection Island is an excellent study area, not under wire, comparable in many respects to average pheasant range.

3. The particular purpose of the study was to establish bases for good management practices and to consider the effects of and the relationships between Ring-necked pheasants and agriculture as practiced on the island.

4. Protection Island, a formation of sedimentary and glacial origin, is located in the Strait of Juan de Fuca, about two miles off shore, near the mouth of Puget Sound.

5. The total area of the island is approximately four hundred acres. One hundred and twenty acres are devoted to agriculture. About eighty acres of the island support woodland. The sand spits at either end of the island comprise about forty-seven acres and the remaining one hundred and fifty acres contain grassland and sand dunes.

6. The climate is temperate with an average annual rainfall of 13.39 inches.

7. The shelter cabin was located on nearly the highest point of ground on the island, thus affording an excellent view of the major portion of the island at all times.

8. Protection Island is owned by Mr. William E. Grimshaw of Seattle, Washington. The island has been leased and farmed for many years. Mr. Harry F. Purnell has farmed the island since 1936.

9. Pheasants were apparently first liberated on Pro-

tection Island in 1882. After reaching tremendous numbers they disappeared.

10. In May, 1937, H.F. Purnell, with the cooperation of the Washington State Department of Game, liberated two male and eight female Ring-necked pheasants. At least two of the females died before they could have completed nesting. The next spring, according to Purnell, there were about thirty five birds entering the breeding season.

11. In the sixteen nests of the 1938 nesting season, ninety-one eggs were found, of which seventy-four, or 81.32 per cent, hatched. Fertility was 83.57 per cent. The average number of eggs per nest was 5.86.

12. A drive census on November 10, 1938 revealed thirty three males and forty-three females or a total of seventy-six known individuals. Adverse weather conditions, rendering the birds difficult to flush, gave a poor count. Later observations indicated that approximately one hundred and ten birds were resident on the island on January 1, 1939.

13. Pheasants normally roosted on the north side of the south dunes. There were three notable major exceptions to this rule.

14. From April until the last of June all night roosts in one spot were rarely found, indicating that long time nocturnal roosting during this period was practiced by unmated or somewhat abnormal birds.

15. At the end of June there commenced a gradual resump-

tion of nocturnal roosting, with young birds apparently being the first to do so. Roosting was again normal in August.

16. Slightly over fifteen per cent of the population were found dead due to predation or accident. Two feral house cats were responsible for 41.17 per cent of the known causes of loss of birds.

17. During the four months May through August, 2.81 per cent of the 1939 increase of birds were found dead.

18. Predators, other than the cats, known to have been present on the island at some time were:

- a. Marsh Hawk
- b. Western Pigeon Hawk
- c. Duck Hawk
- d. Western Goshawk
- e. Sharp-shinned Hawk
- f. Cooper's Hawk
- g. Short-eared Owl
- h. Dusky Horned Owl

19. Purnell's tractor was responsible for the deaths of some young pheasants.

20. Breeding plumage was strongly evident by the middle of January but crowing did not really get started until the twelfth of March. Display activities were not seen until the last of March.

21. Matings were first observed on April 15 but undoubtedly some matings had been consummated prior to that date.

22. Of 718 recorded observations on pheasants feeding in various types of cover, 414, or 57.60 per cent, were in

grain fields which comprise 30.48 per cent of the total area. The point given emphasis by these figures is that the birds spend a much greater portion of their time in the grain fields than the amount of grain consumed by them tends to indicate.

23. The following three groups of food items were not measureable:

Cultivated peas were avidly fed upon by pheasants when available. Had Purnell been raising pea seed, considerable damage would undoubtedly have been wrought by the birds.

Volunteer and crop potatoes were heavily utilized by pheasants.

Beds of Cluster lilies, wild onion and Spring Gold were extensively dug up by pheasants. It is not known whether some part of the plants or some insects harbored by the plants were sought.

24. Some other important items in the diet were; wheat, yellow mustard, barley, chickweed and fiddleneck. The occurrence of these items in pheasant stomachs gave some basis for measurement.

