THE SURVIVAL OF JUVENILE RING-NECKED PHEASANTS ON ELIZA ISLAND, WASHINGTON, DURING 1952

by

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INTRODUCTION

This paper presents the results of a juvenile ring-necked pheasant, Phasianus colchichus Linnaeus, survival study conducted during 1952 on Eliza Island, Washington. Comparisons between the survival of game farm and wild bird stocks were made while predator control was attempted. This thesis is the tenth in a series concerning Eliza Island pheasant research problems. Desiring field research on game farm pheasants, the Oregon and Washington State Game Commissions since 1947 have fostered study problems to be carried out on the island. These studies are co-ordinated and directed by the Oregon Cooperative Wildlife Research Unit[1], with supervision by Mr. Arthur S. Einarsen, Biologist, United States Fish and Wildlife Service.

The 1951 juvenile pheasant study on Eliza Island conducted by Hartwell, a graduate student, was duplicated in 1952 with two main exceptions: (1) seven groups of game farm birds (20 birds per group) were liberated instead of

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[1] U. S. Fish and Wildlife Service, Wildlife Management Institute, Oregon and Washington State Game Commissions, Oregon Agricultural Experiment Station and Agricultural Research Foundation, Cooperators.

the eight groups in 1951, and (2) avian predator control was attempted.

The limited size of this island, approximately 160 acres, made possible a systematic canvassing of the field for pheasant mortalities which should be accounted for in a survival study. Observations of the pheasants, their movements and behavior, in the wild were made possible by the isolation of the island. From liberation to final harvesting of the pheasants, the observers were able to reduce the field time due to these advantages which normally would be required on a non-island location.

The climate of Eliza is somewhat similar to that found in western Oregon and western Washington for which areas these research problems were mainly being conducted. Some agricultural practices with which pheasants are associated on the mainland were employed on Eliza Island in order to simulate their mainland habitat.

Problems undertaken in former studies on Eliza Island were: the disposition of adult game farm hen liberations before and after laying their complement of eggs (Scott, 1947-1948; Salter, 1948; Hoffman, 1949), winter mortality studies of game farm and wild stock with or without predator control (Nelson, 1947-1948; Corthell, 1948-1949; Hansen, 1949-1950; Wick, 1950-1951), and the survival of different age classes of juvenile game farm pheasants as compared to wild stock (Hartwell, 1951). Two separate

summer studies were completed in successive years on the last mentioned problem. The 1951 study was without predator control whereas the 1952 investigation involved predator control.

The purposes for studies using juvenile pheasants ranging from six to ten weeks of age were twofold. The game commissions desired to know the effectiveness of game farm releases of birds of these ages for later use by sportsmen and which age classes survive best in the wild. Game farms have in recent years developed improved methods of incubating and brooding, and it is desirable to test the survival rate of these birds in the field.

State pheasant farms have frequently had a problem in acquiring and in using domestic chickens to incubate and brood the pheasant eggs and young. Diseases carried by the chickens were difficult to control, resulting in the loss of thousands of young pheasants on game farms. Even with diseases curbed at times reinfestations were a constant threat. Today game farms have even more difficulty in finding and purchasing the necessary hens as most poultry producers are breeding out the brooding quality of chickens and are stressing egg and meat production. With these two important points in mind, it seems only natural that the game commissions have turned in most cases to mechanical incubators or brooders so as to reduce or eliminate the introduction of diseases from outside sources. This

practice also would eliminate the problems of obtaining domestic hens and of using excessive man hours in maintaining these chickens during incubation and in coop field-rearing projects.

Of the seven groups of juvenile pheasants utilized in the 1952 study, three were hen hatched and hen brooded. Their survival was compared to the four mechanically incubated and brooded groups. The results of the 1952 study compared to the findings made in the 1951 study are presented in this report in an attempt to answer some of these questions; namely, which age groups survive best, and to what extent incubating and brooding techniques affect such survival.

THE RESEARCH AREA

Physical Description

Located approximately eight miles southwest of Bellingham, Washington, Eliza Island, comprising approximately 160 acres, is one of the smaller islands found in the Puget Sound area. The closest land is Lummi Island, three-quarters of a mile to the west. The nearest mainland point is approximately three and one-third miles to the east. The surrounding barrier of water quite naturally offers isolation to Eliza for controlled research problems with game birds.

Eliza Island is owned by the Pacific American Fisheries Company and was used by them until 1934. This company employed the island for a "haul out" and maintenance base for its vessels during the closed or slack fishing seasons. Installations erected included shipways, warehouses and dwellings. A fire destroyed most of these structures in 1938, leaving a few that were rebuilt and utilized by the research personnel.

Desiring a controlled island research area, the Oregon Cooperative Wildlife Research Unit leased Eliza Island after a thorough search of the Puget Sound islands. This lease has been in effect since 1947, and present plans call for ending the long-term island research in late 1953.

Eliza Island is shaped in what has been aptly described a deformed capital "T". The longitudinal axes of Eliza, closely paralleling the compass points, provide a basis for identifying land areas. North Point, South Point, and West Point, then, are to be found at the three extremities of the "T". Figure 1 (obtained from Hansen thesis, 1952) shows North and South Bays which are used for anchorage or island transportation facilities. It is to the advantage of occupants of Eliza Island that there are opposite bays, making possible landing of the motorboat or the mail plane in whichever location is in the lee side during storms. Mail plane service twice a week and the use of a small motorboat were the modes of transportation.

