SURVIVAL AND INCREMENT OF AN EARLY SPRING RELEASE OF RING-NECKED PHEASANTS ON ELIZA ISLAND, WASHINGTON

by

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SURVIVAL AND INCREMENT OF AN EARLY SPRING RELEASE OF RING-NECKED PHEASANTS ON ELIZA ISLAND, WASHINGTON

INTRODUCTION

This report contains the results of a study designed to measure the survival and increment between April 2 and December 8, 1948, of an April release of ring-necked pheasants (Phasianus colchicus Gmelin) on Eliza Island, Washington.* The primary purpose of the investigation was to determine the results of an April release of a certain class and known number of game farm hens. The investigation was financed by the Oregon Cooperative Wildlife Research Unit,** and was under the supervision of Mr. Arthur S. Einarsen, Biologist, United States Fish and Wildlife Service.

Although artificial propagation of pheasants has been practiced for many years, there are still many unknowns in the applied use of this technique of providing sport for gunners. Realizing this, the Oregon State Game Commission, in 1947, began a comprehensive program to

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* Oregon Cooperative Wildlife Research Unit and Washington State Game Commission cooperating.

**United States Fish and Wildlife Service, Wildlife Management Institute, Oregon State Game Commission, Oregon State College, Agricultural Experiment Station, and Agricultural Research Foundation, cooperating.

definitely ascertain those fundamental facts that would result in the most effective procedures when artificial propagation was invoked. The Commission requested its research agency, the above mentioned Cooperative Unit, to begin a series of studies in order to determine the relative merits of certain accepted game farm practices.

For some time the standard procedure on Oregon game farms has been to specially feed year-old penned pheasant hens during the egg-laying period in order to induce them to lay large numbers of eggs. When the egg-producing period is nearly over, the proper disposition of these hens presents a problem. The game manager is faced with the question of whether they should be liberated immediately, kept for a fall liberation, or held over until the following spring and then released. Some of the factors he should consider when comparing the desirability of each method are:

1. If the hens are released immediately will they do any natural nesting in the wild during the remainder of the season, and if they do reproduce, what will be the net gain, if any?

2. If the hens are kept penned until fall and then liberated, what percentage of this liberation will be available for reproduction the following spring?

3. If the hens are held over until the following spring and then liberated, what will be the reproduction

rate and net gain, if any, and how will the reproduction and gain compare with that of the birds in item one?

In order to determine the answers to these and similar questions concerning the most effective way to conduct artificial propagation, the Cooperative Unit set up a long-range study designed to compare the results of different age class releases of ring-necked pheasants. The field research has been conducted on Eliza Island, Washington.

The technique of utilizing an island as a research area has gained considerable favor in the past few years. Nestler (1946) pointed out the advantages of island research areas; Taylor (1947) strongly urged the use of more such areas; and Buss (1946) summarized the effectiveness of such a method in reducing research time. Previous experience (1937-45) in supervising ring-necked pheasant research on Protection Island, off the coast of Washington, had convinced Mr. Einarsen, Leader of the Cooperative Unit, of the desirability of islands for such work. Before the current project was begun, he made an intensive survey of available islands on the West Coast. As the result of this search, Eliza Island, Washington, was finally chosen as being the most nearly suited for the purposes of the study. Eliza was occupied by Cooperative Unit personnel on March 14, 1947, and has been used for research purposes since that time.

To date, three phases of the study have been completed. Scott (MS) conducted Phase I which dealt with the productive ability of 100 game farm hens and 10 cocks which were released in June, 1947, after the hens had laid a normal complement of eggs at the game farm. The results of this study indicated that hens of this class did reproduce, but that they did not produce a clutch approximating the number found in what is considered to be an average clutch. Phase II was covered by Nelson (MS) who studied the winter survival of 53 hens between December 20, 1947, and April 1, 1948. He found that there was a survival rate of about 30 per cent during this 104-day period. Phase III, which is covered in this report, was concerned with the productive ability of 50 game farm hens and 5 cocks released in April, 1948, before the hens had laid any eggs at the game farm. The results of the 1948 release and a comparison with the results of the 1947 release are given here.

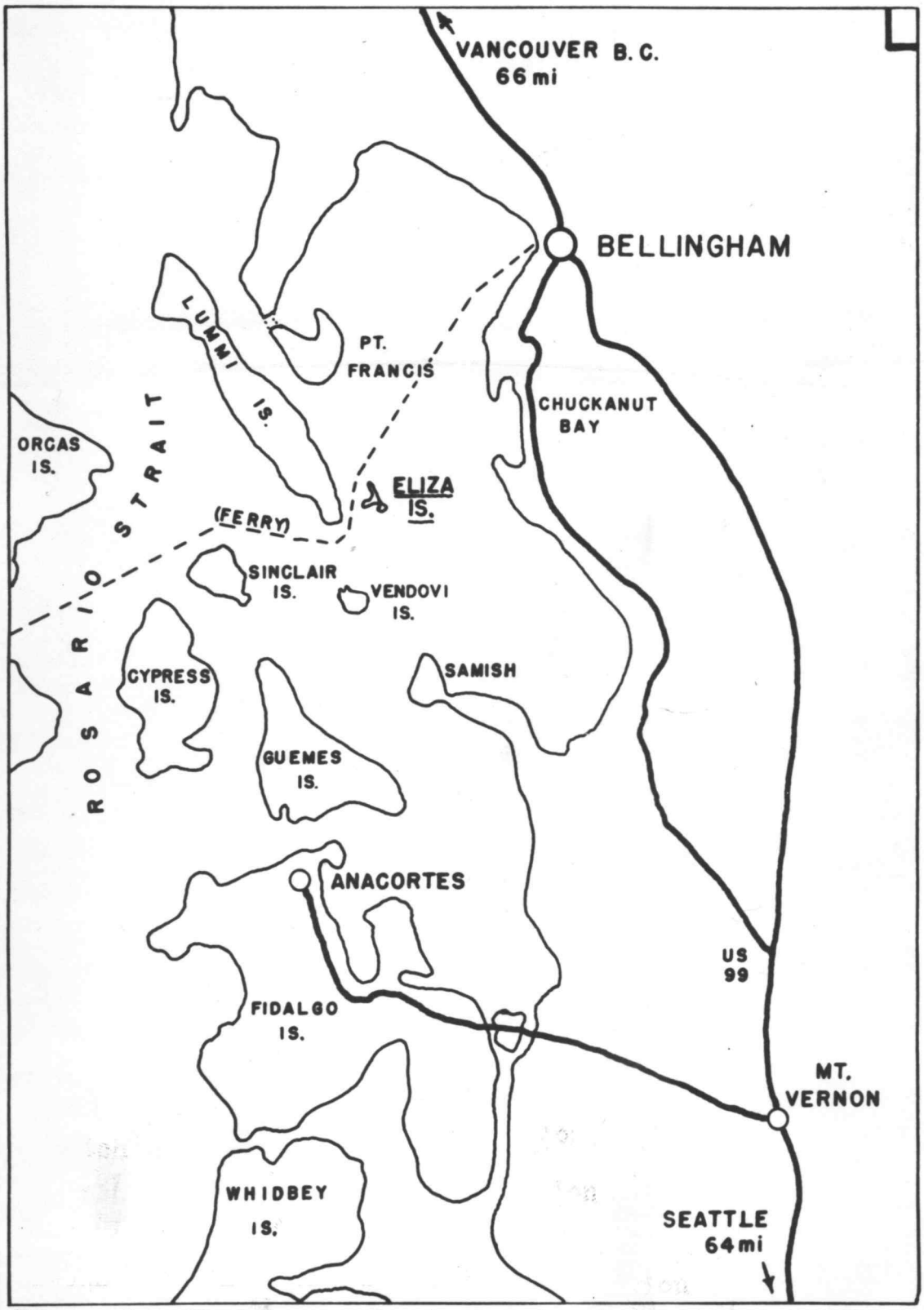

Figure 1. Sketch map showing regional location of Eliza Island. (Map by Robert F. Scott)

THE AREA

GENERAL DESCRIPTION

Eliza Island is located on the eastern fringe of the San Juan Islands group in northern Puget Sound (Figure 1). A general description of the area by the Washington Writer's Project of the W P A (1941) is as follows:

> "The average (rainfall) in the (Puget Sound) section is 36 inches. The rainiest month is likely to be December and the driest, July. Winter temperatures average 40°F., with a daily average minimum of 35°. Summers average 61°F. with a daily average maximum of 74°. Puget Sound area crop seasons average 207 days."
>
> "Some of the islands in the "dry belt" which has only about 20 inches of rainfall annually, are so arid that a species of prickly cactus flourishes. (This plant was not present on Eliza Island). However, most of the islands are heavily wooded, and a temperate climate, together with a favorable average rainfall, has encouraged cultivation of the larger bodies of land."

PAST USE

Since only a small portion of the total land area of approximately 158 acres is good soil, Eliza Island has never been cultivated for commercial purposes, although approximately 50 acres are tillable. At one time, however, it was used as a chicken ranch. Sometime after this venture ceased, the island was acquired by Pacific American Fisheries Incorporated. This company used the island as

a winter haul-out base for cannery tenders which plied the waters of Puget Sound gathering salmon caught in fish traps set up at strategic points. During the hey-day of this operation a crew of several hundred men lived on the island caring for gear and sea-going equipment. Many structures such as web-houses, dormitories, shipways, docks, and work houses were erected. In 1934, the fish traps were prohibited and the importance of Eliza as a base of operations quickly dwindled. In 1938 a fire virtually cleared the island of all standing structures. From 1938 until a period during the war years, when it was used as a bombing range, the island was cared for by a watchman. After its wartime use, the island had not been used, except for occasional picnics and clam digging parties, until it was leased and occupied by the Co-operative Unit.