25. Pheasants learn or are at least aware of the difference between new and old grain sprouts. They prefer new sprouts. Wheat sprouts were preferred to those of barley.

26. In the event of anticipated heavy pheasant damage to newly sprouting grain, a light seeding around the edges of the fields being damaged would possibly serve to divert

the attention of the birds until the original planting was beyond the desirable stage for the pheasants.

27. Feeding on cereal grains on Protection Island was principally confined to waste material.

28. The tall stubble remaining after the harvest enabled the birds to travel through the grain fields with comparative ease and safety.

29. In 0.6201 acres or 0.633 per cent of the wheat field, where pheasants had fed heavily, 64.05 per cent of normal sprout growth remained.

30. Elsewhere in the wheat, where feeding on sprouts was comparatively light, it may be said that the birds contributed to the development of the stand of grain by causing the young sprouts to "stool out" more than would be normally expected.

31. Seven crops and eleven gizzards were collected from thirteen pheasants. Twenty-four different items were found in those organs.

32. In most cases the high percentages of miscellaneous vegetation found in the crops and gizzards was composed of grass and grain chaff which is of comparatively little value as food to the birds and passes through the intestinal tract practically unchanged in physical appearance.

33. Some experimental work on the ability of pheasants to exist on an exclusive diet of leafy vegetable matter should be conducted.

34. At no time were pheasants ever seen utilizing free drinking water from any source. Apparently pheasants on Protection Island are completely capable of sustaining life on succulence and dew alone, as far as water is concerned.

35. The first nest of the 1939 nesting season was found on May 5. Twelve of its fourteen eggs hatched on May 13.

36. Of the ninety-six eggs found in eleven nests of the 1939 nesting season, sixty-two, or 64.58 per cent, hatched. Seventy-four eggs, or 77.08 per cent, were fertile. The average number of eggs per nest was 8.73.

37. Of forty-four broods of young birds observed from May 14 to August 3, the average number of chicks was 6.93.

38. During the last two weeks of the above mentioned period, most of the groups seen contained two or three times as many birds as the average brood and usually contained birds of separate age classes.

39. During a drive census on October 13, 1939, two hundred and twenty male pheasants, one hundred and eighty females and thirty of undetermined sex were tallied for a total of four hundred and thirty birds. The increase represented by this figure is roughly 321.0 per cent over 1938.

40. There was a survival of approximately sixty-six per cent of the eggs deposited in 1939.

CONCLUSIONS

In view of the objectives set forth for this study the following conclusions are drawn:

1. A concentration of as many as one bird per acre, after grain was well established, caused no appreciable damage to grain crops on Protection Island.
2. No set rules can be given regarding pheasant behavior, for pheasants react differently under different conditions.
3. Free drinking water is not essential to the well being of pheasants on Protection Island.
4. The survival of Ring-necked pheasants on Protection Island is very high. The low spring and summer rainfall may be one reason for this fact.
5. The chief value of the drive census method of inventory is to indicate trends in populations and to show the relative rate of increase or decrease over a period of years.
6. Pheasants normally roost in areas of medium cover. The degree of density of roosting cover varies with weather conditions and with the seasons.
7. Night-long roosting in one spot is rarely practiced by pheasants during the mating and nesting season.
8. Pheasants that do roost in one spot for long periods during the mating season are probably abnormal in

some respect.

9. Feral house cats are the most successful of the predators on pheasants on Protection Island.

10. Tractors are often responsible for the deaths of young pheasants.

11. Crowing and courtship activities by pheasants become pronounced during the middle of March on Protection Island.

12. Mating was not commonly practiced by pheasants until the early part of April.

13. Pheasants quickly become aware of the difference between new and old grain sprouts.

14. Broods of young pheasants are easily dispersed by predators. The young so dispersed attach themselves to other broods.

TABLE II

AREAS ON PROTECTION ISLAND

Determined by Planimeter
from
Enlarged Aerial Photograph, Fig. 1.