The rather steep-sided strip of forested land between North and South Points is termed East Bank. It rises to a height of 60 feet in one section. Not labeled in figure 1 is a narrow constriction of land connecting South Point and the woods to the north which is referred to as the Neck. Another wooded section is located on West Point. In the middle section of the island, between these two forests, is a low area called the Flat which has two water areas. One is a brackish water lagoon and the other a fresh water marsh. These descriptive land terms will be used throughout this text.

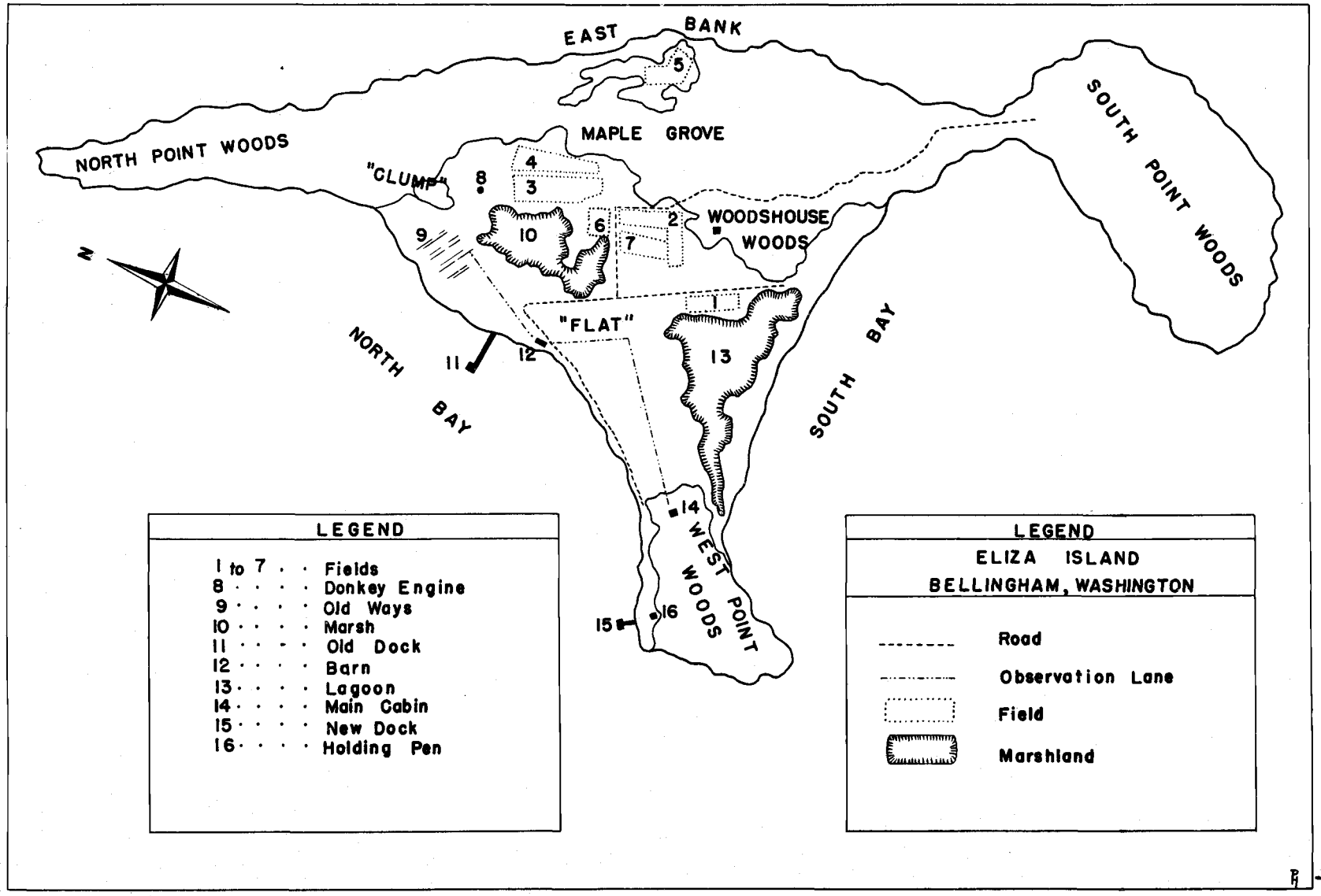

Figure 1. Map of Eliza Island (After Hansen, 1952)

Biological Description

Flora

Approximately 100 acres of the land mass is covered by conifers and deciduous trees. The remaining acreage, namely the Flat, is predominantly grassy vegetation.

The dominant woody vegetation is Douglas fir*, grand fir, giant cedar and western yew. Deciduous trees include red alder, Oregon maple, Douglas maple, madrone, willow, and western serviceberry. Heavy concentrations of Himalaya and wild blackberry vines are scattered around the eastern edge of the Flat.

Small grain and alfalfa fields are located in the Flat which also has a number of grasses. Baltic rush, reed canary-grass, orchard-grass, saltgrass and downy-brome grass are perhaps the most dominant. About one-sixth of the open area is tillable for producing agricultural crops.

Fauna

A variety of birds frequent Eliza Island, although there is a pronounced absence of wild mammals. Due to a domestic rabbit poisoning campaign in 1942, no mammals other than a few bats are to be found.

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* Scientific names of all plants, birds, reptiles, and amphibians are listed in the appendices.

Numerous species of song birds and shore birds are on or near the island during the year, with seasonal migrations of many species of ducks and geese noted through the year. The avian species found are essentially the same as those found in the northeastern part of the Puget Sound.

The island has an abundance of garter snakes in the early summer along with Pacific tree frogs, western toads, and, to a much lesser degree, alligator lizards.

