THE WINTER MORTALITY AND MOVEMENT OF WILD AND GAME-FARM RING-NECKED PHEASANTS ON ELIZA ISLAND, WASHINGTON

by

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THE WINTER MORTALITY AND MOVEMENT OF WILD AND GAME-FARM RING-NECKED PHEASANTS ON ELIZA ISLAND, WASHINGTON

This report presents the results obtained in a comparative winter mortality study of wild and game-farm ring-necked pheasants, Phasianus colchicus torquatus (Gmelin), on Eliza Island, Washington, from December 8, 1950, to March 31, 1951. This was the eighth in a series of studies that have been conducted on the island since March, 1947, by the Oregon Cooperative Wildlife Research Unit[1], under the leadership of Mr. Arthur S. Einarsen, Biologist, United States Fish and Wildlife Service. The purpose of these field experiments has been to examine various factors dealing with reproduction and survival of ring-necked pheasants under natural conditions.

The Oregon Cooperative Wildlife Research Unit serves a three-fold purpose: (1) investigates and performs basic research on game management problems of importance to the cooperators, especially the Oregon State Game Commission; (2) demonstrates by example the effectiveness of wildlife research; (3) aids in the training of personnel in

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[1] Oregon State Game Commission, Washington State Department of Game, United States Fish and Wildlife Service, Wildlife Management Institute, Agricultural Research Foundation, and Oregon State College, cooperating.

wildlife management through field experience and graduate academic studies.

This field experiment was the fourth and concluding winter mortality study of ring-necked pheasants on Eliza Island. The three previous investigations were by Nelson (1947-1948), Corthell (1948-1949), and Hansen (1949-1950). The objectives of these studies have been generally five-fold: (1) to determine by field observations, on a systematic basis, the factors affecting the overall survival of pheasants during the winter period; (2) to determine the comparative survival of hen versus cock pheasants; (3) to compare the mortality of game-farm stock with that of wild pheasants; (4) to ascertain the effect and effectiveness of predator control as a management technique by comparing the results of controlled and non-controlled studies; and (5) to study, secondarily, the social behavior, cover preferences, and feeding habits of wintering pheasants under island conditions.

The first experiment, conducted in the winter of 1947-1948, was a study of the mortality of game-farm hen pheasants. Of the 53 hens and one cock released, 33 deaths, all hens, were recorded. Avian predators accounted for 17 of the mortalities. Predatory mammals killed 12 birds. A feral cat was responsible for the demise of 11 of the 12. No predator control was attempted

(Nelson, 1949).

In the second winter study, 1948-1949, 22 cocks and 10 hens, equally divided as to game-farm and wild origins, were used as study animals. A 60 per cent loss of hens, of both game-farm and wild origin, was noted, compared with a 73 per cent mortality among game-farm cocks and a 36 per cent loss in cocks of wild origin. These figures indicate, among cock pheasants at least, that game-farm birds are not well adapted for survival under wild conditions. Predator control was not attempted (Corthell, 1950).

A total of 50 pheasants, 40 hens and 10 cocks, were used in the winter study of 1949-1950. Of the 50 birds, 26 were of wild stock and 24 were of game-farm origin. Both game-farm and wild hen pheasants suffered a 50 per cent mortality. All four of the game-farm cocks released survived the study period. Only one, or 16.6 per cent, of the six wild cocks was killed. Predator control was practiced in the experiment. Predations, however, continued at a near-normal rate, as compared to non-controlled studies, indicating, possibly, that predator control acts only as a delaying action on Eliza and is not a valid management technique (Hansen, 1951).

The purpose of the present study, the concluding winter mortality experiment on Eliza Island, was to

compare the survival of three distinct groups of pheasants: (1) 15 juvenile wild birds, 10 hens and five cocks; (2) five juvenile game-farm cocks; and (3) 10 adult game-farm hens that had been conditioned to life in a natural environment by living in the wild on Eliza during the summer of 1950. An important consideration to be kept in mind while reading this report is the fact that a slight majority of the birds used, 16 of 30, were unaccounted for and were believed to have left the island during the period of study.

This paper is divided into four major sections. The chapter on "Procedure" deals mainly with the mechanical aspects of a field problem. The origin of the pheasants used as study animals is discussed as are liberation method, dispersal, techniques of field study, and harvesting procedure.

In the chapter entitled "Observations", the social behavior, cover preferences, foods and feeding habits, weather conditions, and other minor factors associated with the daily life of the pheasant are discussed.

A chapter on "Results" presents an analysis of the pheasant mortalities recorded in the study.

The fourth major section of the report is concerned with a summary analysis of the four winter mortality studies conducted on Eliza Island, 1947-1951.

In organizing a report by this method, a certain amount of overlapping in subject matter undoubtedly occurs. It is believed, however, that the arrangement adds to the general clarity of presentation.

LOCATION

Geographically, Eliza Island (Figure 1) is in the northern part of Puget Sound, Washington, on the eastern fringe of the San Juan Island group. On the east, Bellingham Bay separates Eliza from the mainland while Hales Pass on the western side of the island demarks it from the imposing slopes of Lummi Island. Eliza Island is now accessible by private boat or seaplane from Bellingham, which is eight miles to the northeast. No scheduled commercial transportation facilities are available. The biogeography of the area has been given extensive treatment by Nelson (1949) and, hence, will not be presented here (6, p.8).

HISTORY AND DESCRIPTION

The history of the discovery of Eliza Island by Lieutenant Francisco de Eliza of the Royal Spanish Navy in July, 1791, and the subsequent chapters in the history of the island have been covered conclusively by Scott (1948, 8, p.4) and Nelson (1949, 6, p.4) and will not be

FIGURE 1. AERIAL VIEW OF ELIZA ISLAND.
(U.S. ARMY AIR CORPS PHOTOGRAPH)

repeated here.

Eliza Island, although including only 158 acres in land area, has a beach perimeter of nearly three miles. From the geological aspect, the structure of the island is interesting, for apparently the present land mass was originally divided into two smaller islands: (1) the mile-long, rugged, eastern wooded section, which includes about 50 per cent of the present land area; (2) the smaller, but rocky, western point. In fairly recent geologic history, probably through the force of currents and the gravelly nature of the sea bottom, a sand flat was built up between these two rock islets, joining them and creating the present outline of the island. Indicative of the recent nature of this development is the presence of a brackish marshy lagoon on the island flat, probably a remnant of the channel which once separated the two islands. Thus, Eliza has a "gangly" shape, somewhat resembling an isosceles triangle with the short sides deeply and unevenly concave.