Scale - 1 inch equals 992 feet

Total Area	394.4214 Acres	
Wheat Field	97.1370	"
Barley N.W. cabin	7.4547	"
Barley N.E. cabin	6.7770	"
Barley below water tank ..	5.6475	"
Barley top water tank hill	3.1626	"
Grain Field Totals	120.1788 Acres	
Central wooded section ...	16.2648 Acres	
North wooded section	65.5116	"
Total of woods	81.7764 Acres	
West Spit	7.0029 Acres	
East Spit	41.1138	"
Total of Spits	48.1167 Acres	
Grassland and Dunes	144.3495 Acres	<u>144.3495 Acres</u>
Total of all areas	394.4214 Acres	

TABLE III

47

Summarized Data Regarding
the 1938 Nesting Season-----
Eggs Found in Each Nest

Nest Number	Total Number	Number Hatched	Fertile Unhatched	Number Infertile	Unknown
1	4	4			
2	4	4			
3	1	1			
4	6			6	
5	3				3
6	8	8			
7	5	1	1	3	
8	3	3			
9	4	4			
10	5	5			
11	6	6			
12	9	6			3
13	8	8			
14	11	10	1		
15	7	7			
16	7	7			
	91	74	2	9	6

Summarized Data Regarding Eggs Observed

91 eggs found	100.00 %
74 eggs hatched	81.40
2 eggs fertile (unhatched)	2.17
9 eggs infertile	9.88
6 eggs unknown	6.55

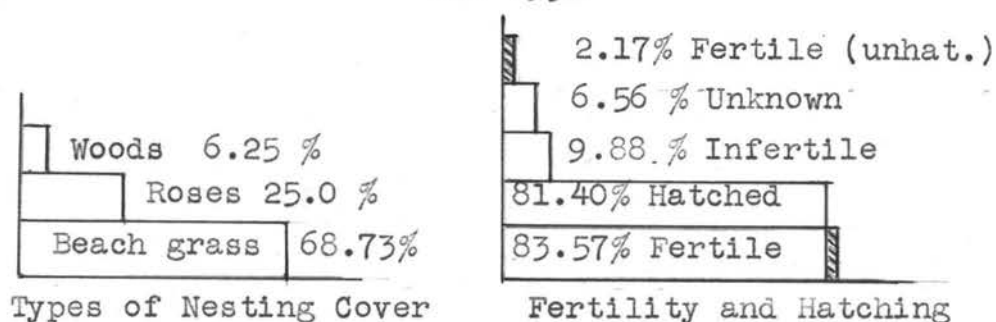
Average Number of Eggs per Nest -- 5.68
-----Graphic Display of Nesting Cover and Egg Condition
For 1938

TABLE IV

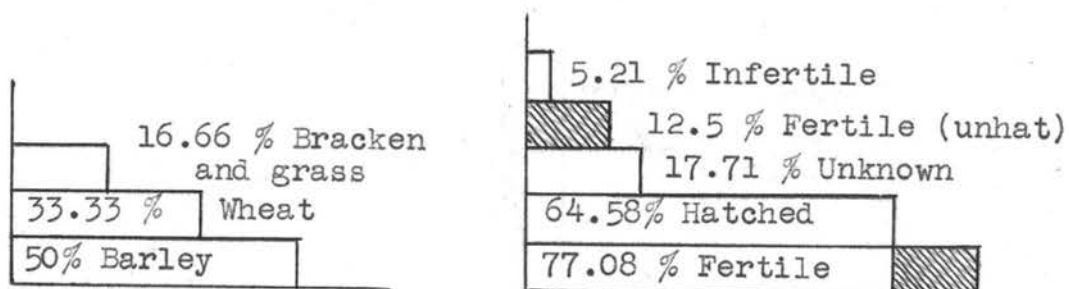
48

Summarized Data Regarding
the 1939 Nesting Season-----
Eggs Found in Each Nest

Nest Number	Total Number	Number Hatched	Fertile Unhatched	Number Infertile	Unknown
1.....	14	...	12	.....	2
2.....	8	...	7	.....	1
3.....	8	...	6	.....	2
4.....	15	.....	.....	.....	15
5.....	7	...	6	.....	1
6.....	8	.....	.....	8	
7.....	12	...	11	.....	1
8.....	6	...	6	.....
9.....	6	...	5	.....	1
10.....	6	...	4	.....	2
11.....	6	...	5	.....	1
	96	62	12	5	17