Insects are an important part in the diet of pheasants on the island, especially the juvenile birds during the summer. Numerous pheasants were observed chasing grasshoppers over the Flat during the summer and early fall. Other kinds of insects were also in demand, as evidenced by diggings in rotten stumps found in the wooded areas. Pheasant scats frequently exhibited marked numbers of insect remains until fruits and grain became available, after which time insects appeared in the scats to a lesser degree.

Climate

A comparatively mild season prevailed on Eliza in 1952, with only one rather severe storm experienced in early January.

Temperature, barometer, and rain gauge readings were taken daily, and these records were used as aids in interpreting pheasant behavior. The prevailing summer winds

were from the southwest or northwest. The more common "southeaster" and less frequent "northeaster" characterized the late fall and winter conditions. Wind was a disturbing factor during observation periods for the pheasant sounds and movements were usually difficult to detect.

Average annual precipitation for the Bellingham area is 34.37 inches. On Eliza Island, 19.41 inches of rain were recorded during 1952. As Eliza Island is in the rain shadow of Vancouver Island and the Olympic Mountains its average annual rainfall is less than the mainland to the east. An unexpected deluge of rain fell July 22, 1952, the day following the pheasant releases of 140 game farm juveniles and undoubtedly contributed to a high mortality. Rain fell sporadically throughout the summer, contributing to the growth of rank stands of vegetation. Orchard-grass reached heights of 5½ feet in many places, figure 2.

Temperatures during 1952 on Eliza Island ranged from a low of 21° to a high of 74° F. Charts giving the temperatures and rainfall during the 1951 and 1952 study periods are presented in Appendix D.

Figure 2. Showing mowed lane for facilitating observations in rank growths of orchard-grass

THE STUDY PROCEDURE

Description of Field Methods

The limited size of Eliza Island allowed the systematic planting of pheasants, the checking of survivals and mortalities, feeding studies, observing behavior and other habits, controlled predation, and lastly, the harvesting of the remaining birds at the termination of the experiments. Following the removal of the last bird another study project may be started without concern of ingress and egress of pheasants. Severe weather is probably the main factor which might interfere with the reliabilities of observation.

Methods of field work used primarily in this study were: (1) "semi-gridding", (2) observing from the barn tower, (3) checking pole trap lines, and (4) visiting hawk preference areas. The latter two methods were used in conjunction with predator control.

Until the pheasants, both the nesting and release stock, began dispersing to the island extremities in the fall almost all observations were confined to their main concentration area. This included the forest edges bordering the east side of the Flat, the Flat, and extending to West Point. An occasional trip to South or North Points was made to discourage landing or nesting of predatory birds.

A check to ascertain the beginning of fall pheasant dispersal was made by visiting North and South Points weekly, starting in late July, and searching for the first pheasant signs such as tracks, scratching areas for food, dust baths, roosting sites, or scats.

"Semi-gridding" was necessary to discover any pheasant mortalities. This was a process of closely scanning the ground while walking slowly in parallel paths over a selected area. This method was used throughout the period of study and resulted in the discovery of pheasant nests, mortalities immediately following release, and kills which otherwise would have been impossible to locate with consistency.

Following heavy rainfalls in the spring and summer of 1952, rank growths of vegetation made pheasant observations difficult even with the gridding method. However, use of an enthusiastic Labrador-Chesapeake retriever resulted in the locating of many pheasant carcasses which otherwise would have been difficult to find.

Although normally great reliability would not be placed upon field observations from one stationary point, a system of hawk control involving the use of a single observation position was developed at Eliza Island in 1952. The barn tower, approximately 25 feet high and overlooking the Flat, was utilized for these stationary observations.

The observer was situated in an elevated position which enabled him to sight hawks flying to or from the island and those attempting attacks on pheasants or other wildlife forms outside the forest. Prompt interception of the hawks resulted from the early sighting of them from the tower.

The single observation position on the barn tower used in hawk control activities also permitted observations of pheasants on the Flat within the range of field glasses and spotting scope.

As part of the active predator control program in 1952, pole traps were placed in areas which hawks were known to frequent or might be expected to occupy. The line of traps, placed in and about pheasant concentration areas, was visited early each morning. This walk allowed pheasant and hawk observations and, at the same time, insured early removal of predators and song birds from the padded pole traps.

Realizing that some hawks had a preference for the forest edge as well as clumps of isolated trees on the Flat, these areas were cruised daily checking for pheasant kills or the hawks themselves. This procedure enabled early discovery of any kills before the predator could move the carcass with identifying band numbers. By moving slowly and carefully the observer was usually able to see

the pheasants and their predators. This method was used primarily during the seasonal hawk migrations in the spring and fall.

Predator Control

Attempted control of avian predators on Eliza Island was employed during four previous studies and during the 1952 investigation. Success of this type of control in the various years, according to Arthur S. Einarsen, varied from slight to what might be considered good results, on a localized research basis.

Predator control practices began January 26 and continued until the beginning of the pheasant harvest on October 29, 1952. Methods of predator collection in this program included use of pole traps, jump traps placed on carcasses of dead hawks and pheasants, and an owl decoy. A rifle or shotgun was carried at all times.

Realizing that predators might be present at any time, controls were carried out each day of the week. It was believed that daily vigilance would be a reliable way to test a predator control program fairly. Occasionally when trips to the mainland were required the field observer's wife took over the predator watch. The system of predator control was modified slightly in the fall of 1952 upon the arrival of Phillips and Black, graduate research assistants who completed the summer study.

Removal of predators before April was done to clear the island of any resident forms. This resulted in the trapping of one horned owl, two sharp-shinned hawks, and shooting of four northwestern crows before the release of the adult breeding stock on April 9. Trapping and shooting continued through October 29, with a total of 34 avian predators taken. None were collected during June and July. These two months served as a demarcation between the hawk and owl spring and fall migrations. Table 1 presents records of the predators taken during 1952.