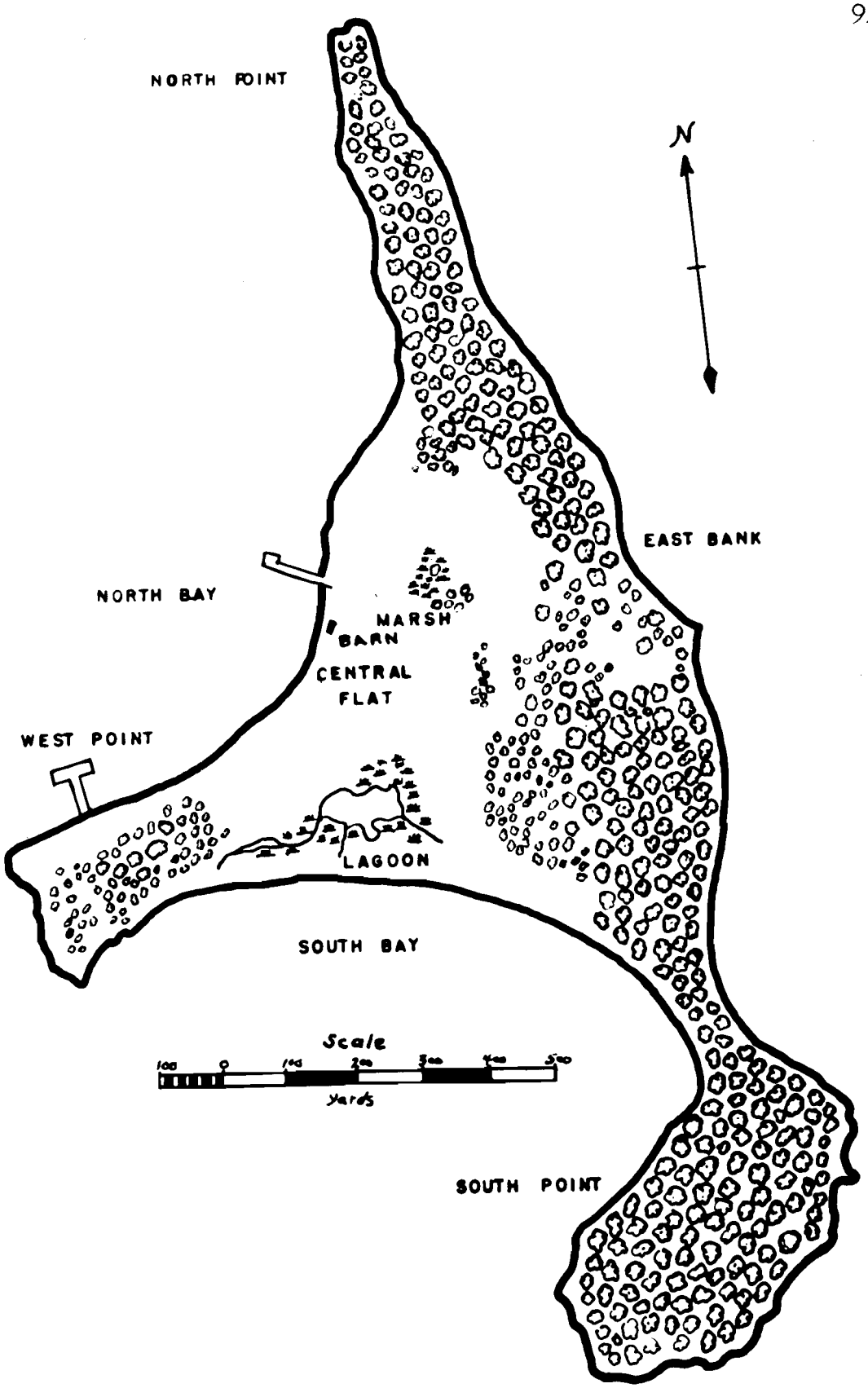
The wooded rocky areas on west point and the eastern section of the island are several feet higher in elevation than the flat. Elevation reaches a maximum of 60 feet above sea level in the south point woods. The shape and direction of the island's points make the physical aspect simply denotable as, North point, South point, West point,

and the Central flat (Figure 2). These terms are used extensively in referring to areas in the text of the report.

FIGURE 2

DIAGRAM MAP OF ELIZA ISLAND SHOWING PRINCIPAL PHYSICAL FEATURES.

(MAP BY R. L. SALTER)


NORTH POINT
N
EAST BANK
NORTH BAY
MARSH
BARN
CENTRAL
FLAT
WEST POINT
LAGOON
SOUTH BAY
Scale
100 0 100 200 300 400 500
Yards
SOUTH POINT

PROCEDURE

METHODS OF FIELD STUDY

The amount of usable and factual information obtained in a study such as this one appears to be directly proportional to the field effort and time expended. From the liberation on December 8, 1950, until the commencement of live-trapping on March 7, 1951, a major portion of the daylight hours of most days was devoted to observations. Daily field study varied, however, in time and intensity. Weather, at times, was a hindering factor. Occasional extreme winds, rains, and cold weather tended to hamper field work.

In an effort to use the time available in the best possible way, three techniques of field study were tried. The first method, "gridding", which consisted of traversing sectors of the island by walking back and forth along imaginary parallel lines, systematically covering all the terrain, was found to be valuable only if a small area required detailed attention.

In the second method, the island was divided into six fairly equal areas. One area was to be searched thoroughly each day of the week with the extra day set aside for sections deserving special consideration. It was found,

in this method, than an excessive amount of time was spent in unlikely habitat.

The third method, which will be termed "wandering", proved to be the most effective. In this type of field procedure, a different route through the selected habitat was taken on each trip. Whims which would lead one off the general route were usually catered to. This may seem to be haphazard, but it proved to be the most successful method. Naturally, the areas of pheasant concentration were searched more thoroughly than sections with lower densities.

One pointed exception to the wandering method of observation was made during the series of Great Horned owl, Bubo virginianus[2], predations. The presence of an owl and the probable locale of its predations could be ascertained by a daily visit to a series of poles, stumps, and snags, which extended from the northeastern upper-flat area southward, in nearly a straight line, to a stack of old fish-trap pilings on south bay. This trip, which may be called the "owl run" utilized about 15 minutes of field time each day. Of the seven predations discovered during the study, five were found along the route of the "owl

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[2] Scientific names of plants and animals are included in the text only the first time the specific animal or plant is mentioned.

run".

An attempt was made, throughout the tenure of the observations, to cover the entire island twice a week. Complete notes were compiled daily. Emphasis in observations was placed on bird losses, social behavior, movement, and habitat preferences. As an aid to food studies, a representative group of pheasant droppings were collected each week. An efficient Springer Spaniel dog was available and proved helpful in locating birds and as a field companion.

At the conclusion of the study, the island was thoroughly searched in an attempt to account for all evidence which might have been overlooked during the regular observation period, December 8, 1950, to March 31, 1951.

HISTORY OF THE BIRDS USED

A total of 30 ring-necked pheasants were used for the winter mortality study of 1950-1951. Of this number, 15 were juvenile wild birds, 10 were adult game-farm hens, and five were juvenile game-farm cocks. To provide background, a detailed examination of the history of each group of birds may prove helpful.

The first class of birds includes 10 juvenile wild hens and five juvenile wild cocks. These birds were trapped on Eliza during October of 1950 for use in this

winter study. They were the offspring of game-farm adults released on the island in April, 1950.

The second group of birds, 10 adult game-farm hens, form a rather unique segment in that they were used in two consecutive studies on the area. They were shipped to Eliza in April, 1950, for use in the summer study. In October, they were live-trapped for re-release in this experiment. These pheasants, although of game-farm origin, had lived in the wild on Eliza for seven months before being trapped for use in this study. Thus, they had been conditioned to life in a natural environment prior to the study. Incidentally, it is also interesting to note that these birds formed a part of the parent group of pheasants that reared the juvenile wild hens and cocks noted above.

A group of five juvenile game-farm cocks form the third distinct class used in the study. These birds arrived at Eliza on December 6, 1950, from the Whidbey Island, Washington State Game Farm, for use in the winter project.

All of the pheasants seemed to be in excellent condition at the time of release. A few of the juvenile wild hens were small, by weight, as they had hatched late in the summer. The release weights of the individual birds are given in Table 1.

TABLE 1

A LISTING OF RELEASE-HARVEST WEIGHTS AND DISPOSITION OF THE PHEASANTS USED ON ELIZA ISLAND, WASHINGTON, DECEMBER 8, 1950-MARCH 31, 1951.

Sex[3]	Origin[4]	Band No.	Release Weight (Lbs.-Oz.)	Harvest Weight (Lbs.-Oz.)	Gain-Loss (Oz.)	Disposition[5]
F	AGF	47701	2--2	----	-	U
F	AGF	47702	2--1	----	-	U
F	AGF	47703	1-13	----	-	P
F	AGF	47704	2--2	2--2	0	H-S
F	AGF	47705	2--6	----	-	U
F	AGF	47706	1-15	----	-	U
F	AGF	47707	1-15	2--7	plus 8	H-S
F	AGF	47708	2--1	----	-	U
F	AGF	47709	1-15	----	-	U
F	AGF	47710	2	----	-	P
F	JW	47712	2	----	-	U
F	JW	47713	2--3	2--4	plus 1	H-S
F	JW	47714	2	2--3	plus 3	H-LT
F	JW	47715	2--3	----	-	U
F	JW	47716	2--1	----	-	P
F	JW	47717	1-13	----	-	U
F	JW	47718	1--4	2--2	plus 14	H-S
F	JW	47719	2--6	----	-	U
F	JW	47720	2	----	-	U
F	JW	47721	1-15	----	-	U
M	JGF	32411	2--4	----	-	U
M	JGF	32412	2--5	2--7	plus 2	H-LT
M	JGF	32413	2--8	----	-	P
M	JGF	32414	2-11	----	-	P
M	JGF	32415	2--9	----	-	P
M	JW	32416	2-14	----	-	U
M	JW	32417	2-14	----	-	U
M	JW	32418	2--9	----	-	U
M	JW	32419	2-15	----	-	U
M	JW	32420	2--9	not weighed	-	H-LT

[3] M and F indicate male and female.