Summarized Data Regarding Eggs Observed

96 eggs found	100.00 %
62 eggs hatched	64.58
12 eggs fertile (unhatched) ...	12.50
5 eggs infertile	5.21
17 eggs unknown	17.71

Average Number of Eggs per Nest -- 8.73
-----Graphic Display of Nesting Cover and Egg Condition
for 1939

Types of Nesting Cover

Fertility and Hatching

TABLE V

Summarized Data Regarding
Observations on Feeding Birds

Food or Cover*	No. of ob- servations	Per Cent
1. Wheat	216	30.20
2. Barley	198	27.50
3. Beach grass	80	11.20
4. Roses	60	8.30
5. Snowberry	46	6.50
6. Vetches	17	2.40
7. Red-flowering Cur't.	16	2.20
8. Liliaceae	11	1.50
9. Brome grass (sp.) ..	7	0.97
10. Gooseberry	6	0.83
11. Bracken	6	0.83
12. Alfalfa	6	0.83
13. Umbellifereae**.....	6	0.83
14. Yellow Mustard	5	0.69
15. Potatoes	5	0.69
16. Peas	4	0.55
17. Gumweed	4	0.55
18. Lupine	4	0.55
19. Horehound	3	0.41
20. Ocean Spray	3	0.41
21. Dandelion	3	0.41
22. Fiddleneck	2	0.28
23. Cherry	2	0.28
24. Oregon Grape	1	0.14
	718	100.00

* These are representative, random samples of birds having been seen in cover composed mainly of the above items or feeding on the items listed.

** Several members.

Analysis of the Contents of Seven Crops
and Eleven Gizzards from Thirteen Pheasants
on Protection Island in Per Cent by Volume
September 1938 to January 1940

1. Male - killed by dog in pea field, 9/15/38.

<u>Crop</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Peas (cultivated)	98.2
	Yellow Mustard	1.8
<u>Gizzard</u>	Wheat	18.3
	Snowberry	18.3
	Vetch	4.8
	Insects	3.8
	Yellow Mustard	0.9
	Fiddleneck	0.4
	Miscellaneous vegetation	38.6
	Gravel	15.4

2. Male - killed by flying into a fence, 2/21/39.

<u>Crop</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Yellow Mustard	97.4
	Insects	2.5
	Bindweed	0.1
<u>Gizzard</u>	Cherry (sp.?)	13.1
	Leaves (rose)	4.5
	Snowberry	4.0
	Bindweed	1.3
	Yellow Mustard	1.1
	Insects	0.4
	Vetch	0.2
	Miscellaneous vegetation	59.0
	Gravel	16.4

3. Male - killed by cat in barley field, 5/28/39.

<u>Crop</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Chickweed, Field	71.0
	Barley	12.9
	Leaves (Medicago)	6.5
	Fiddleneck	6.4
	Dove's foot Geranium	3.2

4. Female - killed by tractor in wheat, 7/8/39.

<u>Gizzard</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Moss Campion	6.3
	Miscellaneous vegetation	42.7
	Gravel	51.0

5. Female - killed by Marsh Hawk, potato patch, 8/7/39.

<u>Crop</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Wheat	59.9
	Insects	2.9
	Bindweed	2.9
	Peas	2.9
	Beach Pea	0.4
	Miscellaneous vegetation	20.3
	Gravel	15.6

6. Female - killed by Owl, in wheat field, 8/17/39.

<u>Gizzard</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Wheat	23.5
	Leaves (Melilotus)	3.5
	Bindweed	2.2
	Vetch	0.1
	Yellow Mustard (trace)	
	Miscellaneous vegetation	42.3
	Gravel	28.3