PHYSICAL FEATURES

As may be seen in the aerial photo, Figure 2, Eliza Island is shaped somewhat like a deformed capital "T". The north-south axis is about one mile in length and the east-west axis is a little over one-half mile long. Because of the directional alignment of the axes, it is natural to speak of the various landmarks as "North Point", "West Point", "East Bank" etc., and these and similar terms are used when referring to various sections of the

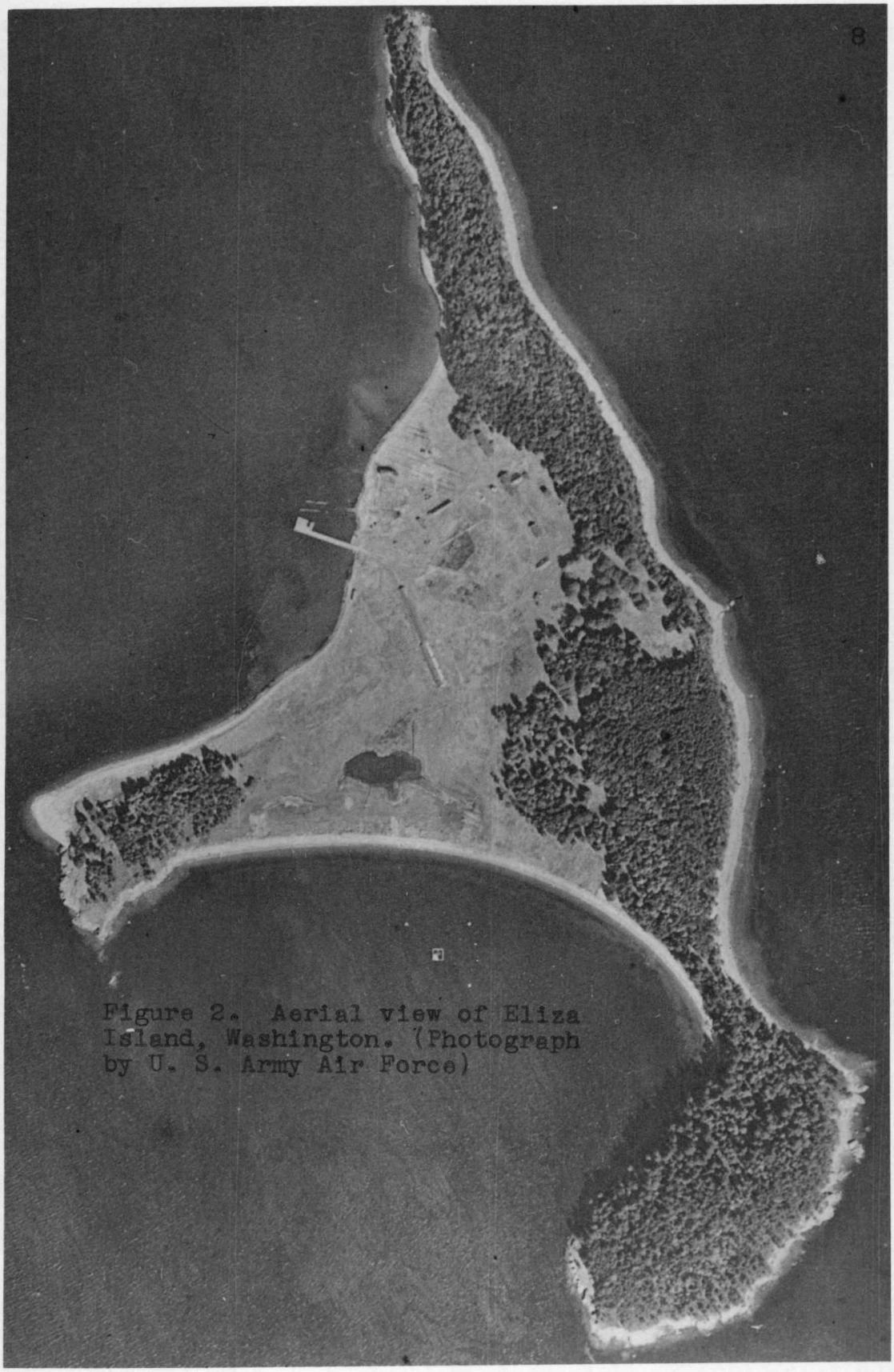

Figure 2. Aerial view of Eliza Island, Washington. (Photograph by U. S. Army Air Force)

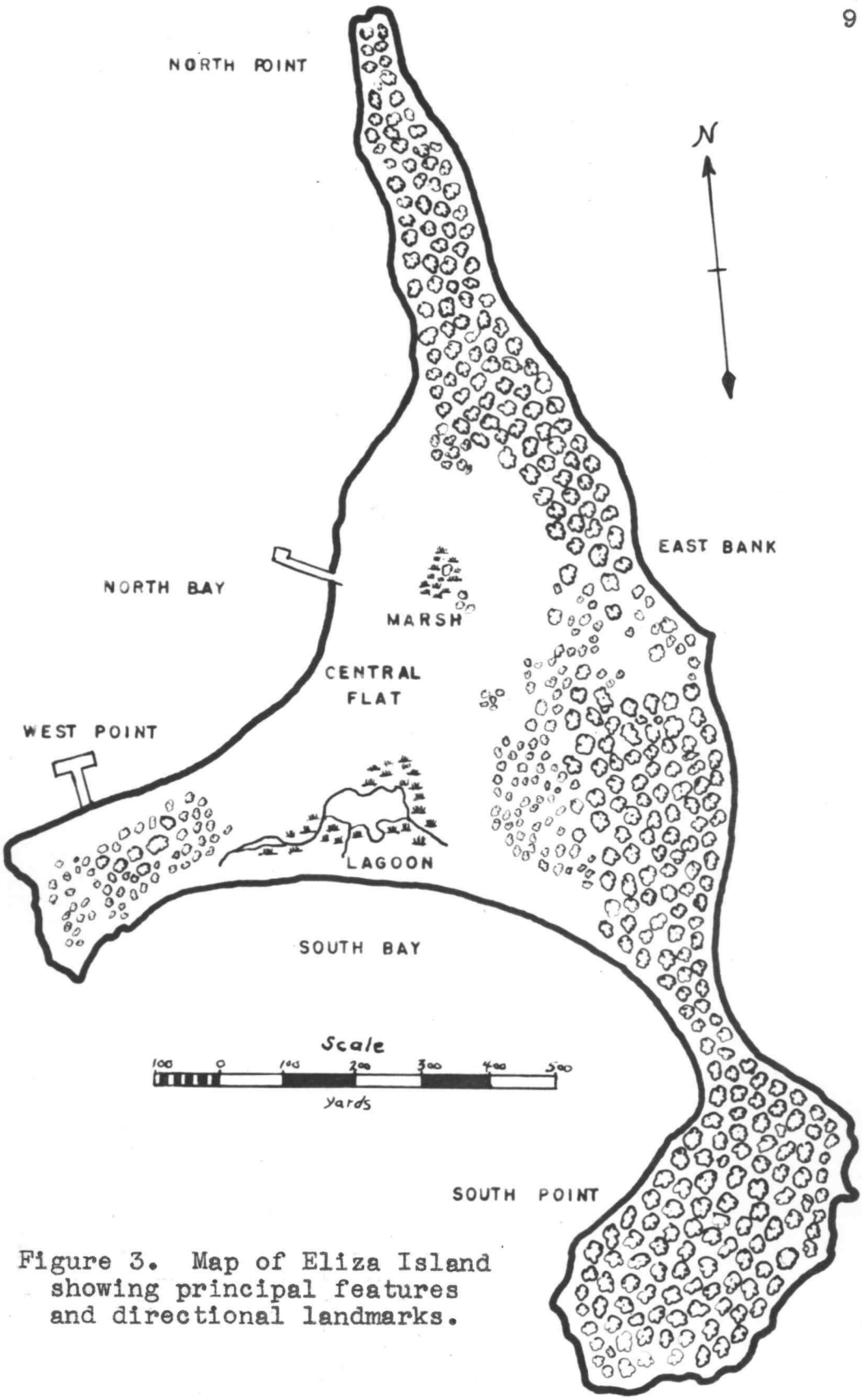

Figure 3. Map of Eliza Island showing principal features and directional landmarks.

island. These landmarks are shown in Figure 3.

A narrow, wooded ridge, with an average height of 40 feet, extends from North Point to South Point, where the highest spot on the island, 60 feet, is found. Along the eastern face of this ridge and all around North and South Points where the photo shows wooded area, there is a steep slope down to the beach. The western face of the middle portion of this ridge slopes down to the area known as the "central flat" which at its lowest point is only about two feet above sea level. On the western edge of this flat there is a slight rise up to the wooded portion of West Point, which is 20 feet above sea level. The tip of West Point is about three-fourths of a mile from Lummi Island, the nearest land to the west.

Two small bodies of water occupy a portion of the central flat. Rainfall run-off is the primary source of water for these ponds, but with a high tide and strong south wind, a considerable amount of salt water spray is carried over from South Beach into the lagoon, accounting for its brackish condition. During the summer months, the marsh generally goes dry, but the lagoon, although it may shrink in size considerably, retains some water all summer.

The "beach cabin", "resident cabin", and "west cabin" (Figure 4) are structures which remained after the fire in 1938. These buildings have been added to and