[4] GF means game-farm, W--wild, J--juvenile, A--adult.

[5] U means undetermined, P--predation, H--harvested, S--shot, LT--live-trapped.

BANDING METHODS

The pheasants were taken from the holding pen, banded, weighed, and placed in the release crate on the morning of December 8, 1951. To aid in the identification of predator kills, the right leg and left wing of each bird was banded.

The leg bands of the wild birds were painted with a bright-yellow enamel and the tails of this group were shortened by cutting off two inches of feathers. These methods were used in an attempt to provide a usable technique for differentiating between the wild and game-farm birds in the field. Both of these modes proved to be worthwhile in the ensuing field work. The yellow bands were easily distinguishable, especially so when observing a bird with binocular field glasses. The squarely-clipped tail feathers were helpful in identifying predator kills.

All birds were carefully weighed, at the time of banding, so that comparison between late fall and early spring weights could be made (Table 1).

THE LIBERATION

After being banded and weighed, the birds were taken in the crate to the release site. The site chosen for

the liberation was selected for three reasons: (1) it was near the center of the island giving the birds an equal opportunity to disperse to any section; (2) the site was adjacent to protective cover consisting of orchard grass, Dactylis glomerata, matted alfalfa stalks, Medicago sativa, and young Douglas fir seedlings, Pseudotsuga taxifolia; and (3) the area was easily visible from a tower vantage point on the barn (Figure 2) so that escape activity could be carefully noted.

The crate was placed on the release site at 0950[6]. After allowing 10 minutes for the birds to settle, the sliding panel of the crate was opened wide enough to provide an unhampered exit. The first bird to leave the crate, a juvenile wild hen, emerged at 1005. She was quickly followed by a juvenile-game-farm cock and four juvenile wild cocks, in quick succession. By 1100, birds having left the release area could be seen peacefully feeding on the western flat. The last bird left the crate at 1125, 85 minutes after the crate had been opened. It seems worthy of note, although not surprising, that since the crate opening faced to the west, all of the birds except one wandered westward over the flat. The weather was clear and mild with no wind.

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[6] Military time system: e.g., 8 a.m. - 0800; 8 p.m. - 2000.

This liberation was an adaptation of the "gentle release" advocated by Buss (1, p.86). The primary rule in this type of release is to avoid forcing the birds from the crate. They should be permitted to find their own way to freedom and, in this way, are possibly better able to adapt themselves more readily to the new environment. A temporary supply of scratch grain was scattered in the release area in the event that the birds experienced difficulty in procuring food. As may be noted in Table 1, no losses were attributable to the release.

DISPERSAL

Most of the birds remained on the western flat area for two days following the release on December 8, 1950. By the third day, however, west point had been visited and a few birds, mainly cocks, had ventured to the wheat, oat, and barley fields on the upper flat. The central woods border area and the upper flat were becoming increasingly popular by the fifth day. On December 18, 11 days after the liberation, all areas of the island had been tentatively explored by the pheasants.

THE HARVEST

Harvesting the surviving birds was necessary to prepare the island for the succeeding experiment and to

conclude the present study accurately. This was accomplished by a combination of live-trapping and hunting.

Live traps were erected in likely places on the island in early March. These traps were rectangular, box-like structures, 12 feet long by eight feet wide by one and one-half feet high, enclosed by a double layer of purse seine netting (Figure 3). On each end of the trap was a fan-shaped tunnel-like opening. The principle employed was that the pheasant could find its way into the trap but experienced difficulty in getting out. Scratch grain, primarily corn, provided the most successful bait. Snow on the ground during a part of the live-trapping period contributed to the success of the endeavor. The traps were put into operation on March 7, 1951, and removed on March 21 when hunting was begun.

The harvest was concluded on March 31, 1951. A total of six birds were taken during the regular harvest period, Table 1. The number is small because a major proportion of the birds are believed to have moved off the island during the study period. A juvenile wild cock, band number 32420, escaped the hunters during this period and was not taken until the 1951 fall live-trapping operations. Live-trapping accounted for two of the birds harvested while hunting efforts took the other four. As

FIGURE 3. PHEASANT LIVE TRAP IN OPERATION, MARCH, 1951.

can be seen in Table 1, three of these birds were juvenile wild hens, two were adult game-farm hens, and the remaining bird was a juvenile game-farm cock.

OBSERVATIONS

WEATHER CONDITIONS

The winter of 1950-1951 on Eliza Island was characterized by mild and comparatively gentle weather. Several strong windstorms, notably in January, and a heavy freak snowfall during the first two weeks in March provided the only deviation from the normal humid mild winter conditions typical of the marine coastal areas of Washington and Oregon.

Complete daily weather records were kept at Eliza Island, Table 2. Rainfall was measured and recorded three times daily through the use of a standard rain gauge. A recording thermometer kept accurate temperature readings. An aneroid barometer was used to determine barometric pressure. The direction and velocity of wind, degree of cloudiness, and distance of visibility were estimated and recorded, Table 2.

Since Eliza is in the "rain shadow" of Vancouver Island and the higher islands of the San Juan group, it receives a moderate annual rainfall which usually averages less than 20 inches. In the period covered by this study, 14.48 inches of rain was recorded, most of which fell in December, January, and February, Table 2.

A freak snowstorm in early March resulted in bringing nearly three feet of snow to the island (Figures 4, 5). Driving winds and freezing weather combined to keep the snow pack on the ground until March 15.

The climate remained temperate throughout the winter averaging about 40° F. Short stretches of freezing weather, primarily in January, were combined with strong northeast winds. High barometric pressure cells in Canada frequently caused flows of dry, cold air from the north. A natural gap in the mountains northeast of Eliza provided an easy passageway for the winds. The minimum temperature recorded during the study was 17° F. on January 29, 1951. January, the coldest month, had a mean temperature of 38.2° F. as compared to an average of 46.9° F. for December and 40.9° F. in February, Table 2.

Apparently, winter weather, except in extreme winds and heavy rains, did not seriously hamper the daily activities of the pheasants. Dark, rainy days tended to shorten the feeding period of the birds. In heavy windstorms, they sought protective cover and remained safely concealed until the wind abated. Very few birds were resident on Eliza during the snowfall of March since a large group of birds, 12 to 16, are believed to have flown from the island previous to the snow. The pheasants

FIGURE 4

AVERAGE SNOW DEPTH ON FLAT,
MARCH, 1951.

FIGURE 5

SNOW COVER ON CENTRAL FLAT
AND WEST POINT, MARCH, 1951.