7. Male - killed by tractor in wheat, 8/17/39.

<u>Crop</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Wheat	50.8
	Peas (and pea vegetation)	17.0
	Leaves (Melilotus)	15.3
	Vetch (trace)	
	Miscellaneous vegetation	16.9
	Gravel (trace)	
<u>Gizzard</u>	Wheat	7.8
	Vetch	2.3
	Snowberry	1.8
	Yew seed (?)	0.4
	Miscellaneous vegetation	49.4
	Gravel	38.3

TABLE VI CONTINUED

8. Female - killed by cat under dense cover of Ocean Spray, 8/27/39.

<u>Gizzard</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Snowberry	5.7
	Wheat	5.1
	Vetch	2.8
	Bindweed (trace)	
	Miscellaneous vegetation	57.6
	Gravel	29.8

9. Male - killed by combine in wheat field, 9/3/39.

<u>Crop</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Wheat	13.5
	Bindweed	11.0
	Barley	10.5
	Vetch	8.0
	Insects	4.0
	Miscellaneous vegetation	34.0
	Gravel	19.0
<u>Gizzard</u>	Wheat	17.0
	Insects	1.7
	Vetch	0.3
	Yellow Mustard	0.1
	Miscellaneous vegetation	13.9
	Gravel	67.0

10. Female - killed by Marsh Hawk in Beach grass dunes, 9/19/39.

<u>Gizzard</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Leaves (Melilotus)	3.8
	Snowberry	2.9
	Insects	1.9
	Bindweed (seed coats only)	1.0
	Miscellaneous vegetation	58.5
	Gravel	31.5

11. Female - killed by Cooper's Hawk on grassland, 10/6/39.

<u>Gizzard</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Vetch	7.3
	Wheat	5.3
	Seeds (sp.?)	1.6
	Red-flowering Currant (?)	1.3
	Barley	1.3
	Leaves (Melilotus)	1.1
	Bindweed	0.4
	Yellow Mustard	0.1
	Miscellaneous vegetation	63.0
	Gravel	18.5

12. Female - killed by Hawk or Owl on grassland, 1/23/40.

<u>Gizzard</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Wheat (chaff)	11.8
	Barley (chaff)	2.3
	Seed (sp.?)	2.2
	Insect (pupa)	0.7
	Snowberry	0.2
	Vetch	0.2
	Miscellaneous vegetation	44.3
	Gravel	38.6

13. Male - found dead in wheat, cause unknown, 1/23/40.

<u>Crop</u>	<u>Food Items</u>	<u>Per Cent by Volume</u>
	Potato (?)	28.5
	Fiddleneck	16.4
	Yellow Mustard	14.3
	Barley	11.1
	Heron's bill	8.2
	Vetch	1.3
	Insects	0.7
	Beach Pea (trace)	
	Miscellaneous vegetation	19.3
<u>Gizzard</u>	Potato (?)	7.1
	Buds	2.7
	Vetch	2.6
	Fiddleneck	2.5
	Heron's bill	2.4
	Gumweed (?)	1.7
	Snowberry	0.7
	Vetch (cultivated)	0.4
	Miscellaneous vegetation	43.0
	Gravel	37.0

TABLE VII

Occurrence of Food Items in Crops and Gizzards
from Thirteen Pheasants from Protection Island

Items in Stomachs	Occur- rence	Per Cent of Occurrence	Per Cent of Total Volume
Misc. veg.	15	12.60	33.42
Gravel	14	11.76	22.57
Vetch	13	10.92	1.64
Wheat	10	8.40	11.71
Bindweed	9	7.56	1.05
Insects	9	7.56	1.00
Yellow Mustard .	8	6.76	6.43
Snowberry	7	5.88	1.85
Leaves (3 spp.) .	6	5.04	1.92
Barley	5	4.20	2.11
Fiddleneck	4	3.36	1.43
Peas (cult.) ...	3	2.52	6.56
Beach Pea	2	1.68	0.02
Heron's bill ...	2	1.68	0.58
Potato (?)	2	1.68	1.96
Seeds (?)	2	1.68	0.21
Red-fl. Curr't* .	1	0.84	0.07
Geranium	1	0.84	0.18
Cherry	1	0.84	0.72
Chickweed	1	0.84	3.95
Yew (?)	1	0.84	0.02
Buds	1	0.84	0.15
Moss Campion ...	1	0.84	0.35
	119	100.00	100.00