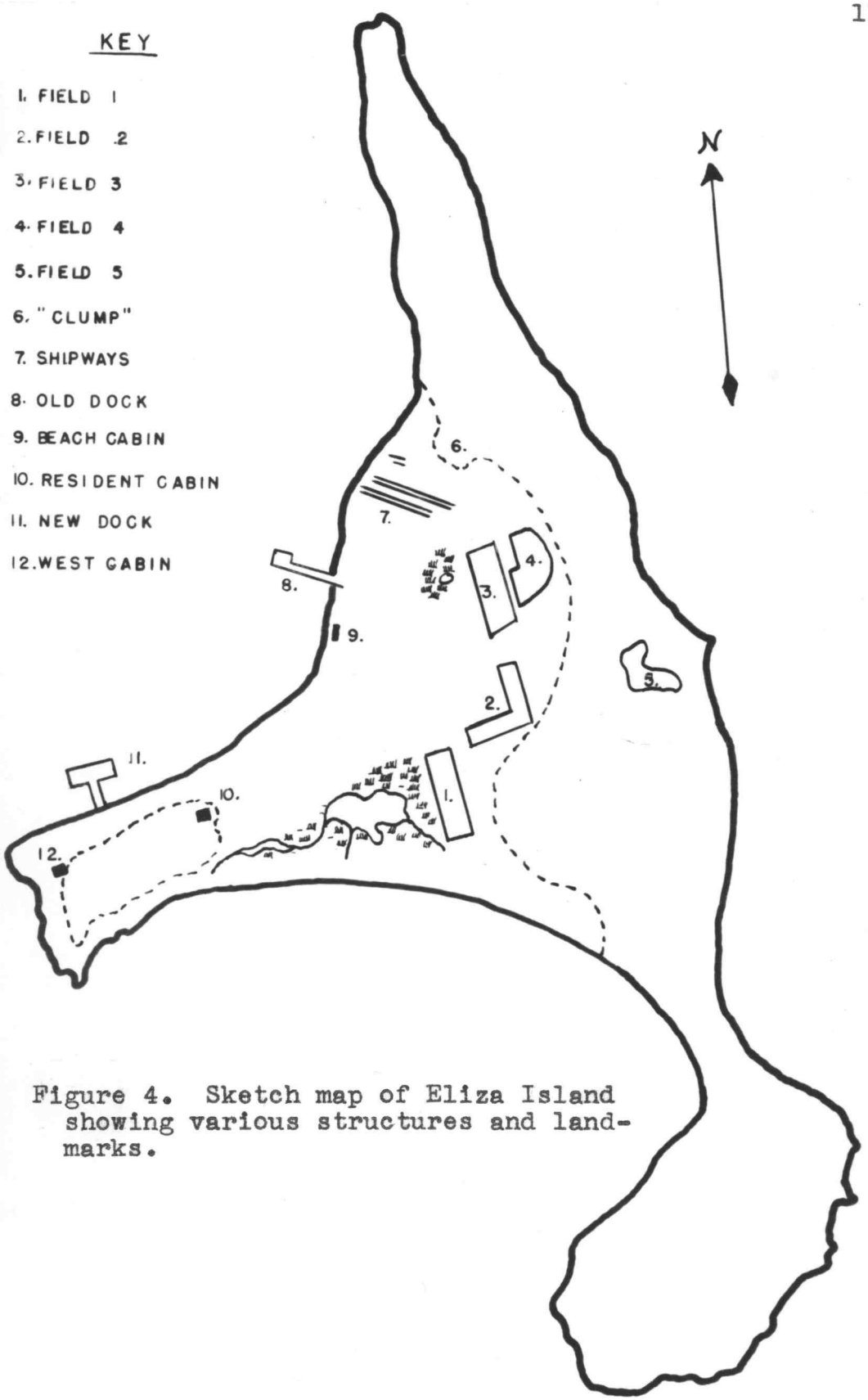

Figure 4. Sketch map of Eliza Island showing various structures and landmarks.

Figure 5. Beach cabin and lookout tower. Old dock in left background and tip of North Point in right background. (Photograph by R. A. Corthell)

Figure 6. View of pheasant holding pen on West Point, looking north. (Photograph by R. A. Corthell)

modified by Cooperative Unit personnel to serve as a storage shed and lookout point (figure 5), observers' quarters, and visitors' quarters, respectively. Most of the other buildings visible in the aerial photo were burned to the ground.

A small section of woods known as the "clump" projects out into the northeast central flat area and is frequently used as a reference point. The "shipways" and the "old dock" on North Beach are remnants of the days when the island was used as a cannery tender base. The "new dock" on West Point was erected by Cooperative Unit personnel in the summer of 1948. The "Fields #1-#5" are small grain plots which have been put in since the Cooperative Unit took over the island. Some of the structures and landmarks mentioned above may be seen in Figure 7, which is a panoramic view of the western portion of the island.

FLORA

The flora of Eliza Island is not significantly different than that found elsewhere in the temperate climate of western Oregon and western Washington. The primary components of the wooded portions of the island are Douglas fir*, Western red cedar, lowland fir, and

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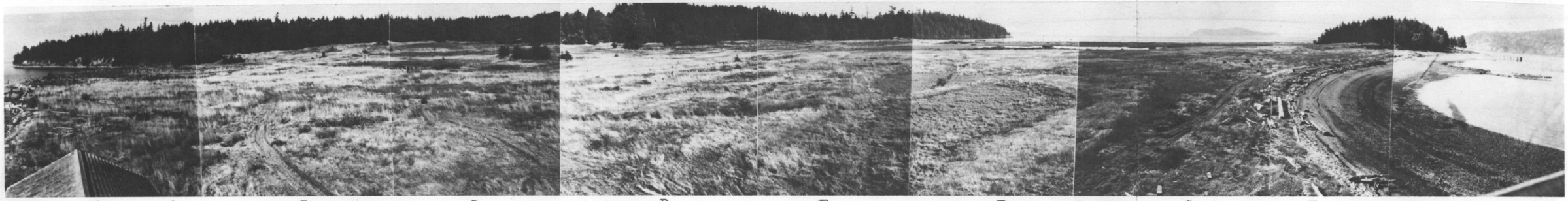
* Scientific names of plants mentioned are in Table 12.

Figure 7. Panorama of the western portion of Eliza Island taken from tower on the beach cabin.



A. North Point in left background; shipways in right center.

B-H. Central flat area. Note the "clump" in left background of B; marsh just past small building in C; swale in E and F; lagoon in F and G.

H-I. West Point and new dock in background; Lummi Island in distance.

some yew. Along the edges of the coniferous stands or in places where the forest canopy is not too dense, there are mixed stands of broad-leaved maple, red alder and madrone. The shrub species found most commonly on the steep banks are ocean spray, salal, red-flowering currant, wild rose, and snowberry. The principal species found in and around the marsh and lagoon are salt grass, glass wort, bulrush, three-square, and spike-rush.

The central flat area supports a wide variety of grasses and other herbs. Small, irregularly shaped swales which wind throughout the area, typically have rushes, silver-weed, and salt grass growing in them. Although the intervening strips are only one or two feet above the swales, they are much drier and carry such wasteland species as cheat grass, dock, mullein, and yarrow. As they near the wooded sections, some portions of the flat also have orchard grass, bracken fern, and vetch. There is a luxuriant stand of purple beach pea on the narrow strip on South Beach between the beach line and the lagoon.

FAUNA

Although the flora of Eliza Island can be considered to be normal, the mammalian fauna is definitely abnormal. The only mammals observed during Phase III were one feral cat, presumed to have been dropped off from a visiting

boat or a survivor of the islands previous occupancy, and several bats.

At some time during the previous periods of occupancy, a few domestic rabbits escaped their pens and, in the manner of such animals, the few quickly became a great many. In short order the rabbits were in actual danger of eating themselves out of house and home. To prevent further defoliation of the remaining vegetation, a poisoning campaign was begun. This campaign was very thorough and succeeded in wiping out not only the entire population of rabbits, but also, apparently, all other small ground mammals. In addition, before the island was used as a bombing range, the resident black-tailed deer (Odocoileus hemionus columbianus) herd of about 25 animals was trapped and removed to the mainland. These two facts then, explain the scarcity of mammals on the island. The implications of this lack of "buffer" species will be discussed later.

The numbers and species of waterfowl, song, sea, and other birds present on and around the island do not differ markedly from those found elsewhere in the Puget Sound region.

PROCEDURE

THE RELEASE

This phase of the long-range study of ring-necked pheasants on Eliza Island was concerned with the survival and increment of a group of hens which were liberated in the spring before they had laid any eggs at the game farm. The phase immediately preceding, Phase II, had dealt with the winter survival of 53 hen pheasants. Phase II ended with a shooting harvest of the surviving birds. What was thought to be the last remaining hen (see section on mortality) was collected on April 1, 1948, and the stage was set for the beginning of Phase III.

The pheasant stock used in Phase III came from the Oregon State Game Farm at Eugene, Oregon. They were of the Phasianus colchicus Gmelin strain and were birds from the late 1947 broods which were raised at the farm and held as breeding stock. The shipment, consisting of 50 hens and 5 roosters, was crated at Eugene, Oregon, on the afternoon of March 22, 1948, and carried to Bellingham, Washington, via truck. The birds arrived in Bellingham during the early morning hours of March 23, 1948. At 0700 (military time) the crated birds were put aboard the mail boat M. V. Osage, and taken out to the island. They were unloaded on the island at 0800 and by 0830 had

been turned into the holding pen.

The holding pen, shown in Figure 6, was located on West Point and had a southern exposure. The pen was approximately 15 feet by 30 feet long and two feet high. Cotton webbing was used for the sides and two layers of purse-seine webbing were put on the top. A number of salal bushes and the limb of a down fir tree were included in the pen to afford some cover for the birds. A door, three feet long and two feet high, was located at the southwest corner.

The pheasants were fed twice daily on a mixture of wheat and cracked corn. They were offered water and utilized some, but apparently obtained most of their moisture from rain and dew off the leaves of salal bushes enclosed in the pen. The birds were relatively unafraid of man. The cocks crowed intermittently during the entire holding period. Two cocks became entangled in the purse-seine webbing over the top of the holding pen and died of injuries received in their struggles to get free. One other cock became similarly entangled but was discovered and cut down before death occurred. This cock and a similarly scalped hen seemed to be active and alert when released.

The last one of the pheasants from Phase II was thought to have been accounted for on April 1, 1948. Therefore, the birds used in Phase III were released on

the morning of April 2, 1948. It was an overcast day with a light rain falling. There was a 5 m.p.h. wind from the southeast. A trail of feed was made leading to the door of the pen and at 0917 the door was opened. The observers repaired behind some nearby bushes so as not to disturb the birds. The pheasants moved back into the corner near the door, but none made a move to get out. At 0940 one observer moved over to the pen and stood at the corner diagonally opposite the door. This forced most of the pheasants into the corner where the door stood open. Finally one hen stepped out at 0944. She was followed closely by a cock. The three cocks were among the first 11 birds to leave. There was no apparent realization among the birds that the doorway was an opening to the outside. Several times birds got up on the two-inch sill, looked around, and then stepped back inside. None of the birds were crowded out, but they were kept in the vicinity of the open door by the actions of the observer. The first 19 birds walked out and wandered down the trail. Then, at 0955, one flew. As if at a signal, all those that were outside took off and dispersed. Some flew to West Point and others to the central flat. When the unpenned birds outside flew, all those still in the pen tried to fly also. They soon quieted down and began going out again, mostly one at a time. After seven more had gone out, one flew again.

Immediately they all took off. This time, 11 birds went out the exit in short order, all flying as soon as they stepped up on the sill. At 1005, one hen flew straight out to sea and splashed into the water about 100 yards from shore. A boat, which was standing by, picked her up and brought her back, a little wet, but none the worse for wear. When picked up she was swimming strongly for the beach. At 1010, the last bird flew out of the pen and went to West Point. About two-thirds of the released birds went to West Point and one-third to the central flat. All were quite strong in their flight. The total release included 50 hens and three cocks.

A sex ratio of one cock to ten hens was desired in this Phase, so two additional cocks were ordered to replace those lost in the holding pen. The Washington State Department of Game supplied these two birds. They came from the Whidby Island Game Farm and were received and released on the morning of April 12, 1948. They were liberated by Field #2.