Figure 4

Figure 5

TABLE 2

A TABULAR ANALYSIS OF THE WEATHER CONDITIONS PREVAILING DURING THE WINTER STUDY PERIOD, DECEMBER 8, 1950 - MARCH 31, 1951

A. Precipitation, rain and snow, in inches, as measured at weekly intervals during the study period.

Month	1st week	2nd week	3rd week	4th week	5th week	Total	Snow
December	----	.61	1.08	1.81	.37	3.87	----
January	1.21	.23	1.22	1.55	----	4.21	----
February	1.41	2.37	.63	.08	----	4.49	2.5
March	.08	.12	1.14	.41	.16	1.91	35.0
Totals						14.48	37.5

B. Number of Rainy, Cloudy, and Clear Days, by Months

Month	Rainy Days	Cloudy Days (without rain)	Clear Days
December	15	6	3
January	19	2	10
February	15	3	11
March	16	5	10
Totals	65	16	34

C. Wind Direction, by Quadrants, in Days per Month

Month	Calm	Southeast	Southwest	Northeast	Northwest
December	1	12	4	2	5
January	0	13	6	7	5
February	2	4	8	2	12
March	2	8	5	6	10
Totals	4	37	23	17	32

TABLE 2 (Continued)

D. Wind Intensity, Miles per Hour, in Days per Month

Month	Calm	Light (0-15)	Moderate (16-25)	Strong (26-40)	Gale (over 40)
December	1	16	4	3	0
January	0	17	5	5	4
February	2	15	6	5	0
March	2	14	8	3	4
Totals	5	62	23	16	8

E. Mean Temperature, Fahrenheit, in Days per Month and Monthly Average

Month	20	25	30	35	40	45	50	55	Monthly Mean
December	-	-	-	-	4	8	11	1	46.9
January	1	2	3	3	15	6	1	-	38.2
February	-	-	1	5	12	8	2	-	40.9
March	-	1	4	4	9	11	2	-	41.6
Totals	1	3	8	12	40	33	16	1	

that remained chose scrub Douglas fir and Himalaya berry, *Rubus thyrsanthus*, tangles for protection and seldom wandered out to feed.

WINTER COVER

An abundance of pheasant cover was available on Eliza throughout the winter. This cover, embracing all types vital to the welfare of the pheasant, was quite well distributed allowing a large factor of safety in pheasant

movement and adequate protection from the elements. The wooded areas combined with dense blackberry, Rubus sp., tangles to provide travel lanes to favored feeding areas. On the flat, dense salt grass, Distichlis spicata, orchard grass, alfalfa stalks, and old fish-trap wire netting afforded protection.

Winter roosting cover may be divided into two classes: (1) preferred cover during periods of normal weather; and (2) emergency cover for extended protection during the period of deep snow. The most popular roosting cover during normal weather consisted of marsh sedges, Scirpus sp., Carex sp., rushes, Juncus sp., and grasses. The edges of the salt-water lagoon and the fresh-water marsh were prime roosting sites. Salal, Gaultheria shallon, bracken fern, Pteridium aquilinum, and orchard grass on the woods edges also received use as roosting cover. The choice of marsh roosting sites concurs with the findings of Corthell (1, p.15) made on Eliza island during the winter of 1949. Wight (1943), in Michigan, explains the predilection of pheasants for marsh roosting sites in this manner (McAtee, 7, p.134):

> "It is generally believed that pheasants seek marshland for cover but the temperature factor may also be an important secondary influence in this choice, for it has been demonstrated that the winter temperature may be 19 degrees

higher among the marsh sedges than in the grass and mixed hervaceous cover in more elevated locations."

The heavy snowfall of early March forced the birds to seek new roosting cover. Dense scrubby Douglas fir coverts were used extensively and provided good protection. Himalaya berry thickets also furnished satisfactory shelter.

The pheasants often stayed on the roosting site till late in the morning, on the short, dark, rainy days of midwinter, sometimes not leaving to feed until 1100. By 1600, most of the birds were back on the roost. Light intensity seems to be a major factor in determining the time allotted to daily activities. On days of bright sunshine, the roosts were abandoned early and feeding continued to a later hour in the afternoon.

The requirements of the pheasant for escape cover from predators and the hunting activities of man were adequately provided for on Eliza. A multitude of well-spaced blackberry thickets, "hip-high" salal coverts, and growths of coniferous seedlings furnish protection dense enough to foil most avian predators and discourage even the most ambitious hunter. Of the raptors, probably only the small accipiters, the Sharp-shinned hawk, Accipiter striatus, and the Cooper's hawk, Accipiter cooperi, are capable of capturing a pheasant in these thickets.

Avian predator kills, in this study, were normally accomplished while the birds were at roost or in primary feeding areas. Only on one occasion was a kill made in an area of good escape cover.

The need of the pheasant for a special loafing covert was not noticed. Apparently, roosting and escape coverts served as loafing cover.

FOOD

Eliza Island has a variety of trees, shrubs, forbs, and grasses capable of providing a substantial natural food supply for the pheasant. Scott (1948, 9, p.84) lists seven species of trees, seven shrubs, 22 forbs, and five grasses as being contributing food and cover plants for pheasants. In addition to the native vegetation, domestic grains, wheat, oats, and barley were raised on cultivated fields in the upper flat area. The grains were left standing through the winter to provide additional food for the birds. An attempt was made, through the addition of these fields, to more nearly simulate conditions existing in favorable ring-necked pheasant habitat throughout the coastal sections of Washington and Oregon.

During the study period, two grain fields, one of barley and one of a wheat and oat mixture, were available for use by the birds. Both fields received

extensive use, by the pheasants, until the middle of January, at which time most of the grain had been consumed and the birds were obliged to shift their major feeding activities to areas away from the planted fields.

Heavy rains and a peculiar combination of a gale-like southwest wind and an extreme high tide flooded approximately three-quarters of the flat in mid-January (Figures 6, 7). This condition forced the pheasants to seek food along the forest edge and also in the dense wooded areas. The tuberous roots of Starflower, *Trientalis* sp., were used extensively for food in the woods. Vetch seeds, *Vicia* sp., were also popular as food items. Douglas fir seeds provided sustenance during the snow period of March. Snowberry, *Symphoricarpos albus*, and smartweed, *Polygonum* sp., were also known, from observation, to have received use.

SOCIAL BEHAVIOR

Pheasants have often been known to form unisexual packs, that is, groups of hen or cock pheasants. The time of banding usually coincides with the maturing of the broods, at 16 weeks of age or older, and the cessation of sexual activity in late fall. This banding type of social behavior was given careful attention during the study in

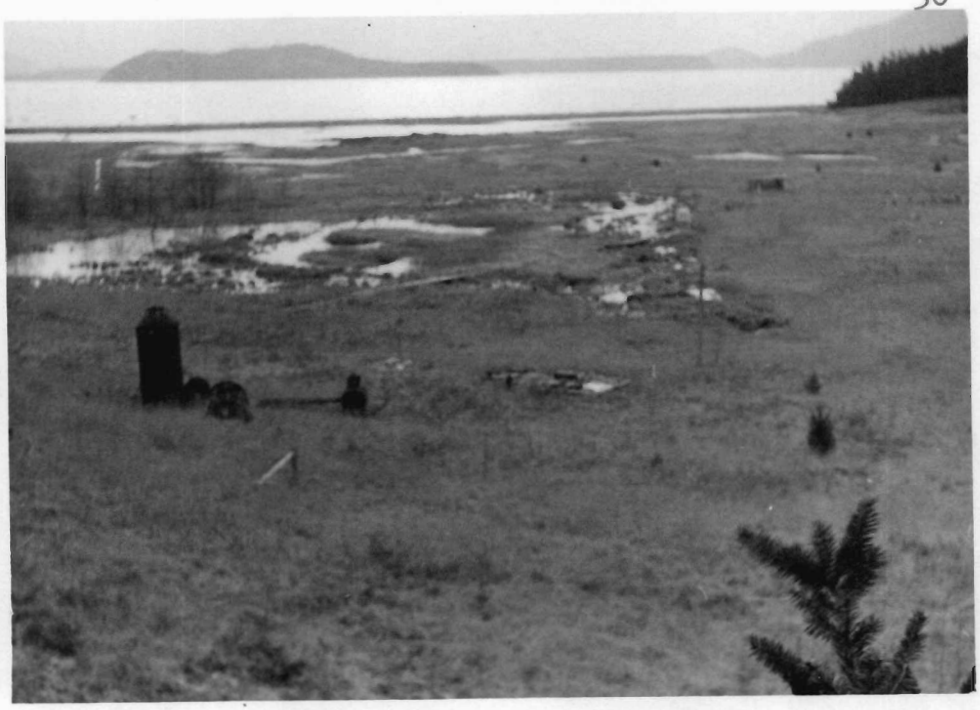

FIGURE 6. THE CENTRAL FLAT IN WINTER WITH AN EXTENSIVE WATER COVER.