* Red-flowering Currant

TABLE VIII

Percentage by Volume of Items in Crops and
Gizzards of Thirteen Pheasants from Protection
Island, by Quarterly Periods

Items in Stomachs	Jan.- Mar.	April- June	July- Sept.	Oct.- Dec.
Misc. Veg.	33.12	.....	34.02	... 63.00
Gravel	18.40	.....	26.17	... 18.50
Wheat	11.80	.....	27.82	.... 5.30
Peas .....	.....	.....	3.95	.....
Yellow Mustard .	22.56	.....	0.25	.... 0.10
Chickweed .....	.....	71.00	.....	.....
Barley	2.68	.. 12.90	.. 0.95	.... 1.30
Potato (?)	12.06	.....	.....	.....
Leaves (3 spp.)..	0.90	.. 6.50	.. 3.05	.... 1.10
Snowberry	0.98	.....	2.61	.....
Vetch	0.94	.....	1.61	.... 7.30
Fiddleneck	3.78	.. 6.40	.. 0.03	.....
Bindweed	0.28	.....	1.55	.... 0.40
Insects	0.86	.....	1.25	.....
Cherry	2.62	.....	.....	.....
Heron's bill	0.92	.....	.....	.....
Moss Campion .....	.....	.....	0.57	.....
Seeds (?)	0.44	.....	.....	1.60
Geranium .....	.....	3.20	.....	.....
Buds	0.54	.....	.....	.....
Gunweed	0.34	.....	.....	.....
Red-flow'g Cur't.....	.....	.....	.....	1.30
Beach Pea .....	.....	.....	0.03	.....
Yew (?) .....	.....	.....	0.03	.....

TABLE IX

A LIST OF SOME OF THE MORE
CONSPICUOUS PLANTS ON PROTECTION ISLAND

PTERIDOPHYTA

POLYPODIACEAE (Fern Family)

Pteridium aquilinum pubescens Underw. Bracken Fern

SPERMATOPHYTA

GYMNOSPERMAE

TAXACEAE (Yew Family)

Taxus brevifolia Nutt. Western Yew

PINACEAE (Pine Family)

Picea Engelmannii Engelm. Engelmann or White SprucePseudotsuga taxifolia (Poir) Britt. ... Douglas FirAbies grandis Lindl. Grand Fir, Stinking FirTsuga heterophylla (Raf.) Sarg. Western Hemlock

CUPRESSACEAE (Cypress Family)

Thuja plicata Donn. Western Red Cedar

ANGIOSPERMAE

MONOCOTYLEDONAE

GRAMINEAE (Grass Family)

Ammophila arenaria (L.) Link. Beach, Holland Grass

LILIACEAE (Lily Family)

Allium acuminatum Hook. Wild OnionBrodiaea hyacinthina (Lindl.) Bak. White Cluster LilyBrodiaea coronaria (Salisb.) Jep. Large Cluster LilyLilium columbianum Hanson Tiger or Oregon LilyFritillaria lanceolata Pursh. Rice-root LilyErythronium oregonum App. Adder's TongueCamassia Leichtlinii (Baker) Wats. Large CamassStreptopus curvipes Vail Twisted Stalk

IRIDACEAE (Iris Family)

Sisyrinchium idahoense Bicknell ... Blue-eyed Grass

ORCHIDACEAE (Orchid Family)

Epipactis decipens (Hook.) Ames. Rattlesnake PlantainCytherea bulbosa (L.) House ..Calypso, Fairy Slipper

DICOTYLEDONEAE

SALICACEAE (Willow Family)

Salix hookeriana Barratt Tree Willow

POLYGONACEAE (Buckwheat Family)