METHODS OF STUDY

An attempt was made to keep conditions on the island as natural as possible. No control of the various avian predators present or of the feral cat was attempted. Human activity was restricted to the extent that it was believed to be comparable to that encountered by pheasants

on farm lands elsewhere. Some plantings of small grain food crops were made. Field #1 had been planted to a mixture of oats and vetch in the spring of 1947 and a good volunteer crop was present in 1948. Field #3 had been planted to oats in the spring of 1947 and a heavy stand of clover and some volunteer oats were present in 1948. Fields #2, #4 and #5 were planted to barley, wheat, and oats, respectively. The last three fields were planted in the early spring just before the release of pheasants for Phase III. These plantings were made in order to approximate the agricultural habitat used by pheasants on the mainland and also to provide winter food crops for later studies.

Daily observations were made throughout the study. Variations of two methods were used. The most common method used was systematic foot coverage. On some days a small area would be covered intensively. On others, a complete tour of the island would be taken with no area getting particular attention. Although most of the predation and nesting information was uncovered while using the intensive method, a surprising number of items were found by just "stumbling" on them while meandering. The physical features of the island are such that it was natural to divide them into three sections; West Point and the central flat, from Field #5 to South Point, and from Field #5 to North Point. An attempt was made to cruise

each of these portions at least every third day. Within these three areas a smaller section would be singled out for intensive search. It was necessary at all times to be alert against the human tendency to follow trails. Although it was easier walking on trails, these seldom disclosed as many items of importance as were found by "beating the brush". An attempt was made to circumvent this trail-walking tendency by studiously changing the route of travel on each trip. If an area was approached from the west on one day, the next trip was planned so that the area would be approached from the east, etc. Another factor considered in the direction of travel was the effect the prevailing southeast wind had upon the ground cover. With the wind at the back of the observer a good view could not be had of the ground because of the bent over vegetation. By walking while facing into the wind, it was possible to get a much better view under this cover. The second method of approach was particularly useful when searching for nests, since many were situated under these natural roofs.

The basis for the other main method of observation was the use of various elevated regions and structures as vantage points from which to watch open areas. Many points along the edge of the woods were sufficiently elevated to afford a clear view of the central flat. The main cabin, which two observers occupied, was located so

that a large portion of the central flat could be seen from it. As shown in Figure 5, a small tower was added to the beach cabin and it was here that most of the hours of stationary watching were spent. From these locations it was possible to observe many avian actions which otherwise would have gone unrecorded. This was true not only for pheasant activities but also for predaceous, song, and sea bird movements.

These lookout positions were particularly useful during the early morning and evening hours. Pheasants normally concentrated their feeding activities during these two periods. In mid-day the birds were apt to skulk in the brushy borders and could be seen only by walking in and flushing them. During the feeding periods, however, they ventured out into the more open areas and their movements could easily be seen from the vantage points. This method was most useful in early spring. As the season progressed and the ground vegetation grew higher, it became more difficult to follow ground movements. A pair of Bausch and Lomb 6 x 30 field glasses was carried at all times while in the field and a Bausch and Lomb 19X spotting scope was also used in the tower.

The military system of a 24 hour day was used in the recording of time. In this system, four digits are used. Daily time begins at midnight. This is written as 0000. In the same manner, 3:05 a.m. is written 0305, 11:00 a.m.

as 1100. After the noon hour (1200), hours and minutes are added on to the 1200 number. Thus, 4:15 p.m. is written 1615, 8:30 p.m. is written as 2030, and so on up to midnight when the cycle starts over again with 0000. This system was used because it was felt to be easier, faster, and also because it tended to eliminate errors which could have crept in while transcribing hastily written field notes using a.m. and p.m. Military time is also used in this report.

During the early portion of the study, regular working hours were observed. An attempt was made to be in the field by 0800 and observations were generally ceased between 1700 and 1800. As the season progressed, it became apparent that the coverage afforded within these time limits was inadequate. This was particularly true during the early morning and evening hours. The pheasants were active before observations were begun and after they were terminated for the day. So that an observer could be afield during these periods of greatest activity, a modified program of daylight saving time was begun. At first the clock was set one hour ahead. As the season progressed and daylight came earlier the clock was set further ahead. By the first of June, daily activities were stepped up 2½ hours from standard time. By this method, observations could begin at 0530, standard time. The evening meal was generally over by

1700, standard time, and the hours from then until dark could be spent in one or more of the lookout positions. Although it was odd to eat lunch when it was only 0930, standard time, it was felt that this method of rearranging the days' activities paid dividends. Pacific standard time was used in recording all field observations.

A female Irish setter was extensively used in the field. She was used primarily as an aid in locating pheasant remains. Her keen nose unearthed many items which probably would have otherwise escaped the attention of the human observer. The natural tendency of the dog was to range far ahead of the person with her, but she was kept in close check at all times. This was accomplished either by use of a leash or by constant verbal commands. In addition to the finding of remains, the dog proved useful in indicating the presence of hidden pheasants. A recent scent brought forth a characteristic change in her attitude. She would assume a crouching position and greatly increase the tempo of her wagging tail. When these actions were noted the observer would attempt to prevent the dog from following the scent and thereby avoid flushing the pheasant. This was done particularly during the nesting season. These tell-tale actions of the dog which indicated the presence of pheasants were especially helpful in the heavy cover

found on North and South Points. Difficulty would have been encountered in following pheasant movements in these areas without the aid of such an indicator.

A small notebook was carried in the field and sight records, nesting data, predator remains and other pertinent facts were recorded in it as they were noted. Each evening this material was entered in a large notebook. A supply of coin and regular letter envelopes was also carried. The coin envelopes were used as containers for droppings and other small matter. The larger envelopes were used to carry feathers, bones and larger remains. Data pertaining to the enclosed material were recorded on these envelopes and they were then filed.

One drive census was made during this Phase. On September 6, 1948, three observers with the use of one dog attempted to cover the island. After eliminating reflushes, it was estimated that 54 pheasants were seen. Evidence uncovered during a controlled shooting and trapping harvest held later, disclosed that there were actually at least 113 pheasants on the island at the time of the census. The discrepancy may be explained by the lack of manpower. The heavy cover and tendency of the birds to run instead of flushing precluded any possibility of getting a complete count.

The observers utilized all resources at their command in trying to follow the developments of this

Phase. The insular condition and relatively small size, 158 acres, of the island favored accurate determinations. However, it was apparent at once that one or two observers could not hope to discover all evidences of pheasant movements, nesting, predation and other activities. This Phase was primarily concerned with gathering facts on the survival and increment of a known population. The findings which were obtained with this in mind are recorded here. Some observations of pheasant behavior in general were also made. Particular attention was paid to those which were felt to be characteristics of the class of birds involved.

THE HARVEST

Perhaps one of the greatest benefits obtained by using Eliza Island as a research area is the fact that accurate pheasant population determinations may be made at the beginning and ending of each Phase. The standard practice here has been to remove all surviving pheasants at the end of each Phase. This has been done either by shooting or trapping or a combination of both methods. Therefore, when a new Phase is begun, no pheasants except those liberated for the particular program of study in mind are present on the island. During the course of each Phase, the resident population is not subject to the fluctuations due to the egress from and ingress to the

area that are characteristic of less isolated populations. The isolation afforded by the surrounding waters prevents other pheasants from moving into the area, and partially prevents the resident populations from leaving the area. During Phase III, one cock was believed to have died by drowning when flighting over the bay or attempting to fly from the island. When each Phase is completed it is possible to remove all remaining pheasants. This method gives the field worker definite figures on the number of pheasants present at the beginning and ending of each Phase.

In order to follow the above procedure it was necessary to remove the surviving pheasants at the completion of Phase III. A trapping program was begun October 1. This trapping was done because it was desired to obtain a group of wild-reared pheasants for use in a later experiment. Four traps similar in design to those used in Ohio by Leedy and Hicks (after McAtee, 1945) were placed at various locations on the island. A total of 16 birds were successfully trapped and placed in a holding pen for future use. Previous pheasant trapping experience on the island had shown that it was not possible to remove a very large percentage of the total population by this method. The availability of large amounts of natural food during the period the traps were in operation minimized the effect of heavy baits of wheat, corn

and other lures.

In order to facilitate the removal of the remaining pheasants a controlled shooting program was begun. The program was planned so that the beginning date fell within two days of the start of the hunt in 1947. This was done so that accurate comparisons could be made of the survival rate of the two classes of pheasants involved.

The shooting began on November 6, with officials of the Washington and Oregon Game Commissions, leaders of local sportmen clubs, and observers from the Cooperative Unit and the United States Fish and Wildlife Service, participating in the activities. A complete record of the gauge of gun, size of shot, kills, misses, range and other pertinent data was kept for each hunter. These records when compiled with those taken on previous and future hunts on Eliza Island will indicate the comparative values of the various components in regards to hunter success, crippling loss, etc.

The initial shoot lasted most of one day and 12 gunners, aided by four dogs, succeeded in bagging 37 pheasants. After this shoot, the two resident observers took over the hunting and, with the help of one dog, hunted almost every day. They recovered 77 more pheasants of which the last one, a juvenile female, was shot on December 8. An analysis of the harvest appears under the

section on survival.

THE RESULTS

GENERAL OBSERVATIONS

CROWING ACTIVITIES. Since first proposed by Wight (1930), the term "crowing area" has come into general usage when speaking of the areas or "territories" that cock pheasants establish early in the breeding season. Any area on which a cock habitually crows and which he defends from intrusion by other cocks may well be called a "crowing area".

Although a total of five cocks were released during this Phase, there were actually only three cocks active during the breeding season. The injured cock of the original release, although it appeared active and alert on the release date, died soon after liberation. This cock was last seen on April 28 and the unmutilated remains, indicating a "natural" death, were discovered later in the study. Several observations were made on this cock prior to its disappearance and at no time was it seen to crow, nor was it ever accompanied by any hens. Apparently the injury resulting in its death also caused a recession of the breeding urge. The other immediate loss of the liberated cock population was one of the Washington birds. On May 1, the body of one of these cocks was found on the shore line of North Beach. Death

was attributed to drowning, and from the condition of the remains it appeared that the bird had been dead for at least two weeks.

The fact that only three cocks were actively crowing during the breeding season made it possible to quite accurately map out the particular territories established by each cock. The crowing areas or territories of these three cocks are shown on the map in Figure 8. They are numbered for easy reference. No evidence was observed of any particular spot or spots within the territories being favored for use as a crowing point.