By the end of April, 28 pole traps had been placed in operation along the forest edge, on the Flat, on West Point, and in the Neck area. The traps were placed either on isolated poles or were leaned against tall unscalable dead snags which the hawks appeared to prefer as lookout points. The poles ranged in height from a minimum of 7 feet to approximately 30 feet. Since several old electric power poles were located on the eastern edge of the Flat, these were equipped with ladder steps and with a trap at the top. Most traps used were the Oneida Victor No. 1, well padded to minimize leg injuries to birds.

The main disadvantage of this method of trapping was its non-selectivity in collecting all types of birds. Song birds, namely Oregon juncos, song sparrows, red-winged blackbirds, and robins, were regularly caught.

TABLE 1

Summary of Avian Predators Collected on Eliza Island, Washington, Between January 26 and October 29, 1952

Name	Number
Cooper's hawks	5
Sharp-shinned hawks . . .	5
Red-tailed hawks	2
Pigeon hawks	1
Duck hawks	1
Marsh hawks	5
Horned owls	2
Northwestern crows	13
Total predators taken	34

Total trapped . 7
Total shot . .27

Even with close attention and employment of padded jaws, the trap usually maimed the small birds so severely that they had to be killed. Robins released with broken legs were sometimes seen around the island, with only the absence of a limb detracting from a seemingly healthy external appearance.

The Verbail trap, a trap which has been tested at the Patuxent Research Refuge, Maryland, and found to be

selective and humane to those birds trapped, might have proved more satisfactory in the island study. This trap could be used at game farms as well as research areas where trapping is necessary to reduce predators.

In late January the carcass of an American goldeneye duck, which had washed up on the beach, was placed under a trap located on the top of a power pole. A great-horned owl twice knocked this carcass off and escaped. The duck carcass then was placed at the base of a dead tree with a trap wired to the trunk; the owl was caught on its next attempt to take the duck carcass. This live horned owl served to decoy the many crows which came to the island to feed or nest. The crows would torment the owl in its pen, and during this distraction it was possible to stalk the crows. The owl was also placed in a chicken wire cage in an exposed position to attract crows within easy shooting range.

Charles Hansen, former graduate student stationed on the island during 1949-50, used dead hawk and pheasant carcasses as attractors during his winter and summer studies involving predator control. He reported this baited method, using traps placed on about six pheasant carcasses during the winter study, was successful in catching hawks at four of the "sets". In regard to hawks' eating carrion, Hansen further cites records during his

winter study in which Cooper's hawks attacked a pheasant carcass ten days apart and in one case about a month later (4, p.21). Hawk carcasses were reported to be attacked by their own species during September and October of the 1950 summer study, with one record of a Cooper's attacking another caught in a pole trap (Field notes of Hartwell and Wick).

In the 1952 program an adult cock pheasant was killed by a Cooper's hawk in late May. A Cooper's hawk, supposedly the original killer, was trapped on the carcass later the same day. It escaped,and the carcass was then left in an exposed area for a two weeks period but was not molested again.

Hansen's baited method, using hawk carcasses, was tried repeatedly from April through August, 1952, but proved ineffective during this study. Collected hawks were placed either on the ground in an exposed position or on pole traps. A total of five carcasses, including two red-tailed hawks, one marsh hawk, one sharp-shinned hawk, and one Cooper's hawk, was used as bait. None of these was attacked even though similar live hawks were observed flying over the immediate area. Apparently other food was plentiful during this period, and the hawks were not attracted to the carrion of their own kind. No baiting was employed in September and October, 1952, by

Phillips and Black. Perhaps if baiting had been employed during these two months, hawks might have been attracted to the carrion as was found to be the case during the fall of 1950.

Trying to flush or sight avian predators from the forest areas was difficult. Normally it was not possible to flush a hawk or an owl from the wooded section unless they were making a kill attempt or feeding on a victim. The element of surprise was continually in favor of the predator in woody areas where noises or even slow movements of the observer allowed the predator to move out silently ahead.

Utilization of the observation platform on the barn tower solved this difficulty by offering unimpeded views of most of the pheasant concentration areas. From this point hawks were easily observed in their flights to and from the island or while attempting attacks outside the forest on pheasants or other forms of wildlife. One blind spot existed along the East Bank, and hawk approaches from this area might have gone undetected. From the barn tower vantage point the observer was able to follow the raptors' flight patterns over most of the island and to plan a path of interception on the ground. This method resulted in more birds being shot than had been possible in past island study programs. Results of the 1952 predator

control campaign showed a marked reduction in predation as compared to the 1951 study, table 6. Twenty-three pheasants were lost through predation for a 12.71 percent loss from 181 birds in the field during 1951, with control not attempted. During 1952 three pheasants were killed by predators for a 2.13 percent loss from 141 birds in the field. The number of predators present was either comparable in the two years or slightly higher in 1952, so the reduction of predation by an active control campaign is best shown in these percentages.

Since daily routines prevented being present in the barn tower during all the daylight hours, a system of observation based on the times the predators were most active during the day was developed. Crows were taken at any of the daylight hours in spring and early summer only. From March through August the hawks were most active between 9:30 a.m. and 1:00 p.m., and again between 2:00 p.m. and 5:30 p.m. Hawks and crows normally came to the island between these two time periods from the mainland or Lummi Island. In this system the advantage of the element of surprise was with the observer. Shooting of 27 of the 34 collected predators points to the success of this method of sighting and interception. The balance of those collected were trapped, a system over which the observer had no control other than to place the trap on a likely predator landing area and to keep the trap activated.