Rumex acetosella L. Red Sorrel or Sour DockRumex crispus L. Curly Dock

Polygonum convolvulus L..... Black Bindweed
Polygonum aviculare L. Knot-weed

Salicornia ambigua Michx. Glasswort, Pickleweed

Abronia latifolia Esch. Yellow sand-verbena

<u>Stellaria media</u> (L.)	Cyrill	Common Chickweed
<u>Cerastium arvense</u> L.		Field Chickweed
<u>Silene Hookeri</u> Nutt.		Indian Pink
<u>Lychnis alba</u> Mill.		Moss Champion
<u>Lychnis coronaria</u> (L.)	Desr.	Mullein Pink

Calandrinia caulescens H.B.K. Red-maids
Montia perfoliata (Donn.) Howell ... Miner's Lettuce

Berberis aquifolium Pursh. Oregon Grape
Berberis nervosa Pursh. Mountain Oregon Grape

Capsella-Bursa pastoris (L.) Moench. Shepherd's Purse
Cakile edentula (Bigel.) Hook. Sea Rocket
Raphanus sativus L. Wild Radish
Brassica campestris L. . Wild Turnip, Yellow Mustard
Sisymbrium officinale (L.) Scop. Hedge Mustard

Ribes sanguineum Pursh. Red-flowering Currant
Ribes divaricatum Dougl. Coast Black Gooseberry

<u>Holodiscus discolor</u> (Pursh.) Maxim	Ocean Spray
<u>Amelanchier florida</u> Lindl.	Serviceberry
<u>Rubus</u> spp.	Blackberry
<u>Rosa</u> spp.	Roses
<u>Prunus emarginata</u> (Dougl.) Walp. var. <u>erecta</u> Piper		Wild Cherry
<u>Prunus demissa</u> (Nutt.) Dietr.	Western	Choke Cherry

Lupinus littoralis Dougl. Seaside Lupine
Trifolium spp. Clovers
Melilotus alba Desr. White Sweet Clover
Melilotus officinalis (L.) Lam. Yellow Sweet Clover
Medicago sativa L. Alfalfa

LEGUMINOSAE (Cont.)

- Vicia americana Muhl. Wild Pea
Vicia sativa Cultivated Vetch
Vicia spp. Other Vetches
Lathyrus maritimus (L.) Bigel. Purple Beach Pea

GERANIACEAE (Geranium Family)

- Geranium molle L. Dove's-foot Geranium
Erodium cicutarium (L.) L'Her. . Filaree or Afilaria

ACERACEAE (Maple Family)

- Acer circinatum Pursh. Vine Maple

RHAMNACEAE (Buckthorn Family)

- Rhamnus Purshiana DC. Cascara or Chittem

HYPERICACEAE (St. Johnswort Family)

- Hypericum perforatum L. St. Johnswort or Tipton-weed

VIOLACEAE (Violet Family)

- Viola Howellii Gray Violet

CACTACEAE (Cactus Family)

- Opuntia polyacantha borealis Coult. ... Prickly Pear

UMBELLIFERAE (Parsley Family)

- Lomatium utriculatum (T. & G.) C. & R. ... Spring Gold

ERICACEAE (Heath Family)

- Gaultheria shallon Pursh. Salal
Arbutus Menziesii Pursh. Madrone or Madrona
Arctostaphylos uva-ursi (L.) Spreng. ... Kinnikinnic

PRIMULACEAE (Primrose Family)

- Dodecatheon Hendersonii Gray. Shooting Star, Birdbill

CONVOLVULACEAE (Morning Glory Family)

- Cuscuta squamigera (Engelm.) Piper Marsh Dodder

BORAGINACEAE (Borage Family)

- Amsinckia intermedia F. & M. Fiddleneck

LABIATAE (Mint Family)

- Marrubium vulgare L. Horehound

SCROPHULARIACEAE (Figwort Family)

- Gastelleja angustifolia G. Don. . Indian Paint Brush

OROBANCHACEAE (Broom-rape Family)

- Orobanche grayana Beck. Broom-rape

TABLE IX CONTINUED

PLANTAGINACEAE (Plantain Family)