FIGURE 7. THE CENTRAL FLAT IN SUMMER WITH WATER COVER LIMITED TO LAGOON AREA.

an effort to determine the characteristics of sex packs, especially in a situation in which a limited number of birds was involved.

Hen pheasants proved to be more gregarious than cocks. From an examination of daily sight records, kept throughout the study, it was noted that hens were observed in groups of two or more 55 times, or in 39.4 per cent of the sight records. Grouping among cocks occurred only 18 times, or in 21 per cent of the notations.

The largest group of hens seen was composed of 11 birds. Groups composed of seven and nine hens were also reported. During late December and early January, when sex grouping among female pheasants seemed to be the most pronounced, four definite packs comprising most of the 20 hens on the island were under surveillance.

Cocks, apparently, were less inclined to form sex packs (Table 2). The male pheasant seemed to be by nature more of a solitary bird. In contrast to the hens, who evidently had no set territory, nearly every cock had a definite niche, usually a favored roosting covert, as a hub for his feeding and grazing activities. In several instances, a pair of cocks was seen feeding in the grain fields. Some of these birds also roosted together. Although no significant data are available, it appears

that cocks of game-farm origin were more inclined toward grouping than were wild cocks.

On one occasion, six cocks, along with seven hens, were seen feeding together in a wheat field. When approached, the cocks ran out of the field and into the woods nearby. The hens seemed to wait until the cocks were gone and then flushed and flew in another direction.

The apparent activity of each sex pack, hen or cock, observed was carefully noted (Table 3). These activities can be broken down into four rather broad categories: feeding, grazing, roosting, and loafing. The difference between feeding and grazing, in this case, is one of intensity. Feeding denotes congregation in a certain spot, such as a wheat field, for the express purpose of gathering food. Grazing, on the other hand, applies to groups wandering through an area, picking up stray seeds, grit, etc. Roosting applies to a nightly bed ground while loafing signifies resting momentarily in daytime. A survey of Table 3 shows that hens were most often seen in packs while feeding and grazing, 18 and 19 times respectively. Cocks were observed feeding six times and loafing seven times.

The sex pack in pheasants seems to be a loosely knit group. The size of the individual pack may fluctuate

TABLE 3

AN ANALYSIS OF THE HABITS OF SEX PACKS, IN PHEASANTS, ON ELIZA ISLAND, WASHINGTON, DECEMBER 8, 1950 - MARCH 31, 1951

Activity	Groups of Hens	Groups of Cocks
Feeding	18	7
Grazing	19	3
Roosting	13	2
Loafing	5	6
Totals	55	18

from day to day. For example, one hen pack, under daily observation, varied in numbers between five and nine during the existence of the group. It was noticed, on several occasions, that a small segment of a large pack will stray away to feed or graze in an area quite apart from the main group, only to join the pack again when the immediate activity was concluded. It is unlikely that grouping affords protection. Indeed, a group would possibly be more vulnerable to a predator attack.

Companionship may be the key to the puzzle of sex banding. This, of course, does not explain why the packs are unisexual. Packs are formed in late fall when breeding or sexual desires are at a yearly low ebb. The break-up of the bands in late winter coincides with the increased stimulus for the new season. Under these

circumstances, one would surmise that the winter groups would be bisexual.

ACTIONS OF GAME-FARM COCKS

The juvenile game-farm cocks, used in this study, provided an indication that game-farm birds are less capable of caring for themselves in a natural environment than pheasants of wild stock. Of the five game-farm cocks released for the study, three of them had fallen victim to Great Horned owls by January 14, 1951. To provide a comparison, none of the five juvenile wild cocks used in the study were taken by predators, Table 1.

These game-farm cocks seemed to be in excellent condition at liberation time. It was noted, however, especially in the early part of the study, that they were weak fliers. A cock, flushed on the day following the release, flew about 10 yards and then folded up, falling into the lagoon on the island flat, Figure 2. A brisk wind blew him ashore and the bird walked away, apparently unhurt. On another occasion, a game-farm cock was approached to within three feet. The pheasant hid in the sparse cover, evidently thinking that he was safe and did not move until prodded with a stick. Even then, the cock refused to fly but, instead, walked away. At still

another time, a cock was found hiding under a dead bough in the central woods area. This pheasant remained in position for several minutes before deciding that his hiding place had been discovered.

E. W. Taylor (1950), in a British Columbia pheasant study, noted an apparent variable quality in game-farm birds. He states (9, p.108):

> "This is not intended to be a reflection on game-farm management but rather the basis for inquiry as to whether or not more attention might be given to producing a type of bird which might be established more successfully in the wild. Development of stock for the especial purpose of liberation might, through suitable feeding and rearing programmes, be fruitful."

RESULTS

LOSSES THROUGH PREDATION

A total of seven pheasants, or 23.3 per cent of the entire population, was killed by avian predators during the course of the study. Two birds of prey, the Great Horned owl, which killed six pheasants, and a small accipiter, probably the Sharp-shinned hawk, which was responsible for the other mortality, were the only successful pheasant predators during the experiment.

No attempt was made to control predation in this study. Only very complete evidence was considered in listing a death. A mortality was counted only when a vital body part was found. The only possible mammalian predator on the area during this field experiment was a domestic dog since no native mammals, except bats, inhabit the island.

Of the seven mortalities, three of the birds were juvenile-game-farm cocks (Table 4). The other four pheasants killed were hens, two adult game-farm birds and two birds of the juvenile wild hen class. In Table 4, the number of pheasants of each class released is compared with the number of pheasants of each class taken by predators. Another column in the table lists the percentages

of each group of birds killed by predators.

TABLE 4

PREDATION ON PHEASANTS ON ELIZA ISLAND, WASHINGTON, FROM DECEMBER 8, 1950 - MARCH 31, 1951 AS MEASURED BY NUMBER OF BIRDS IN EACH CLASS KILLED

Class of Pheasant	Birds Released	Birds Killed	Per cent of Class Killed by Predation
Juv. Game-Farm Cocks	5	3	60
Adult Game-Farm Hens	10	2	20
Juv. Wild Hens	10	2	20
Juv. Wild Cocks	5	0	0
Totals	30	7	23.3

The first pheasant kill occurred on December 26, 1950, and the last victim was discovered on January 20, 1951. Thus, all seven mortalities attributed to predators were consummated in the space of 26 days. Coincidentally, Great Horned owls killed the first six pheasants. The last mortality discovered can be credited to an unidentified accipiter.

Great Horned owls were efficient killers, usually seeking their prey in the hours of darkness and dropping on them with silenced wings and grasping sword-sharp talons. Like all "true epicures", owls apparently have a fairly standard procedure for eating. In devouring a

pheasant, Great Horned owls usually begin by pulling off the head and then eating back through the breast and wings. Errington (1938), in an Iowa study, states (2, p.193):

> "--given live rats, ground squirrels, quail, or young chickens, the Great Horned owl regularly ate the head first."

The smaller feathers, most of the bones, and the legs and feet, are often eaten. Even the large bones are crushed and swallowed. The intestines, gizzard, and other visceral portions appear to be the only body parts which they do not relish. The indigestible portions of the meal are regurgitated in the form of pellets. In this study, the pellets proved to be invaluable in identifying pheasants killed by Great Horned owls. On several occasions, a pheasant leg with the band attached was found safely preserved in the pellet.

The amount of food required to satiate the owl apparently varies according to the hunger of the bird. It is possible that other factors such as the presence of other predators, time of day, or even the mental disposition of the owl may affect the size of the meal devoured. Evidence gathered in this study indicates that a mature pheasant will sustain an owl for a period of about two days.

Great Horned owls are large birds and find it a simple task to carry their prey to a new location. Feathers and body parts of the same predation were found in as many as seven places, and on one occasion, as widely separated as half a mile. Smaller raptors, such as the Cooper's and Sharp-shinned hawks, although able to move a pheasant carcass several yards, probably experience difficulty in carrying a bird for any longer distance.