The most active time of hawks, in which they actually chased or killed pheasants, was between 3:00 p.m. and 5:00 p.m. A great deal of soaring and apparently just looking over the area was done by them during the remaining time periods.

As the season of increased avian migration progressed into September the time schedule for interception of predators was revised, because hawks and owls then became more active in the early morning hours before 9:30 a.m. Since owls would be expected to be active in early twilight, also, control at this time was instituted.

Monthly sight records of predators observed in both 1951 and 1952 would seem to indicate at first glance that a lower number of predators were on the island in 1951 than in 1952. In comparing those months of primary concern in the studies, July, August, September, and October, the records show a total of 52 days in which certain predators were sighted in 1951. On the other hand, the same species were sighted 77 days during the same period in 1952. Species in consideration were those assumed to be the most potential killers, judging from past island observations and data as well as the 1952 study. These include Cooper's hawks, sharp-shinned hawks, red-tailed hawks, marsh hawks, and horned owls. Tables 2 and 3 summarize monthly sight records of all types of predators

seen during 1951 and 1952, and they indicate clearly a greater number of predators sighted in 1952 than in 1951. The lower numbers in 1951 might indicate less raptor pressure than in 1952. However, this was probably not the case since the 1952 observations were directed primarily skyward or towards likely hawk coverts, whereas more time was spent during the 1951 study in searching the ground for mortalities, since no predator control was in effect. It would appear that the latter method may have resulted in recording fewer observances of raptors in the area than was the case in 1952 when a different system of observation and control was employed.

TABLE 2

Monthly Record of Predators Sighted During 1952 on Eliza Island, Washington

Predator	Number of Days Seen												Most Seen In One Day
	*Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Cooper's hawk		1		5	1			9	10	4	2	3	5
Sharp-shinned hawk		1						1	7	8	2		2
Red-tailed hawk		2		2	5	3	1	4	8	7	4	2	6
Pigeon hawk				3	1							1	1
Duck hawk				2				3		2			1
Marsh hawk				3	2		3	5	4	5	1		1
Horned owl		1								1			1
Northwestern crow	22	22	27	29	23	7	1			5			57
Bald eagle	16	27	27	25	25	24	18		1	10			10

* Observations and predator control began January 26.

TABLE 3

Monthly Record of Predators Sighted During 1951 on Eliza Island, Washington

Predator	Number of Days Seen												Most Seen In One Day
	Jan.	Feb.	Mar.	*Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Cooper's hawk								1	14	14	2		3
Sharp-shinned hawk									4	2			1
Red-tailed hawk				2				1	2	1	1		1
Pigeon hawk													0
Duck hawk				1					2	3	1		1
Marsh hawk					1			3	6	4			1
Horned owl													0
Northwestern crow				4	12	11	1		4	20			62
Bald eagle				9	6	1		1		6			2

* First release and observations began April 10.

OBSERVATIONS

The Releases

Breeding Stock Release for Wild-Reared Birds

Two ring-necked pheasant releases were made during the 1952 survival study, one on April 8 and the second on July 21. The first release was composed of six adults, five hens and one cock. A second cock died, supposedly of an internal injury, in the holding pen before liberation and was replaced on April 9 by another from the Whidbey Island Game Farm. The birds were released on the Flat and flew rapidly towards the eastern forested area. These birds obtained from the Whidbey Island Game Farm were liberated to produce wild stock from which a survival comparison might be made with game farm juveniles released later in the season.

The adult pheasants were banded on both legs and marked with colored neck bands. These bands were made of a plastic upholstery material, "Col-O-Vin", and were 2.75 inches long by 1 inch wide. Rivets were placed in one end of the tags and stainless steel wire was attached through this eye. The wire penetrated the dorsal feather tract at the base of the pheasant's neck, and another tag was fastened at the end of the wire. The resulting appearance of the birds is shown in figure 3. This type of