Plantago lanceolata L. ... English or Black Plantain

RUBIACEAE (Madder Family)

Galium kamschaticum oreganum (Britt.) Piper Bedstraw

CAPRIFOLIACEAE (Honeysuckle Family)

Lonicera ciliosa Poir. Climbing Honeysuckle

Symphoricarpos albus (L.) Blake Snowberry

Linnaea borealis L. var. americana Rehder. Twin Flower

Sambucus glauca Nutt. Blue Elderberry

VALERIANACEAE (Valerian Family)

Valerianella congesta Lindl. Corn-salad

COMPOSITAE (Composite or Sunflower Family)

Tragopogon porrifolius L. Salsify, Vegetable Oyster

Taraxacum officinale Weber Dandelion

Grindelia nana Nutt. Small Gum-weed

Grindelia integrifolia DC. Common Gum-weed

Aster Douglasii Lindl. Common Wild Aster

Eriophyllum lanatum (Pursh.) Forbes ..Woolly Sunflower

Achillea millefolium L. Yarrow or Milfoil

Matricaria matricarioides (Less.) Porter Pineappleweed

Cirsium spp. Thistles

Centaurea Cyanus L. Bachelor's Button

TABLE X

COMMON AND SCIENTIFIC NAMES OF PLANTS
MENTIONED IN TEXT AND TABLES

Alfalfa	<u>Medicago sativa</u> L.
Barley	<u>Hordeum vulgare</u> L.
Bindweed	<u>Polygonum Convolvulus</u> L.
Bracken Fern	<u>Pteridium aquilinum pubescens</u> Underw.
Cactus	<u>Opuntia polyacantha borealis</u> Coult.
Campion, Moss	<u>Lychnis alba</u> Desr.
Cherry, Western Choke	<u>Prunus demissa</u> (Nutt.) Dietr.
Cherry, Wild	<u>Prunus emarginata</u> (Dougl.) Walp..
Chickweed, Field	<u>Cerastium arvense</u> L.
Clover, White Sweet	<u>Melilotus alba</u> Desr.
Currant, Red-flowering	<u>Ribes sanguineum</u> Pursh.
Elderberry, Blue	<u>Sambucus glauca</u> Nutt.
Fiddleneck	<u>Amsinckia intermedia</u> F. & M.
Fir, Douglas	<u>Pseudotsuga taxifolia</u> (Poir.) Britt.
Geranium, Dove's foot	<u>Geranium molle</u> L.
Gooseberry, Coast Black	<u>Ribes divaricatum</u> Dougl.
Grass, Beach (or Holland) .	<u>Ammophila arenaria</u> (L.) Link.
Gumweed	<u>Grindelia integrifolia</u> DC.
Heron's bill (Filaria) ...	<u>Erodium cicutarium</u> (L.) L'Her.
Lily, Large Cluster .	<u>Brodiaea coronaria</u> (Salisb.) Jepson
Lily, White Cluster .	<u>Brodiaea hyacinthina</u> (Lindl.) Baker
Madrona	<u>Arbutus Menziesii</u> Pursh.
Maple, Vine	<u>Acer circinatum</u> Pursh.
Mustard, Yellow	<u>Brassica campestris</u> L.
Ocean Spray	<u>Holodiscus discolor</u> (Pursh.) Maxim.
Onion, Wild	<u>Allium acuminatum</u> Hook.
Pea, Beach	<u>Lathyrus maritimus</u> (L.) Bigel.
Pea, Cultivated	<u>Pisum sativum</u> .
Potato	<u>Solanum tuberosum</u> .
Radish, Wild	<u>Raphanus sativus</u> L.
Red-maids	<u>Calandrinia caulescens</u> H.B.K.
Roses	<u>Rosa spp</u>
Snowberry	<u>Symphoricarpus albus</u> (L.) Blake
Spring Gold	<u>Lomatium utriculatum</u> (T. & G.) C. & R.
Vetches	<u>Vicia spp.</u>
Wheat	<u>Triticum aestivum</u> L.
Willow, Tree	<u>Salix hookeriana</u> Barratt.

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