A rather unusual habit of the owls was the manner in which they cached their prey after having eaten the first meal. The owls would choose a grass hummock which offered some protection on the sides and from above, and stuff the bird firmly and neatly into this pocket (Figure 9). Oftentimes, the bird would be placed squarely on its back with the breast up. In most cases, the carcass was put in head first. Furthermore, this method of hiding prey was apparently practiced only if a sizable meal remained on the bird. During the study, owl kills of two pheasants, a Greater Scaup, Aythya marila nearctica, and an American Goldeneye, Glaucionetta clangula americana, were discovered in which the body was hidden in this manner.

A juvenile wild hen mortality, discovered on December 26, 1950, was apparently the first owl predation consummated. The original evidence, consisting of the right

wing, a few primary feathers from the left wing, and an assortment of body feathers, was found in a wheat and oat field on the upper flat area. This was probably the site on which the kill was made. Evidently, the bird had been attacked in the early morning hours while feeding. Several clipped tail feathers found widely scattered in the same field identified the bird as a juvenile wild hen. Other feathers from this kill were found in an area of old pilings about 300 yards from the field. On January 12, 1951, an owl pellet was found under a telephone pole near the grain field. The pellet contained the bones and the leg of a hen pheasant with band number 47716 attached, thus definitely identifying the victim.

The second pheasant kill was found on December 29, 1950, three days after the first mortality had been found. The bird, also a hen, had been killed, apparently while feeding, in a barley field near the lagoon. Head, neck, and breast feathers, scattered over an area about 15 feet in diameter, comprised the first evidence located. Since no further clues could be found in the immediate vicinity, it seems logical to assume that the owl had made the kill, eaten the head, neck, and part of the breast, and then moved the carcass to another location. Later the same day, the right wing, gizzard and other visceral parts, and

a large group of feathers were found in a secluded stack of old pilings about 200 yards south of the kill area. Two days later, on January 1, 1951, an owl pellet which contained pheasant bones and leg band number 47710 identified the bird as an adult game-farm hen.

Another juvenile wild hen was an owl victim on December 30, 1951, in a grass and shrub covered field near the south bay. Although this was definitely the work of a Great Horned owl, the mortality remains somewhat of a mystery as no band number, to specifically identify the bird, could be located. Feathers were found scattered in a circle around an old snag stump, 25 feet high. Upon climbing to the top of the snag, a group of clipped hen tail feathers was discovered. This evidence identified the bird as a juvenile wild hen pheasant. Several pieces of intestine and body feathers, with patches of skin attached, were found on a stump nearby.

The first of three owl predations on juvenile game-farm cock pheasants occurred in an alfalfa field on the morning of January 1, 1951. As the body was still warm, the kill had been made only an hour or two earlier. The head, neck, and part of the breast had been eaten and the carcass neatly hidden in a tussock of grasses. This bird had evidently been at roost when attacked; in fact, the

roost was scarcely 10 feet from where the body was found. A wide trail of feathers led directly from the roost to where the carcass was hidden. This cock wore band number 32413. Figures 8 and 9 show the body and roosting site.

The second owl kill on juvenile game-farm cock pheasants occurred on January 11, 1951, when the body of cock number 32414 was found. Feathers and bones from this mortality were found in seven different places. The bird was killed in a marshy swale, near the north edge of the flat, apparently while roosting.

The last pheasant to be victimized by a Great Horned owl in the study was found on January 14, 1951. The bird, juvenile game-farm cock number 32415, was killed in the marshy border area which separates the brackish lagoon from field 1, a barley field, on the central flat. The first evidence discovered consisted of head and back feathers with patches of skin and flesh attached. It was not until three days later that the cock's right leg, with band intact, was found.

In an attempt to determine the predilection of Great Horned owls, a careful record was kept of owl kills on birds other than pheasants. An examination of these records shows that owls are known to have victimized a Greater scaup, an American goldeneye, a bufflehead,

FIGURE 8. COCK PHEASANT KILLED BY GREAT HORNED OWL; BODY PARTIALLY CONCEALED IN GRASS TUSSOCK.

FIGURE 9. ROOSTING SITE (lower left) WITH TRAIL OF FEATHERS LEADING TO THE CARCASS OF THE SAME COCK PHEASANT (upper left central).

Figure 8

Figure 9

Charitonetta albeola, and two Western grebes, Aechmophorus occidentalis. A constant large population of ducks and grebes were present throughout the study, compared to a small pheasant population. Therefore, evidence possibly indicates a dietary preference for pheasants over water birds, at least during the study under discussion.

The only pheasant kill not attributable to Great Horned owls was the predation mortality of an adult game-farm hen, number 47703, discovered on January 20, 1951. The kill appeared to be the typical work of an accipiter, probably the Sharp-shinned hawk. The remains of the bird were found under a dense, scrubby fir thicket in the wooded southern section of Eliza. Characteristically, the first evidence consisted of a large pile of body feathers plus a part of the pheasant's skull. A pin-point puncture hole was found in the occipital region of the skull. This is, in many cases, apparently a diagnostic feature associated with accipitrine kills. The legs, pelvis, and part of the backbone were found on a log about 10 yards from the original find. Several weeks later, a few wing feathers and bones were found under a small Douglas fir about 50 yards away.

Several other birds of prey paid temporary visits to the island during the study period. A Snowy owl, Nyctea

nyctea, came to the island for four days in mid-December. During his stay, he was known to have killed a Greater scaup and a Glaucous-winged gull, Larus glaucescens. A few transient duck hawks, Falco peregrinus ssp., passed through Eliza in January and February. A Greater scaup was apparently their only victim. During a storm in late January, a Red-tailed hawk, Buteo jamaicensis ssp., drifted through, but probably made no kills. Bald eagles, Haliaetus leucocephalus ssp., were present in comparative abundance throughout the winter but confined their predatory inclinations to fish and sea birds.

LOSSES THROUGH MOVEMENT

The major pheasant loss, recorded during the study, was charged to movement of the birds from the island. In total, 16 birds, or 53.3 per cent of the released population were believed to have been lost in this manner. This segment of the population may be divided, for clarity, into two categories: (1) a group of four birds whose flight from Eliza Island was observed; and (2) a group of 12 pheasants, who are assumed to have flown from the island, but whose exodus was not witnessed.

On the morning of December 12, 1950, four birds, in a group, flew off the west point of Eliza, headed in a

westerly direction, toward Lummi island. These birds appeared to drop into the water about 600 yards west of the island. A boat search of the area was unsuccessful. The day of their departure was mild and cloudy. A light breeze was blowing from the southeast. Scratchings in the grassy-rock area, from which the flight started, indicated that the birds had been peacefully feeding.

The fate of the other 12 pheasants, believed to have flown from the island, was undetermined. Except for the fact that they are unaccounted for, no concrete evidence can be presented. A number of clues or circumstances, however, can be brought forth to substantiate the presumption that they did leave Eliza.

The most outstanding set of circumstances concerns the fate of a sex pack composed of five to eight hens. This pack was formed in mid-December and was observed in field studies nearly every day from the date of its inception until it was last seen on January 5, 1951. These birds frequented the upper flat area and north point. It is highly improbable that they were the victims of predators. If so, surely some evidence would have been discovered. Another possible assumption that the pack had broken up or joined other sex packs is equally unlikely. On January 20, 1951, a careful canvass of the island

pheasant population made clear the fact that a large segment of the hen population was missing. The shy and retiring personality of the pheasant hen could, conceivably, keep the bird hidden from sight observations, but signs of feeding activities and roosting sites could easily have been found. In view of these circumstances, there is but one logical suggestion--that these hens flew off the island, probably in a group, shortly after January 5, 1951.

The disappearance of the remaining pheasants, listed as unaccounted for, was even more mysterious. This group was believed to be composed of from four to seven birds. An examination of the release records indicates that most of these birds were cocks. It is presumed from sight observations and track counts made during the snows of early March, that these pheasants departed sometime in February. The birds may have left in a group. It seems more likely, however, that they left singly or in pairs, since most of the birds were believed to be male pheasants.

What cause or causes could have motivated these 16 birds to leave the island? In the first place, there is the possibility of population pressure, that is, territory or personality pressure from other pheasants on the island. This theory can be largely discounted by the small population of pheasants present during the study and by the fact

that sexual desires were, presumably, at a low ebb in the winter time.