The cock in Area #1 was apparently from the original release. He stayed on West Point until April 25 and then moved out on the central flat by the beach cabin. On May 4, this bird was seen to leave the area by the beach cabin, walk along North Beach and make a circuit all around West Point, then come back by way of the central flat until he was near the beach cabin again. The round trip took about 1½ hours. He crowed at short intervals during the entire trip. Progress could be noted both by seeing the bird and by hearing him crow. From May 4 until May 29, this cock divided his time between West Point and the beach cabin. On some days he stayed almost exclusively at one end of the area and on other days he roamed over the entire territory. On the morning of May 30, feather remains indicating a cock kill

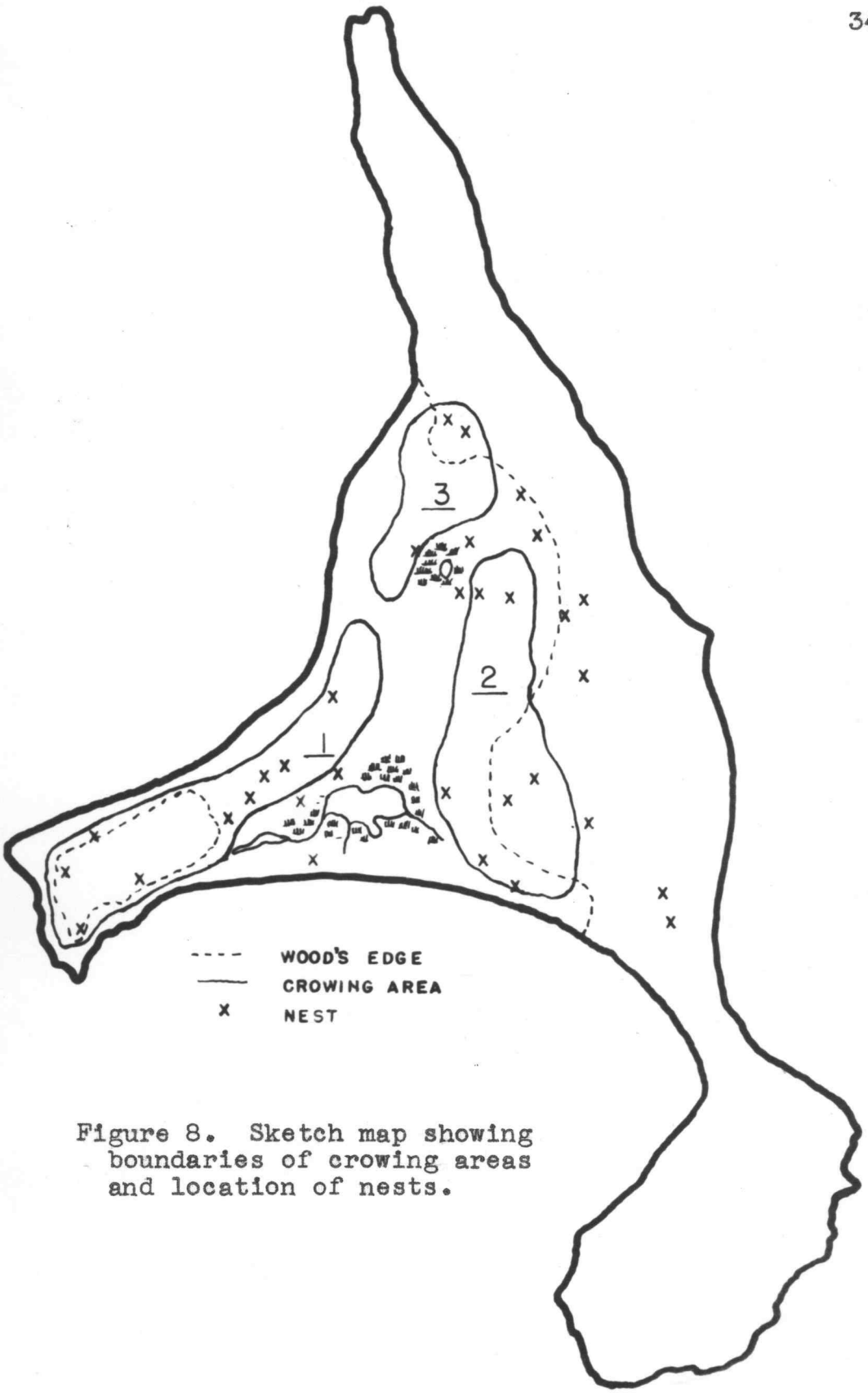


Figure 8. Sketch map showing boundaries of crowing areas and location of nests.

were found at the eastern wooded edge of West Point. All evidence pointed toward the cat as being the responsible predator. No crowing was heard in Area #1 for the remainder of the season.

The cock in Area #2 was apparently from the original release. Several days after the release a cock was seen and heard crowing around Fields #1, #2, and #4. Many times after that, a crowing cock accompanied by hens was observed in the area indicated on the map.

The cock in Area #3 was apparently from the release of Washington birds. No crowing cocks were observed near the "clump" before this release. Two days after the release a crowing cock was observed there and was seen in this vicinity many other times during the remainder of the season. After the death of the cock from Area #1, the cock in this area extended his range out onto the flat further than he was ever noted to go before.

During the crowing season, cocks could be heard throughout the day, but the greatest activity was in the early morning and evening hours. The crowing of cocks in Areas #1 and #2 began tapering off around the first of June. The last cock crow was heard on July 9.

MATING ACTIVITIES. Sight records indicated that after the liberation each active cock began using a certain territory for a crowing ground. During the

remainder of the breeding season, whenever a cock was seen within one of these territories he was usually accompanied by one or more hens. The largest numbers of hens were generally present during the morning and evening feeding periods. The most seen at any one time with a cock was nine.

The first known copulation was observed on April 16. A total of six such actions were noted, the last occurring on July 6. The characteristic plumage display, strutting, and bobbing of the cock as reviewed by Wight (after McAtee, 1945) was not noticed as being a preliminary action in any of the mating observed. Instead, the mating activities witnessed during this Phase were of the following fashion.

During the morning and evening feeding periods the cocks ranged over the individual territories, alternately feeding and crowing. A scattered group of hens moved with each cock, feeding as they went along. Suddenly, the resident cock would make a dash for one of the nearby hens. Sometimes the hen submitted readily, but on other occasions quite a chase ensued before she either acquiesced or the cock desisted in his efforts. If particularly desirous of escaping these attentions, the hens took wing. This generally cooled the cock's ardor, but occasionally one continued the pursuit by flying after the fleeing hen. These flights were generally less than

30 yards. On one occasion copulation occurred immediately after a pair landed from such a flight.

FOOD AND WATER. The findings of Scott (MS) that in the summer months on Eliza an abundance of natural food was available and readily utilized by the pheasants, were substantiated during this Phase. In addition to the natural foods, by early fall, when the population was at its highest level, the grains in the various fields were available and utilized to a great extent.

Scott reported that in the late summer of 1947 the marsh on the island dried up and that a large number of pheasant tracks in the mud was evidence that the birds were searching for water. He concluded that the shortage of fresh water was of no serious consequence during the short dry period. The marsh held standing water throughout the course of Phase III, and therefore, there was no such shortage.

On most mornings, even during the summer months, there was dew on the ground cover. Also, in July, the driest month, it rained on seven days during the month. The experience with the pheasants in the holding pen, where they utilized very little of the water in containers but apparently preferred to use that available from rain and dew on the salal leaves, indicated that this may be their natural preference. Some moisture was no doubt

also obtained from the green vegetation normally included in a pheasant's diet.

Animal foods apparently are an important part of the diet of juvenile pheasants. Trippensee (1948) stated that young pheasants " - - - need a food high in protein, much of which is derived from a diet of insects". During the study a partial collection was made of the insects on the island. In the course of making this collection, it was determined that, when compared to other habitats, an adequate supply of insects was available for the pheasant chicks during the entire growing season.

POPULATION BEHAVIOR. During the period of liberation, approximately one-third of the pheasants went to West Point and two-thirds went to the central flat. In order to allow the birds to become adjusted in the new environment, no extensive trips in the field were taken on the release date or during the day following it.

On the second day following the release, a walk around the island revealed that the pheasants had spread to all the extremities. At least five hens were present on South Point, and two hens were seen on North Point. No pheasant activity was noted on South Point during the period between April 17 and July 20, nor was any seen on North Point between April 14 and July 17. No cocks were seen on either of these points during the breeding season. At least six hens and one cock were present on West Point

during the breeding season.

These records indicate that after liberation the hen pheasants quickly spread as far as the limitations of the island would allow. This rapid spread is in line with the finding of Einarsen (1945) who reported that pen-reared pheasants had been recovered six miles from the liberation point on the day following their release. There is also an indication that the North and South Points held a hen population for approximately two weeks and then were deserted by the birds and were not repopulated, either by the same or different pheasants, until after the nesting season. Seemingly, the best explanation for these movements would be that, when prompted by the mating urge, the hens were attracted from these Points by the crowing cocks in the more central areas. After the nesting activities were over, the juvenile and adult population again spread to all extremities.

An example of how improved habitat encourages an extension of range was also noted during this Phase. During Phases I and II, the ground cover of native grasses and weeds in Field #5 had been left undisturbed. Pheasants were seen only occasionally in this area during the course of these two Phases. Before the start of Phase III, Field #5 was cultivated and planted with oats. Throughout the course of Phase III, this field, and the immediate area surrounding it, was frequented by pheasants

to a much greater degree than it had been previously.

An interesting observation was made on the morning of October 25. During a half-hour period between 0830-0900, 63 pheasants were seen to pass between the resident cabin and North Beach. The birds, consisting of 42 hens and 21 cocks, were all headed for West Point. About noon they were seen to return to the central flat by way of the South Beach. The cause for this mass movement is not known. The areas with the greatest available food were in the opposite direction. Perhaps it was an attempt on the part of the birds to move to another area. If this was the case, they were definitely thwarted by the natural boundaries of the shore line.

NESTING ACTIVITIES

NEST LOCATIONS. After the pheasants had been released from the holding pen on April 2, a check of the area revealed that two eggs had been laid in the pen during the 10 day holding period. The presence of these eggs indicated that the main egg-laying period was near at hand and so a close watch was kept for any signs of nesting in the field.

The first discovery of a nest was made on May 1. The bulk of the remainder of the located nests were found during May and June, but a few were discovered in the following months with the last one being reported on

March 18, 1949. A total of 32 nests were found.