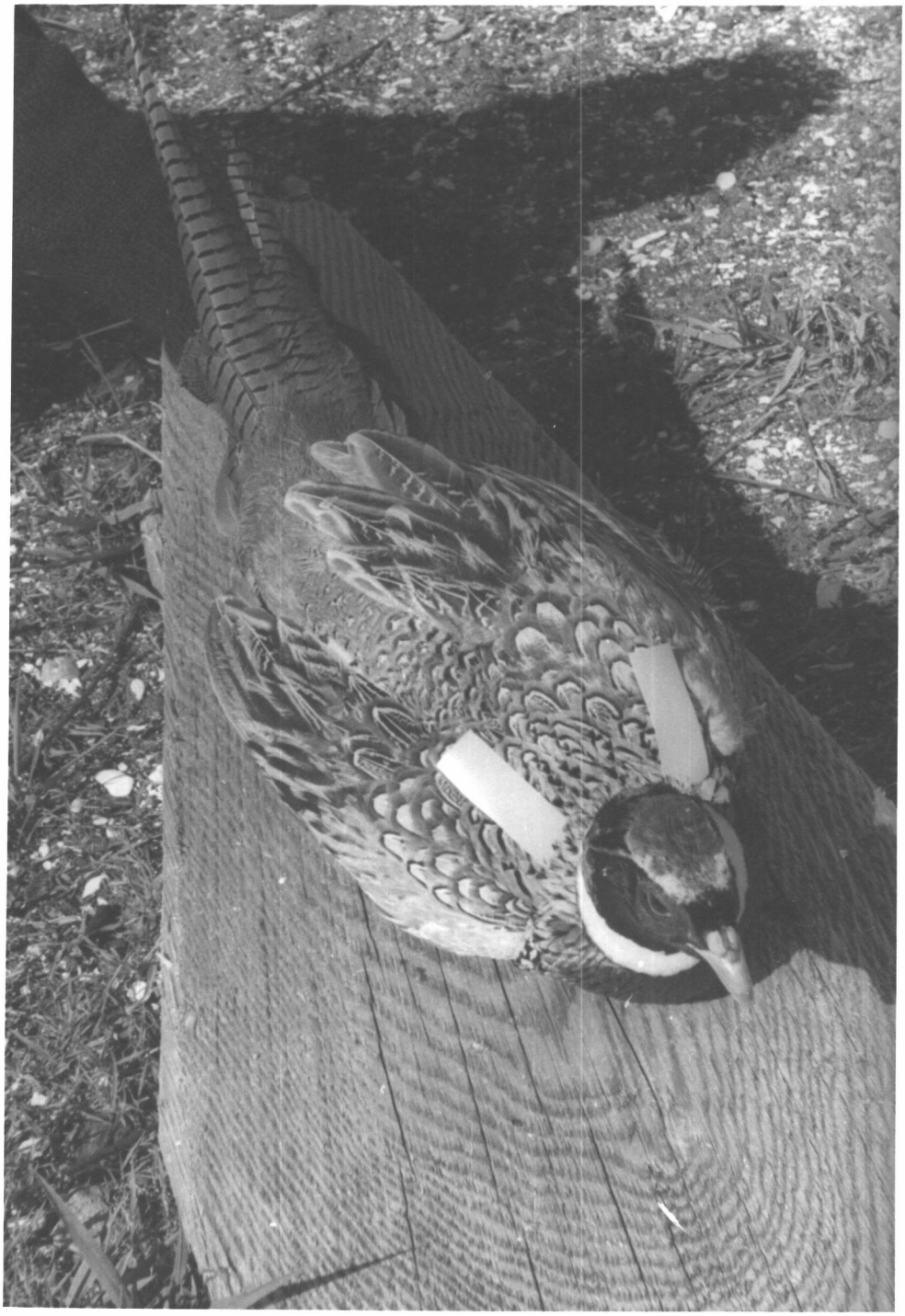

Figure 3. Adult cock pheasant with attached neck bands for field identification

field identification marker aided considerably in identifying specific pheasants.

Crowing territories were set up by the two cocks within a week following release. Their choices of areas differed markedly in that one did most of his crowing within the heavily wooded area east of the Clump, while the other did his crowing around the exposed edges of Field #5. With the northward spring migration of hawks, the latter pheasant fell prey to an adult Cooper's hawk. The remaining cock soon took over the deceased bird's hens. With his wiser or rather more fortunate choice of crowing area, he survived until harvested on November 1. This wooded site apparently enabled the cock to see the approach of a hawk through the lower canopy or to sight those soaring overhead. The deceased cock had chosen an area which provided the hawks cover while watching him in his exposed position.

By late April the vegetation had become quite rank. Few systematic nest searches were made in an effort to reduce possible nest desertions. While watching the Flat for avian predators from the barn observation tower, it was noted in three instances that hens would fly back to within approximately 15 or 20 yards of their nests after feeding. Rather than walk through the heavy grass for a distance up to 50 yards the hens chose to fly, thus

disclosing their nest areas by these flight patterns. The hen flight back to her nest cannot be relied upon too heavily for any one day, but by checking several consecutive days it enabled pinpointing nest locations on Eliza. Nesting and survival data of the breeding stock which are presented in appendix E show that by July 21 the five adult hens had produced an estimated 25 young. Three of the nests hatched between May 20 and 30. A fourth hen, evidently re-nesting, was killed by a dog on June 29, and the fifth hen was found dead. Death had not been caused by predation or a visible external injury; the body was intact.

Although four pheasant chicks less than two weeks old were found dead in the latter part of May and early June, they were not considered as comparable survival material. Since the youngest game farm juveniles to be received in July were six weeks old, it would not be an adequate comparison to compare six-weeks-old birds which had already passed a critical life survival period of the initial two weeks of life. The wild stock (estimated to number 21 birds) which survived to July 21, date of the second game farm release, were aged at seven to nine weeks. Ages were based on hatching dates.

Game Farm Juvenile Release

On July 21, 140 game farm juvenile pheasants were released at Eliza Island. These were in seven groups of 20 birds each, whose ages and methods of rearing were as follows:

Group I - Hen hatched, hen reared, six weeks of age - Whidbey Island Game Farm

Group II - Incubator hatched, brooder reared, seven weeks of age - E. E. Wilson Game Management Area

Group III - Incubator hatched, electric brooded, pen reared, seven weeks of age - Whidbey Island Game Farm

Group IV - Hen hatched, hen reared, eight weeks of age - Whidbey Island Game Farm

Group V - Hen hatched, hen reared, ten weeks of age - Whidbey Island Game Farm

Group VI - Incubator hatched, electric brooded, ten weeks of age - Whidbey Island Game Farm

Group VII - Electric incubated, electric brooded, eight weeks of age - Whidbey Island Game Farm

As can be noted, ages of the seven groups ran from six to ten weeks of age. Groups I, IV, and V were hen hatched and hen brooded, whereas Groups II, III, VI, and VII were mechanically incubated and brooded. The juveniles of Group II were obtained from the E. E. Wilson Game

Management Area, Oregon, with the remaining groups coming from the Whidbey Island Game Farm in Washington.

The groups were designated with Roman numerals from I through VII for purposes of identification in this text. In reference to the juveniles resulting from the first release the term "wild reared" will be used.