A second factor to consider is that the general disturbances from constant field observations may have scared the birds, thus precipitating their movement. Although it must be admitted that this field pressure may have some bearing on the case, it probably was at most a contributing circumstance and not the cause.

The third factor, and the one which seems most plausible, is that pheasants may have a natural inclination toward dispersion. It has often been noted in pheasant studies on Eliza island that groups of birds tend to congregate on the island points. An examination of these areas shows that no highly regarded food plants or especially desirable cover is present. Why, then, do pheasants congregate in these areas? Why, also, have birds been observed on the beaches, apparently attempting to find a way off the island? These actions seem to denote a natural inclination, or an environmental need, of the pheasants to expand and disperse. In the summer study of 1950, on Eliza, several hen pheasants are known to have successfully completed the flight from the west tip of the island across open water to Lummi island which, at the closest point, is over three-quarters of a mile away

(Figures 10, 11). Hansen (1952) on Eliza island reported (4, p.54):

> "--two hens took off from west point and flew out over the water toward Lummi island, which is about a mile away; they apparently left by choice."

Important is the fact that these observations were made in regard to studies on Eliza island. The pheasant, possibly upon finding that he was penned in by water, may have felt a special urge to escape. The principle, however, of dispersal might be of practical application on inland areas.

Noteworthy also is the fact that 15 of the 16 birds believed to have flown from the island were essentially of wild origin. Only one true game-farm bird, a cock, was lost in this manner. Harper (1951), in a California pheasant study on public hunting areas, noted that (5, p.171):

> "--game-farm birds showed little tendency to move off the area; while--resident juvenile wild males moved the most of any group."

Could this mean that wild pheasants tend to disperse a greater distance than game-farm birds? If so, would it not be better to use wild-trapped pheasants rather than those of game-farm origin in stocking new areas.

FIGURE 10. WEST POINT OF ELIZA LOOKING ACROSS HALES PASS TO LUMMI ISLAND.

FIGURE 11. AERIAL VIEW OF ELIZA SHOWING RELATIONSHIP TO LUMMI ISLAND (upper left) AND POINT FRANCIS ISLAND, DIMLY VISIBLE (upper right).

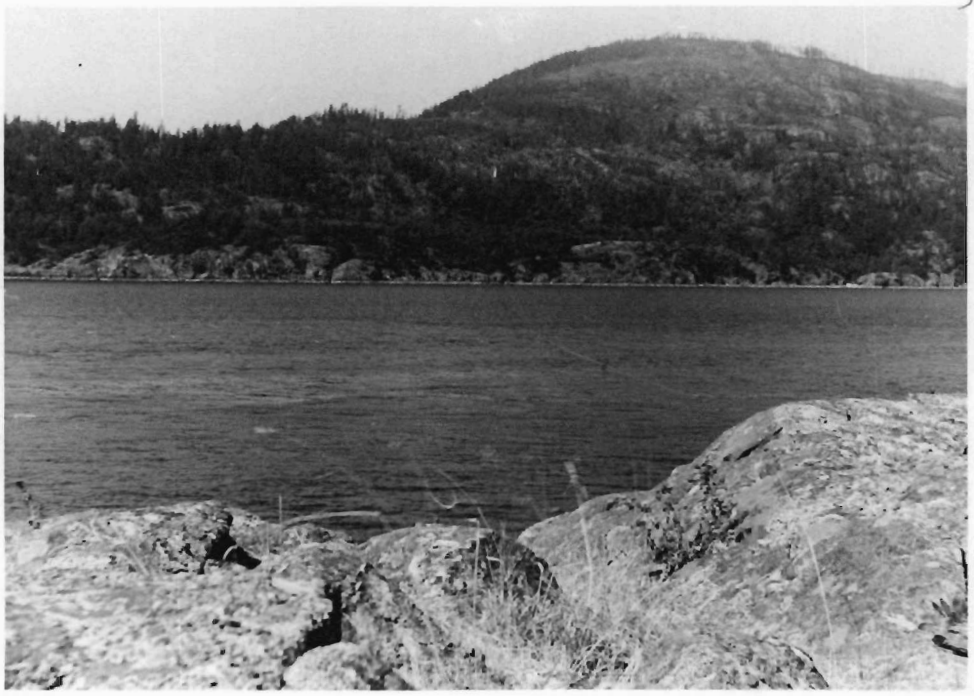

Figure 10

Figure 11

SUMMARY OF WINTER SURVIVAL STUDIES

The study under discussion in this paper represents the fourth and concluding phase in the series of pheasant winter survival studies on Eliza island. Therefore, it seems necessary to attempt a general summation of the results of all these experiments. A summary of this type may serve a number of purposes, two of which appear to be especially important: (1) the combined results of a number of studies would appear to exhibit a closer approximation to actual fact, since the effect of seemingly extreme variations in a single study would be lessened; and (2) an analysis of a group of like studies permits a comparative outlook in dealing with the differences in types of birds and general techniques used in the single study.

Basically, the organizational plan was very similar for the four winter studies. The number, type, and sex of pheasants used in each experiment provided the only major controllable factor. In the first study, 1947-1948, Nelson (6, p.52) used a group of 54 birds, 51 game-farm hens, two wild hens, and one wild cock pheasant. Corthell (2, p.7), in the winter of 1948-1949, used 32 pheasants, 22 cocks and 10 hens. This group was equally divided as to game-farm and wild origins. For the third

study, Hansen (4, p.99) used 50 pheasants, 40 hens and 10 cocks, as experimental animals. Approximately half of Hansen's group were of game-farm origin and half were of wild origin. Only 30 birds, 20 hens and 10 cocks, were used in the concluding study. This last group was composed of 15 game-farm and 15 wild birds.

The effect of weather on winter survival of pheasants in the marine west coast climatic type usually seems to be negligible. Three of the four winter survival studies on Eliza were conducted under normal winter conditions with only minor periods of snow and stormy weather interfering with the feeding processes of the pheasants. The winter of 1949-1950, however, was the most severe in the past 60 years, according to Hansen (4, p.5). The extreme periods during Hansen's study forced a certain degree of hardship on the birds in procuring food and keeping warm. Nevertheless, no losses were directly attributable to the weather. Furthermore, the average weight of the birds at harvest time was slightly above release weight (Table 5). Supplemental food, primarily weed seed, offered to the pheasants in semi-sheltered feeding areas, was used extensively although by no means exclusively. Nelson (1949) used the technique of supplemental feeding (6, p.47) but found a slight weight loss at

harvest time.

TABLE 5

OVERWINTERING WEIGHT CHANGE IN PHEASANTS DURING FOUR WINTER STUDY PERIODS ON ELIZA ISLAND, WASHINGTON, 1947-1951.

Year of Study	Number of Birds Harvested	Total Gain or Loss (in oz.)	Aver. Gain or Loss (in oz.)
1947-1948	17	minus 111	minus 6.53
1948-1949	10	minus 30	minus 3.0
1949-1950	29	plus 70	plus 2.41
1950-1951	6	plus 28	plus 4.67
Totals	62	minus 43	minus .69

An overwintering weight loss in pheasants was observed in the studies of Nelson and Corthell (1947-1949) on Eliza (Table 5). This tendency is counterbalanced in the last two experiments (1949-1951) where slight average weight increases were noted. By combining these facts, it appears that a composite series of factors may affect gain or loss of weight in the individual bird. Possibly, then, overwintering weight change is dependent on the physiological make-up of the individual bird.

The method of liberating the experimental birds followed a gentle release procedure in the last three studies. A hand-forced-release was used in the first experiment. No difference in survival can be noted,

however, in comparing techniques of liberation, since no losses were traced to release procedure in any of the four studies.

The most important factor to consider in a summation of winter survival studies is, of course, what percentage of the birds survived, and what mortality factors worked against survival among the birds that perished.