The nest locations are shown on Figure 8 in conjunction with the established crowing areas. There is some apparent correlation between the nesting sites and the boundaries of the crowing areas. This is similar to the findings of Wight (after McAtee, 1945) who stated that "The nests are built within or near the crowing area - - - ". Leedy and Hicks (after McAtee, 1945) and Randall (1940) also thought it possible that crowing area boundaries had some relation to observed grouping of nests in certain parts of a field.

It is of interest to note that crowing Areas #1 and #2 had many more nests than Area #3. This might have been due to the fact that the cocks using the first two areas were liberated 10 days earlier than the cock in Area #3. Sight observation indicated that this cock did not have as large a harem as did the cocks of the first release.

The number of nests found in each of the four major nesting cover types present on Eliza Island is shown in Table 1. All nests found either in a hayfield or in tall, dense grasses similar to those found in a hayfield were included in that cover type. The "fence-row" cover type was considered to be made up of intermediate grasses, intermingled with light to heavy stands of shrubs. Much of the border areas between grassland

TABLE 1

OCCURRENCE OF NESTS BY COVER TYPES

Cover Type	No. of Nests	% of Nests	No. of Hatched Nests	% of Hatched Nests
Hayfield	9	28	4	27
Fencerow	14	44	6	40
Swale	5	16	1	6
Wooded	4	12	4	27
Totals	32	100	15	100

and wooded sections were made up of this cover type. The "swale" cover type was found in the central flat. It consisted of heavy stands of low grasses and weeds. Some of this type was flooded during the winter months. The "wooded" cover type was considered to be any area where the intermingling branches of the tall forest trees formed a canopy which excluded most of the direct sunlight. The ground cover in this type was generally quite sparse.

As might be expected, Table 1 shows that the heavier ground cover of fencerow and hayfield types was favored for nest location. The hatching percentage of each cover type can also be determined by using the figures in this table. When this is done it is found that the wooded cover type with four out of four had 100

TABLE 2

NESTING DATES FOR SEVEN OBSERVED NESTS

Nest No.	Beginning Date	Hatching Date	No. of eggs Hatched
16	April 14	May 22	13
4	April 25	June 2	12
13	April 30	June 2	11
9	May 1	June 4	11
21	May 5	June 7	8
19	May 20	June 21	9
22	June 14	July 18	4

per cent hatching success. The hayfield and fencerow types had 44 and 43 per cent respectively and the swale type had only 20 per cent success. In an agricultural area the percentage of success in hayfield nesting would probably have been appreciably lowered due to activities such as mowing and raking. Trippensee (1948) states that usually more than 50 per cent of the total nest losses are due to man and his activities, and that of these activities, mowing appears to be the most destructive.

NESTING DATES. The date of hatching was known for seven of the 15 hatched nests that were found. These dates are shown in Table 2. By subtracting 23 days for incubation, one day for the period between the laying of

the last egg and the start of incubation, and one day for each egg in the nest, an approximation was arrived at for the date the first egg was layed. Use of this method disclosed that the first observed nest was started on April 14, just two weeks after the release. The majority of the nests for which hatching dates are known, came off during the first week in June.

Table 2 also shows that as the season advanced, there was a progressive decline in the number of eggs hatched. This is similar to the findings of Randall (1940) who reported a decrease from 15 eggs in April to 7.7 in July, and of Errington and Hamerstrom (1937) who observed a decline from 19.4 in the first half of April to 8.0 in the second half of July. The nests begun on May 20 and June 14 were considered to be re-nesting attempts. The nest begun on May 20 was within 25 feet of a nest, containing 13 eggs, which was known to have been deserted on May 4. The nest begun on June 14 was within 50 feet of a nest, containing 15 eggs, which was known to have been destroyed by crows on May 15.

NESTING RESULTS. The quantitative nesting results of Phase III are given in Table 3. A total of 416 eggs were found in the 32 nests located. Only one "dropped" egg, an egg which is laid at random with no indication of nest building or incubation, was found

TABLE 3

QUANTITATIVE NESTING RESULTS

Information	Results
Number of nests located	32
Total eggs in nests	416
Dropped eggs	1
Community nests	5
Deserted nests	7
Destroyed nests	6
Hatched nests	15
Average clutch in hatched nests	11.2
Average hatch in hatched nests	9.1
Total hatched eggs	137
Fertility (166 out of 179)	92.7%

during this study.

Most observers making pheasant nesting studies have reported nests which contained eggs laid by two or more hens. These clutches containing the eggs of several hens have been called "compound sets", "dump nests", and "community nests" by various authors. Such nests are generally characterized by having a large number of eggs which are somewhat scattered or indiscriminately stacked as in Figure 9. Probably because of the intrusions of the other contributors, these nests are usually not

Figure 9. Community nest containing 29 eggs. Note scattered arrangement of eggs.

Figure 10. Embryos from eggs left in a hatched nest, indicating probable communal laying.

incubated and so end up as total losses.

Occasionally, however, one of the hens contributing to a community nest is persistent enough with her incubation to bring off a hatch. The results of such a nest are shown in Figure 10. When this nest was discovered, 11 eggs out of a total of 21 in the nest had hatched. There was one other egg almost fully pipped and nine were intact. When the nine intact eggs were cracked open it was found that one was infertile and eight contained embryos as shown in the figure. One of the small embryos was mutilated when cracking the eggs and was not included in the photograph. Baskett (1947) reported that sometimes a hen will lay several eggs after she has begun incubation. This explanation might account for the nearly full term embryo, but it is believed that the smaller embryos were from eggs laid by a hen other than the one doing the incubating. This nest has been listed both as a community nest and as a hatched nest in Table 3, which explains the apparent discrepancy of the four classes of nests adding up to 33 when only 32 were located. The other four community nests contained 24-30 eggs apiece, none of which were incubated.

During the course of the study, human interference caused the desertion of three nests from which the hens were flushed and which thereafter remained inactive. No

reason could definitely be determined for the abandonment of four other nests which were inactive when located. Only one of the seven deserted nests had been incubated.

There were five nests apparently destroyed by crows, and one was lost when the cat killed a hen on the nest. In two instances crows were actually observed stealing eggs from a nest. In the other three cases, where eggs just suddenly disappeared with no traces of broken shells or other sign left behind, crows were tentatively held to be responsible. Previous sight observations had shown that sometimes when raiding a nest they flew away holding an unbroken pheasant egg in their beak. This is similar to the findings of Baskett (1947) who reported that crows often carried whole eggs away from a nest, thereby leaving no identifying evidence.

The 15 hatched nests produced 137 hatched eggs. The discrepancy between the 11.2 average clutch and 9.1 average hatch was due to the combined loss of pipped eggs not completely hatching, part-term embryos as explained previously, and infertile eggs. None of these were significant when considered singly, but together they caused a loss averaging 2.1 eggs per hatched nest.

Fertility was calculated by dividing the number of hatched eggs and eggs containing embryos by the total number of eggs found in hatched and incubated nests.

The fertility of more eggs could have been checked if the method of examining the appearance of the germinal disc to determine fertility (Twining et al, 1948) had been used. However, the observers had no previous experience with this technique and, since there were no incubation facilities on the island with which to check their individual accuracy when using this method, it was not utilized.

NESTING ANALYSIS. It should be re-stated here that the primary purpose of this Phase was to determine the results of the release of a certain class and known number of game farm hens. The results of this release were desired for comparison with those from a previous release of a known number of game farm hens of a different class.

The common practice for observers making pheasant studies has been to compare their findings with those obtained by investigators elsewhere. There is no reason to believe that this is not the proper thing to do.

It is believed, however, that an intensive comparison of the results of Phase III with those of other areas would prove to be invalid. The nesting results may best illustrate why this belief is held. The published nesting results of studies conducted by Randall (1940) in Pennsylvania, Buss (1946) in Wisconsin, and

Baskett (1947) in Iowa, were computed on 310, 350, and 533 nests, respectively. The various factors affecting nest losses, nesting success, etc., were figured on a percentage basis. If the influencing factors on the fate of the 32 nests located in Phase III are computed this way, each nest has a percentage rating of 3.12. Obviously, a detailed comparison between Phase III and these or similar studies would have little value.

The investigation on Eliza Island is scheduled for at least five years. At the end of that time enough data will have been collected to justify a full-scale comparison of results with those found in other areas. In the interim, some outside comparisons are useful, but the primary object is to determine the relationship between the various controlled Phases.

MORTALITY

PREDATION. No predator control was attempted at any time during this Phase, and so the pheasants were subject to predation during the entire course of study. An attempt was made to determine the predator responsible for each pheasant kill that was found. Although it sometimes appeared hopeless, it is believed that quite accurate determinations were made. These determinations were based on a knowledge of two things. The first was a knowledge of the predators present in the area, and the

TABLE 4

RELATIVE PRESENCE OF PREDATORS

Predator	No. Days Seen	First Seen	Last Seen	Largest No. Seen
Northern Bald Eagle	57	4/ 3	12/ 8	4
Cooper's Hawk	27	8/17	11/17	2
Marsh Hawk	10	5/14	10/25	1
Sharp-shinned Hawk	4	10/10	11/24	1
Western Red-tailed Hawk	2	8/ 5	9/ 8	1
Black Pigeon Hawk	2	8/22	10/20	1
Eastern Sparrow Hawk	2	8/ 6	9/ 5	1
Great Horned Owl	1	12/ 3	12/ 3	1
Feral Cat*	250	4/ 2	12/ 8	1

* Not actually seen but known to have been present.

second was a knowledge of the characteristic manner which each predator used in killing and eating its victim.

A tabulated account of all predators known to have been present on the island during Phase III, is given in Table 4. It is entirely possible that some of the avian species were present for more days than are recorded for them in the table. The table does, however, indicate the relative presence of the various predators.

Northern Bald Eagles (Haliaeetus leucocephalus washingtoniensis) were seen on more days than any other

avian predator. The greatest numbers of these birds were seen during the early part of the study. From July 20 to October 7, none were recorded and from October 7 to December 8, they were seen on only nine days. On several occasions, four eagles were seen together, but the usual number observed was one or two. Generally, the eagles did not spend much time on the island. They would sometimes perch in one of the tall trees on North or South Points, but most of the time they were recorded as they passed over the island in their wide-spread search for food. The next most prominent species were Cooper's hawks (Accipiter cooperii) which were seen on 27 days. From actual sight records and pheasant kill records, it was believed that at least one Cooper's hawk was present almost every day during the three month period indicated. On one occasion, September 11, two Cooper's were seen together. The 10 Marsh hawk (Circus cyaneus hudsonicus) records were instances of single birds coming onto the island, coursing the central flat for a while and then leaving, generally within a hour. Three of the four records of the Sharp-shinned hawk (Accipiter striatus velox) were taken during the week beginning October 10.