For identification purposes each of the game farm juveniles was banded with two numbered metal wing bands before being crated at the game farms. The birds arrived at Portage, Washington, five miles north of Eliza, the afternoon of July 21 and were transported to the island by boat.

Preparatory to the arrival of the game farm birds, seven release markers had been erected on the Flat with one group of juveniles to be liberated at each sign. Placed 75 yards apart, they extended east of the residence cabin 375 yards, then north 150 yards, figure 4. This dispersement of markers was designed to help measure movement of the groups in the first weeks after the release and for estimating the distances to mortality locations.

To facilitate observations of the juveniles among the high grasses of the Flat, lanes 10 to 20 yards wide were mowed in criss-cross fashion over the area with observation points at the ends. Some lanes had been mowed

Figure 4. Flat, with markers to the right denoting liberation sites of seven groups of game farm juvenile pheasants

in late May and June in order to check for new broods of wild juveniles; these were mowed again in July. The lanes proved to be advantageous for an observer to note pheasant movements and behavior when present in this area.

Prior to the release of the pheasants, the condition of several juveniles in each group was noted. Most of the birds appeared to be in good shape, while the breast meat on the keel of several juveniles was not filled out too well. The birds in Group II, the seven-weeks-old group, were noticeably lean along the keel. No dead or ailing birds were found in the crates. There were clear skies on the day of the release, and the temperature was 62° F. in the afternoon.

By 6:00 p.m. each group was released from its crate, with Group I at the first marker 75 yards east of the residence cabin and the other groups proceeding east, then north. The birds were liberated by the "violent release" technique as explained in Buss (1, p.86). This method involves the handling, crating, and moving of birds from a game farm to an entirely new liberation site.

The birds flew short distances, up to 100 yards in some cases. No birds were observed to fly out into the bay. Some pheasants flew to West Point and others flew toward the trap wire bounding the north edge of the lagoon and to Fields #2 and #4.

By 7:00 p.m. about 20 pheasants were observed pecking at an unidentified food on the newly disced Field #2. Others could be seen nearby eating green parts of grasses. Most of the groups had had no food since 12 noon of the release day. By 8:00 p.m. roosting had started and few birds were visible on the Flat.

Dispersion

A method to determine in detail the dispersion or movement of juvenile pheasants from their release sites was designed during the study with the following points in mind: (1) how soon do the pheasants search out new territory after their release, and (2) do the birds attempt to leave the island for nearby land at the height of dispersion? A weekly search of the three points of Eliza Island was inaugurated after the second game farm release. Evidence of the extent of dispersal was ascertained by examining the area of each point for the actual sighting of the birds or for the presence of pheasant dust baths, tracks, scratchings, scats, or roosting sites. This procedure for checking the extent of dispersal was continued until October 29, when the harvest of pheasants began.

Prior to the second game farm release on July 21 no wild-reared pheasants had been sighted on North or South

Points. Several of the wild birds had been seen on West Point, but normally they were observed on the Flat or along the eastern forest edge. With both groups present on the island after the second game farm release, it was necessary to develop methods of distinguishing between the wild-reared and the game farm birds. A characteristic of game farm birds was the grouping together of from 20 to 40 juveniles during feeding and roosting. Their lack of alertness and secretiveness towards humans were in contrast to the wild-reared birds, which were more cautious and more rarely seen. A more conclusive form of identification was the occasional observation of the silver wing bands which had been attached to all game farm juveniles.

A dispersal check on July 22, the day following the release of 140 juvenile pheasants, disclosed the groups had moved from the release sites to all parts of the Flat, to West Point, and along the eastern edge of the forest. Greater movements of the birds in the seven groups may have been hampered by an unexpected rain falling on July 22. A total of .44 inches of rain fell and the temperature through the day ranged from 56° to 58° F., with a light wind blowing from the south. Feeding was done by a few pheasants around the Flat. Most of the birds appeared fairly dry and vigorous, while others seemed to be somewhat waterlogged. Two of the juveniles which were flushed

near the trap wire were rain-soaked and unable to fly except for short distances of 5 to 10 yards.

This rain, plus other factors to be discussed in the "Mortality" section, contributed to the complete loss of Group II, seven-weeks-old birds from the E. E. Wilson Game Management Area. Discussion of dispersion from this point on will concern only the remaining six game farm groups plus the group reared in the wild, a total of 141 birds.

By July 29 the birds were using extensively the dust baths in Field #2, which had previously been disced, and were visiting Field #4, which had a good crop of wheat and barley. Through the month of August juveniles numbering up to 45 were seen on West Point, and 30 to 40 pheasants were beginning to feed upon and explore the low tide regions of North Beach. Feeding and roosting continued on the Flat and around its edges.

When low tides exposed the reefs in North Bay it was not unusual to find 15 to 30 of the young pheasants walking out to the end of these exposed areas. Occasionally some of the birds became trapped on the reefs by incoming tides and would eventually fly back to the shore.

On September 2 two juvenile pheasants were flushed from the Neck, marking the greatest distance traveled from the release sites up to that date. By September 22 three pheasants had been flushed on South Point, three

roosts had been found there, and six actively used dust baths had been noted. Several pheasants were flushed from North Point on September 23, marking the first observed appearance of birds on this point.

Less than a month later, on October 15, the pheasant dispersion from the release area had increased as follows: a total of 25 pheasants were seen on a reef off North Point, 21 were sighted at various times on South Point, and West Point continued to be visited by groups of 30 to 40 pheasants.

Phillips and Black on October 20 observed 11 pheasants, mostly cocks, attempting to fly southwest from Eliza Island off the South Point. All returned to the island after a short flight over the water. They reported, also, on October 31 five pheasants were flushed from West Point, with one cock flying two to three hundred yards toward Lummi Island before turning back.