Avian predation was the outstanding mortality factor associated with the group of winter studies. As listed in Table 6, nearly 54 per cent of the mortalities recorded may be attributed to raptor predation. Two species of birds, the Great Horned owl and the Cooper's hawk, were responsible for the majority of these kills. Mammals accounted for 14.7 per cent of the mortalities (Table 6). Most of the mammalian predation was caused by a feral cat which inhabited the island during the first two experiments. It should be noted here, again, that Eliza island is unique in respect to a lack of mammalian fauna. Except for bats, no native mammals are present. This factor presents a two-fold aspect in relation to predation: (1) no native predatory mammals are in the area to prey on pheasants; and (2) the normal buffer population of mice or rabbits, associated with many pheasant populations in mainland habitats, is unavailable for use as a basic food supply for the avian predators. A high density

of song birds, however, offers an adequate source of prey to sharp-shinned and Cooper's hawks.

TABLE 6

AN ANALYSIS OF THE CAUSES OF MORTALITY ON RING-NECKED PHEASANTS DURING FOUR WINTER STUDY PERIODS ON ELIZA ISLAND, WASHINGTON, 1947-1951.

Year of Study	1947-1948	1948-1949	1949-1950	1950-1951	Total	Percent. Caused by Each Factor
Factor						
Number of Mortalities[7]	33	18	21	23	95	100.0
Predation						
Avian	17	12	15	7		
Mammalian	12	2	0	0		
Total					65	68.4
Drowned	3	1	2	4	10	10.5
Unaccounted For	1	3	4	12	20	21.1
Survival	21	14	29	7	71	

[7] Hens and cocks of game-farm and wild stock were grouped together for convenience and clarity.

[8] Mammalian predators included a feral cat for the first two studies and a dog for all four periods.

A loss of pheasants to drowning was noted in every experiment. In total, 10 birds were listed as lost in this manner (Table 6). An unknown number of "Unaccounted For" birds are thought to have been lost in the same fashion. A major loss to drowning, four birds, was found

in the concluding study, 1950-1951. A discussion of possible reasons and causes for the drowning loss is given in the section on "Losses Through Movement" and will not be repeated here.

Another factor of importance to consider in relation to birds listed as "Unaccounted For" is the dense vegetative cover which comprises the botanical make-up of a large portion of the island. It is nearly impossible to discover every mortality, no matter how carefully and consistently the habitat is scrutinized.

One of the primary objectives of these studies has been to compare the survival of game-farm-reared birds to wild-reared birds when the two classes were released together under identical conditions in a natural environment. Although in the discussion on predation losses, the cock and hen populations were grouped together for clarity of presentation, the variation in survival by sex and origin of the bird without regard for cause of mortality, provides an interesting contrast (Tables 7 and 8).

An examination of the data (Table 7) concerning release of hen pheasants shows that in the four studies, 86 game-farm hens and 37 wild hens have been used. The preponderance of the game-farm class can be explained by the fact that Nelson (1948) used 51 game-farm hens and only

two wild hens. In the last three studies, the number of hens of each class has been identical. The data in Table 7 shows that percentage of mortality exceeded percentage of survival in both game-farm and wild hens. The mortality of wild hens was 54.1 per cent. The mortality of game-farm hens was 62.8 per cent. This small difference in percentages indicates no significant difference in ability to survive, under island conditions, between game-farm and wild hens. A more important fact is that 60.2 per cent of the hens, both game-farm and wild, fell to predators or other mortality factors during the four field experiments, 1947-1951.

As shown in Table 8, a total of 43 cock pheasants were used in the Eliza island winter studies. Twenty of these birds had game-farm origins while the remaining 23 were of wild origin. For the four study periods, the percentage of mortality exceeded percentage of survival in game-farm cocks. Mortality for cocks of game-farm origin was 55 per cent. On the other hand, percentage of mortality in cocks of wild origin, 43.5 per cent, was less than percentage of survival. This difference in survival between game-farm cocks and wild cocks, although possibly indicating a trend, is not believed to be large enough to be significant.

TABLE 7

COMPARISON OF MORTALITY BETWEEN HEN PHEASANTS OF GAME-FARM AND WILD STOCK DURING FOUR WINTER STUDY PERIODS ON ELIZA ISLAND, WASHINGTON, 1947-1951.

TABLE 7

YEAR OF STUDY	TOTAL NO. OF HENS USED	GROUPS OF HEN PHEASANTS			
		GAME FARM STOCK		WILD STOCK	
		Mortality	Survival	Mortality	Survival
1947-1948	53	33	18	0	2
1948-1949	10	3	2	3	2
1949-1950	40	10	10	10	10
1950-1951	20	8	2	7	3
Total For Four Study Periods.	123	54	32	20	17
Percentage Mortality and Survival of Each Group.		62.8%	37.2%	54.1%	45.9%
Total Percentage.		100.0		100.0	

Table 8

YEAR OF STUDY.	TOTAL NO. OF COCKS USED.	GROUPS OF COCK PHEASANTS			
		GAME FARM STOCK		WILD STOCK	
		Mortality	Survival	Mortality	Survival
1947–1948	1	--	--	0	1
1948–1949	22	8	3	4	7
1949–1950	10	0	4	1	5
1950–1951	10	3	2	5	0
TOTAL For Four Study Periods.	43	11	9	10	13
Percentage Mortality and Survival of Each Group.		55.0%	45.0%	43.5%	56.5%
Total Percentage		100.0		100.0	

SUMMARY AND CONCLUSIONS

1. This report has considered the observations and results obtained in the concluding winter mortality study of ring-necked pheasants on Eliza Island, Washington, December 8, 1950 to March 31, 1951.

2. A group of 30 ring-necked pheasants, 20 hens and 10 cocks, were released on the study area on December 8, 1950. Of the birds put down, 15 were juvenile wild pheasants, 10 hens and five cocks; five were juvenile game-farm cocks; and 10 were adult game-farm hens. The adult hens were unique in that they had been conditioned to life in a natural environment through their use in the preceding study on the area.

3. Field notes were compiled daily throughout the tenure of the study. The "wandering" method of field observation proved to be an effective technique for gathering information.

4. A harvest, consummated by a combination of live-trapping and shooting, was begun on March 7 and concluded on March 31, 1951. Of the 30 birds released, only seven were collected during the harvest period.

5. Avian predators killed seven pheasants, or 23.3 per cent of the total population, during the study. Of the seven, six were taken by Great Horned owls. An

unidentified accipiter, probably the Sharp-shinned hawk, took one bird. In the juvenile game-farm cock group, three predation mortalities were recorded. The raptors took two juvenile wild hens and two adult-game farm hens. None of the juvenile wild cock pheasants fell victim to predators.

6. A group of four pheasants flew from the island on December 13, 1950. No reason could be found for their departure.

7. The remaining 12 birds, of the original 30, are believed to have been lost through movement, by flight, from Eliza Island. No evidence can be brought forth to substantiate this belief, however.

8. The weather was comparatively mild throughout the winter, apparently producing no ill effects on the pheasant population.

9. Light intensity seemed to be a major factor, among pheasants, in determining the time allotted to daily activities. On dark days, the pheasants often occupied the roost till late morning. The roosts were abandoned early on days of bright sunshine. This factor may be significant in pheasant releases. A release on a dull day might result in very little movement, tending to keep the birds grouped. On the other hand, a release on a day

of bright sunshine may provide a wide, equal distribution.

10. A variety of natural foods were available for use by the birds. In addition, two cultivated fields added wheat, oats, and barley to the list of food plants available. Since five of the seven birds harvested gained weight during the winter, food availability was apparently not a limiting factor.

11. An abundance of pheasant cover was available throughout the winter.

12. Special attention was given to social behavior as regards sex grouping in wintering pheasant populations. Hens were more gregarious than cocks. The small number of birds involved, however, tends to invalidate this conclusion.

13. The five juvenile game-farm cock pheasants, although appearing to be in good condition, exhibited general unwariness and weak flight characteristics.

14. Since the study reported herein is the concluding phase of the present series of winter mortality studies, a summary of the four experiments, 1947-1951, is included in the manuscript.

15. In view of the results of this study, it is humbly suggested that consideration be given toward providing a larger group of pheasants, as experimental animals, for any succeeding island winter mortality studies.

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