The Western Red-tailed hawk (Buteo jamaicensis calurus), Black Pigeon hawk (Falco columbarius suckleyi), and Eastern Sparrow hawk (Falco sparverius sparverius)

were seen only on the first and last dates recorded. Only one sight record was made of a Great Horned Owl (Bubo virginianus saturatus). The feral cat was occasionally seen before, during, and after this Phase, so it was known to have been present during the entire course of the Phase.

With a knowledge of the predators that because of their presence could tentatively be held responsible for a certain pheasant kill, the next thing done was to examine the kill for any characteristic marks. Einarsen (MS) has stated that " - - - identification of the predator can be facilitated by an intimate knowledge of its manner of attack, feeding habits, and other treatment of a victim". Darrow (1938) in his work on the Ruffed grouse used penned animals and birds as a means of obtaining this information. This penning would have been impractical on the island, but even without it some direct evidence of predator feeding habits was obtained. On several occasions a Cooper's hawk was flushed from a very recent kill, in one case before the pheasant was dead, and so some observations were made as to the manner in which this bird usually killed and dressed out its victims.

Quite often small tufts of white fur were found at the scene of a kill. Since the feral cat, the only wild ground mammal on the island, was white, the fur directly

TABLE 5

KNOWN MORTALITY BY SEX, AGE AND CAUSE

Cause	Adult		Juvenile			Unknown		Totals
	M*	F*	M	F	U*	M	F	
Predation								
Cooper's Hawk		5	5	7	4		1	22
Cat	2	7	1	2	13		4	29
Unknown				2			2	4
Handling	1	2	3	1				7
Natural					5			5
Smothered on roost					1			1
Drowning	1							1
Dog					1			1
Totals	4	14	9	12	24		7	70

* M, F, and U indicate Male, Female, and Unknown.

linked the cat with the appearance of the nearby remains.

The determinations of responsible predators, as shown in Table 5, were made by comparing any kill remains with the remains definitely credited to a known predator, and further checking this with the photographs and text of Einarsen's manuscript.

The feral cat, possibly because it was present at all times, accounted for more of the pheasant kills than any other predator. The first cat kill was found on April 3, the day following the release. The remainder

were discovered intermittently during the course of the study. It is possible of course that the cat did not actually kill all the pheasants, particularly juvenile, credited to it. Most of the chick remains consisted only of the primary feathers of the wing tips. Some of these birds could easily have been natural deaths in which the cat acted only as a scavenger.

The Cooper's hawk was the only avian species credited with any pheasant kills during this Phase. The other winged predators were eliminated either by their relative scarcity or because the remains found at a kill did not show the proper evidence to indicate them as being responsible. The Cooper's hawk was first seen on August 17 and by August 21, the first kill credited to the species was found. The determination shown by this bird is remarkable. One day while the pheasant traps were being checked, a great commotion was noted in one of the traps. The observers hurried over and discovered that the disturbance was caused by a juvenile cock in the trap desperately trying to escape a similarly entrapped Cooper's hawk. The only way the hawk could have entered the trap was to walk in through the small entrance at either end. The hawk was liberated immediately, but the observers were reminded of the saying "If looks could kill - - -". Although the cock had several abrasions on his back, he was put in the holding pen and later fully

recovered from these injuries.

Predation was by far the greatest cause of mortality during the study. It is not known what effect the absence of "buffers", species such as small rodents which furnish part of the food of predators and thus lessen attacks on game species, had on the total losses due to predation. It has been said that, generally, if there is no food competition, buffers are essential to game survival (Leopold, 1933). In the same publication Leopold points out, however, that the presence of buffer species may act as a lure to bring mobile predators into an area. Errington and Stoddard (1938) thought that large populations of the cotton rat (Sigmodon hispidus) might cause an influx of predators which would, in turn, increase the rate of quail predation. If there had been buffers present on the island, there may have been less pheasant predation by the Cooper's hawk and the feral cat. This decrease, however, might have been offset by an increase in predation by other species.

The Marsh hawks did not linger on the island very long during any of their visits. Perhaps they were discouraged by the lack of small rodents which normally make up a large portion of their diet. Marsh hawks in other areas have been known to make serious inroads on pheasant populations, being particularly severe on juvenile birds. It is possible that if mice had been present, these hawks

would have spent more time on the island and in the course of their hunting, killed some pheasant chicks.

This matter of the relation between lack of buffers and pheasant predation on the island is now a matter of conjecture, but it need not always be so. The long-range research plan for the island includes a Phase in which buffer species will be introduced, and some accurate determinations can then be made.

OTHER CAUSES. Severe scalping incurred during the trapping operations accounted for five of the seven birds lost in handling. The other two pheasants lost in this way were the injured cock and hen from the original release. Recovery of the cock was discussed in the section on crowing areas. The unmutilated body of the hen was found on April 8, six days after the release. Death was apparently due to the previous injury in the pen. During the trapping operations in the fall, a hen from Phase II, which had escaped the shooting harvest at the end of that Phase, was recovered. For all purposes of tabulation this hen was considered to have taken the place of the hen which died from injuries incurred before liberation.

There were five unmutilated remains of pheasant chicks discovered during the Phase. No reason could be determined for the cause of death and they were listed

as being natural losses. A gradual shrinkage in size of broods as the season progresses is to be expected.

Trippensee (1948) reported that English found cold, wet weather to be responsible for this shrinkage during the first 6 to 10 weeks of life. Although the numbers of natural losses found during Phase III are too small to draw any conclusions, the effect of weather on young chicks may have caused some losses. For that reason Tables 6 and 7, showing rainfall and temperature during the critical months of growth are included. This weather data was taken at the Soil Conservation Service nursery in Bellingham, about seven miles from the island, and is believed to be quite comparable to that actually found on the island.

The balance between life and death for a pheasant chick is most delicate. When one considers the multitude of factors arrayed against their survival, it is indeed a testimony to the bird's adaptability that as many reach maturity as normally do. Many factors such as nest desertion, predation, weather, etc., are obvious. Figures 11 and 12 show one of the unseen factors that contribute to the discrepancy between total eggs laid and harvestable birds available in the fall. In this instance, during the hatching period the hen apparently rolled an egg containing a full term embryo into the shell of a hatched egg. The unhatched chick was unable

TABLE 6

RAINFALL RECORDS FOR SIX MONTHS OF 1948. TAKEN AT BELLINGHAM, WASHINGTON.

Month	No. of days with Ppt.	Ppt.	30 Year Average	Excess or Minus
April	12	1.44	2.43	minus .99
May	13	4.13	1.74	plus 2.39
June	6	2.21	1.76	plus .45
July	7	1.44	.87	plus .57
August	17	3.55	1.19	plus 2.36
September	10	2.27	2.12	plus .15

TABLE 7

TEMPERATURE RECORDS FOR SIX MONTHS OF 1948. TAKEN AT BELLINGHAM, WASHINGTON.

Month	Mean Max.	Mean Max.	Mean	30 Year Mean
April	55.33	37.33	46.33	47.83
May	62.32	42.03	52.18	53.73
June	71.47	49.63	60.55	57.62
July	71.48	48.61	60.10	60.66
August	69.10	51.22	60.16	60.92
September	68.50	42.87	55.69	56.08

to chip its way out of this double shell and so died.

SURVIVAL

The survival of the liberated adult and wild-reared juvenile pheasant population was measured by live

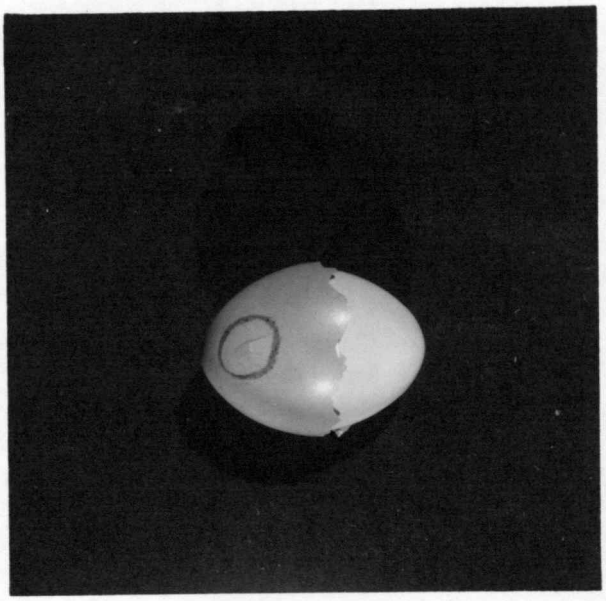


Figure 11. Pheasant egg as found in nest. Note slight crack on outer shell.

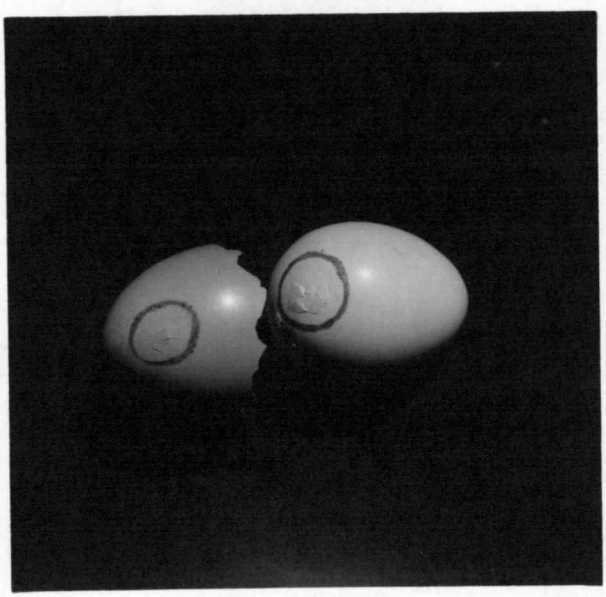


Figure 12. Shell of hatched egg removed. Chick had begun pipping its own shell, but was unable to get through the double layer.

TABLE 8

SURVIVAL, MEASURED OCTOBER 1 TO DECEMBER 8

	Adult		Juvenile		
	Male	Female	Male	Female	Totals
Trapped	1	2	10	3	16
Shot		7	29	41	77
Sub-totals	1	9	39	44	93
Known mortality during harvest		4	5	11	20
Totals	1	13	44	55	113

trapping and shooting between October 1 and December 8. The results are given in Table 8. The number of mortalities known to have occurred during the harvest are also included in the table. These figures indicate the potential survival had there been no losses from handling and predation during the harvest. The discussion below on age ratio is based on the sub-totals in Table 8, and does not include the potential survival.

Table 8 shows that there was a survival rate of 8.3 young for each adult, or expressed another way, that 89 per cent of the birds surviving were juveniles. Kimball (1948) wrote that in South Dakota a ratio of 2.98 young birds for each adult represented good reproduction and would result in a population increase. Buss (1946) cited a five-year observation in Wisconsin which concluded

TABLE 9

PHEASANT WEIGHTS IN POUNDS AND OUNCES
RECORDED BETWEEN NOVEMBER 6 AND DECEMBER 8, 1948.

Sex	Age	Number Weighed	Lowest Weight	Highest Weight	Average Weight
Male	Juvenile	28	2- 8	3-8	2-12
Female	Adult	6	1-11	2-4	1-14
Female	Juvenile	41	1-10	2-7	2-00

that 71 per cent of the birds in any large sample should be juveniles. A comparison of the results on Eliza Island with these figures would indicate that the reproduction and survival during Phase III was very satisfactory. This might be shown by the fact that the 55 liberated birds increased 69 per cent to a total of 93 during the harvest period.

It is possible, however, that this apparently adequate ratio of 8.3 young to each adult is not real. If the adult portion of 11 per cent of the total survival had been larger, the juvenile portion of 89 per cent would have been proportionately smaller. Future studies of the mortality of spring released adult pheasants will have to be conducted on Eliza before the normality of this survival ratio can be determined.

All of the pheasants collected during the harvest appeared to be in good physical condition and free from

any debilitating disease or parasites. The weights shown in Table 9 compare favorably with those recorded for other areas by McAtee (1945).

COMPARISON OF RESULTS OF 1947 AND 1948 STUDIES

NESTING COMPARISON

The productivity as reflected in nesting results of Phase I and III, is given in Table 10. The difference in numbers of pheasants released and class of hens involved in each Phase, should be kept in mind when comparing the results.

The table shows that almost as many nests were studied for the 50 hens in 1948 as for the 100 hens in 1947, and that the total number of eggs in the 1948 nests was much greater than that in the 1947 nests. Perhaps this was natural since the hens in 1947 had already produced a large number of eggs at the game farm, and by the time they were liberated, the egg laying urge was about over for that year.

Scott (MS), who conducted the 1947 study, believed that the five community nests of Phase I were due to a high population density, and substantiated the idea with a pertinent reference to Einarsen who found that community nests on Protection Island were a result of high pheasant populations. The 1948 study seems to indicate that some other factor may also influence community laying. If it were strictly a matter of population density, it seems odd that one half as many hens should

TABLE 10

COMPARATIVE NESTING RESULTS OF 1947 AND 1948 RELEASES

Information	1947 100 Hens	1948 50 Hens
Number of nests located	37	32
Total eggs in nests located	245	416
Community nests	5	5
Hatched nests	25	15
Average clutch in hatched nests	5.1	11.2
Total hatched eggs	127	137
Fertility	82.7%	92.7%

produce as many communal nests. Future studies on Eliza with varying numbers of hens being liberated may throw more light on this matter.

Perhaps the most significant comparison in Table 10 is the difference in size of the average clutch of the two-year study. The 120 per cent increase in clutch size in 1948 probably illustrates the difference in the reproductive capacity of the two classes of hens more than any other factor. This difference is further emphasized if the number of total hatched eggs is divided by the number of liberated hens. By doing this it is found that the 1947 release averaged 1.27 hatched eggs per hen and that the 1948 release averaged 2.74 hatched eggs per hen.

There is some difference in the fertility rate of

the two Phases. Trippensee (1948) refers to five different authors who found that fertility in hatched clutches was 90 per cent or better. The somewhat lower rate of fertility in 1947 may have been due to the time of liberation. Due to the late release in 1947, June 4, any nesting the hens did after that date would be similar to re-nesting attempts for wild-reared or earlier released game farm hens. Randall (1940) found in Pennsylvania that late clutches had a greater percentage of infertile eggs than did early ones.

The 92.7 per cent fertility of the eggs checked in Phase III is worthy of note because of the fact that only three cocks were active during the breeding season. Observers on a California game farm found that under game farm conditions one cock to as high as 50 hens resulted in normal egg fertility (Twining et al, 1948). This study and one conducted by Schick (1947) in Michigan also found that the period for which the servicing by a cock was effective, averaged about 21 and 22 days, respectively. Schick concluded that because of the polygamous nature and long breeding season of the cocks, that a spring sex ratio of one cock to 10 or 12 hens was entirely feasible. The egg fertility in Phase III seems to bear out his conclusions. The importance of the practicality of such a sex ratio lies in the fact that if it were not for incidental hen losses due to

TABLE 11

COMPARISON OF SURVIVAL AND INCREMENT OF

1947 AND 1948 RELEASES

	1947*				1948**			
	ADULT		JUVENILE		ADULT		JUVENILE	
	M	F	M	F	M	F	M	F
Trapped	1	6	1	2	1	2	10	3
Shot	8	24	15	10		7	29	41
Totals	9	30	16	12	1	9	39	44
Combined Total	39		28		10		83	

* Original release - 100 hens, 10 cocks. Survival and increment measured from October 23 to December 5.
** Original release - 50 hens, 5 cocks. Survival and increment measured from October 1 to December 8.

illegal shooting, an increase in the length of hunting season and/or bag limit on cock pheasants would be practical for some areas. The possibility of removing enough cocks to affect the reproduction the next spring seems remote.

SURVIVAL COMPARISON

The feasibility of any phase of game management is generally based on one item - the effect it has on the harvest. Table 11 indicates that from this standpoint the release of the 1948 class of hens was much more successful than that of 1947. By the time of the

harvest, the 1947 release resulted in a 39 per cent decrease of the original population of 110 birds, whereas the 1948 release resulted in a 69 per cent increase of the original population of 55 birds. The age ratio of 0.71 young for each adult in 1947 and 8.3 young for each adult in 1948 further illustrates the more favorable results of the 1948 release.

SUMMARY AND CONCLUSIONS

1. A study was made of the survival and increment between April 2 and December 8, 1948, of an April release of ring-necked pheasants (Phasianus colchicus Gmelin). The release consisted of game farm hens and cocks which were liberated before the hens had laid any eggs at the game farm.

2. In order to shorten research time and to make more accurate determinations, Eliza Island, Washington, was chosen as the area on which to conduct the study. The 158 acre island was considered to be similar to other pheasant ranges in the Northwest.

3. Fifty hens and five cocks were released on April 2, 1948. Daily observations were made of the pheasant activities on the island.

4. Three cocks were present during the breeding season. They established quite definite crowing areas.

5. Food and water were adequate for pheasants during the course of the study.

6. It appeared that pheasant hens moved into crowing areas from adjacent land during the breeding season.

7. The majority of nests were located in fence-row and hayfield cover types.

8. Hatching dates were known for seven nests.

Four of these hatched during the first week in June.

9. There were 32 nests located during the study, of which 15 hatched. The average clutch was 11.2 and the average hatch was 9.1. Fertility of hatched nests was 92.7 per cent.

10. A feral cat was the only mammalian predator present on the island. Various avian predators were present intermittently. Cooper's hawks and the feral cat were credited with 51 of the 70 known pheasant deaths. The effect on predation of the lack of buffers on the island was not fully determined.

11. A shooting and trapping harvest was conducted between October 1 and December 8. A total of 83 birds were recovered. This meant there was a net increase of 69 per cent of the 55 birds released. The age ratio of survivors was 8.3 young for each adult.

12. A comparison was made between this study and a study conducted on the same area the previous year. The 1947 study was concerned with the productivity of 110 hens and 10 cocks liberated after the hens had laid a normal complement of eggs at the game farm.

13. The comparison showed that the 1947 group with a 5.1 average clutch and 0.71 age ratio had a 39 per cent decrease of the original birds, and that the 1948 group with a 11.2 average clutch and 8.3 age ratio had a 69 per cent increase of the original 55 birds.

The above comparisons indicate that for larger returns in the fall harvest, hen pheasants utilized as egg producers in a game farm should not be liberated immediately after the cessation of their egg laying period, but should be kept at the farm until the following spring and then liberated before egg laying begins.

Before this plan is adopted, however, there must be some analysis of the cost of keeping the additional hens at the game farm for a nine-month period. If the cost outweighs the benefits received, naturally there is no basis for the acceptance of such a program. Some experimental winter feeding has been done by the Co-operative Unit. These experiments have shown that by feeding a green food, such as kale, and weed-seed diet, winter feeding costs may be materially reduced from those incurred with a regulation diet. This lowering of cost of winter foods would make the plan of holding hens over until the following spring more feasible.

An attempt has been made to keep this report as objective as possible. It should be remembered that the series of studies on Eliza Island are slated for at least a five-year period. Subsequent pheasant studies on the island may show that some of the conclusions drawn here are invalid due to conditions peculiar to the study area. Time and the results of future experiments will determine this.

TABLE 12

COMMON AND SCIENTIFIC NAMES OF PLANTS

MENTIONED IN TEXT

Common Name	Scientific Name
Alder, Red	Alnus rubra
Bulrush	Scirpus spp.
Cedar, Western Red	Thuja plicata
Currant, Red Flowering	Ribes sanguineum
Dock	Rumex spp.
Fern, Bracken	Pteridium aquilinum
Fir, Douglas	Pseudotsuga taxifolia
Fir, Lowland	Abies grandis
Glass wort	Salicornia sp.
Grass, Cheat	Bromus tectorum
Grass, Orchard	Dactylis glomerata
Grass, Salt	Distichlis spicata
Madrone	Arbutus menziesii
Maple, Broad-leaved	Acer macrophyllum
Mullein	Verbascum sp.
Ocean Spray	Holodiscus discolor
Pea, Purple Beach	Lathyrus littoralis
Rose, Wild	Rosa sp.
Rush	Juncus spp.
Rush, Spike	Eleocharis palustris
Salal	Gaultheria shallon
Silver-weed	Potentilla anserina
Snowberry	Symphoricarpos albus
Three-square	Scirpus americanus
Vetch	Vicia spp.
Yarrow	Achillea lanulosa
Yew	Taxus brevifolia

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