It appears that dispersion to reefs or to the tips of the island's three points is a tendency not only to seek new territory but may be a desire to fly off the island to nearby land. However, nearby in this sense would be an extremely long flight for most pheasants as the nearest land is approximately three-fourths of a mile away.

Other than those cases due to hunting pressure, flights from the island that were observed in 1952 indicated that dispersion occurs gradually until many birds may attempt to leave the island of their own accord. Hunting pressure constitutes abnormal pressure not to be considered in an analysis of a pheasant's natural desire to disperse. That the pheasants leave the island under hunting pressure and are not recovered, however, must be considered in the results of a survival study.

During the harvest on November 3 one wild cock flew from West Point to within approximately 100 yards of Lummi Island, drowning at that point. This was a straight low flight over the water which amounted to approximately 1200 yards.

During the harvest periods of past Eliza Island studies as well as the 1952 program, pheasants often were flushed off the points but in most of the observed cases were recorded as turning back to the island. However, the harvest has resulted in many birds making fatal flights from the island, as well as a few recorded successful flights to Lummi Island.

The movement of pheasants from the island can be classified, at least from the human viewpoint, as either voluntary or involuntary. Voluntary is interpreted as leaving the island with no apparent pressure or

frightening as the cause. Involuntary movement from the island is brought about by hunting pressure or frightening a pheasant accidentally, causing it to flush out over the water.

Dispersal observations made in past studies on Eliza Island offer further substantiation that pheasants, penned in by water, have attempted many flights from the island.

Hansen (1952) reported (4, p.54) that:

> ". . . two hens took off from West Point and flew over the water toward Lummi Island which is about a mile away. It is believed that these birds had not been forced from the island since nothing unusual was observed near them; they apparently left from choice."

An immediate search from a boat did not disclose the fate of the two hens. This flight took place during a winter study, on December 21, 1949, one day after the release of 50 game farm and wild-reared pheasants.

Wick (1952) during his winter study witnessed four pheasants which flew from West Point heading toward Lummi Island (13, p.45). This was on December 12, 1950, and he stated: "Scratchings in the grassy-rock area, from which the flight started, indicated that the birds had been peacefully feeding." These birds appeared to drop into the water about 600 yards west of the Point. A boat search of the area was made but no birds were found. Twelve other pheasants, from a total of 30 released birds,

remained "unaccounted for" at the completion of his study, and he assumed they had flown from the island.

During Hartwell's 1951 summer study an excellent example occurred of a pheasant voluntarily leaving the island which was witnessed by Donald Wustenberg, a graduate research assistant temporarily assigned to the area. From the guest cabin located on West Point, he sighted a cock pheasant standing at the water's edge craning its head and looking toward Lummi Island. The cock took off shortly for Lummi, but approximately two to three hundred yards out it turned back to Eliza Island. This occurred in October.

A case in which the movement of a pheasant from the island was classified as involuntary occurred in late August of Hartwell's 1951 study, when a hen was unintentionally flushed from North Point by observers and a dog. The hen flew north over the water without any hesitation, with the closest land in that direction 2 1/3 miles away. She dropped into the water several hundred yards from the island and was picked up 15 minutes later, having drowned in this short interval.

In the 1952 study, as well as in past studies, other pheasants were accidentally flushed along the beaches out over the water for short distances, but in most cases they were able to swim back to land. A distance beyond

100 yards would normally be fatal to a pheasant attempting to swim to land.

From the field notes of a second study conducted by Hansen (5, p.28) it is shown that several hen pheasants were known to have successfully completed the flight from West Point to Lummi Island, a flight of approximately three-fourths of a mile. Also in Hansen's study, two birds were found drowned on the beach at Point Francis, slightly over two miles to the north of Eliza Island. In this same study five pheasants were retrieved from the water off South Point the day the harvest started, on November 4, 1950. They had flown from the island and dropped into the water among some ducks, apparently forced off the island by hunting pressure. All were drowned, but fortunately the bands were recovered. When weather permitted, precautions were taken on the harvest field day to have boats standing offshore to watch for pheasants flushing from Eliza Island, but of course this precaution was not possible during the remainder of the harvest period when only one or two persons were conducting the hunting operations.

It is possible that dispersal on the island in any one year may differ markedly from other years. In all the Eliza Island studies the normal dispersal has resulted in pheasants eventually appearing over the entire island,

although there was a variance from year to year in the length of time in completing this dispersal. However, movements from the island have always been an unpredictable variable as the chances of seeing pheasants flying from the island were normally remote. Observations by a single observer could not be totally confined to the three points on Eliza, and for this reason there was good indication in the 1952 and past island studies that many dispersal flights from Eliza went unnoticed. Unobserved flights of pheasants from the island in the survival studies distort research findings and conclusions.

It was not ascertained how many pheasants attempted to leave the island during the 1952 study period. A total of 45 juveniles, 9 wild-reared and 36 game farm juveniles, was listed as "unaccounted for" during the 1952 survival study. Of the 141 juveniles in the field on July 21, these 45 "unaccounted for" birds amounted to 31.91 percent. The fact that the island was systematically searched for live and dead birds during the entire study lends support to the thought that the majority of the "unaccounted for" group had flown from the island. However, as has been found in this and past Eliza Island studies, a completely revealing search of 160 acres was a physical task challenging the best of human skills. There is little doubt that some carcasses remain undetected on the island, but

it is doubtful that the total would number 45, especially since the existing dispersal evidence indicates strongly that birds might be unaccountably lost in an Eliza Island study through movement from the island.

Food and Water

On Eliza Island there was an abundance of wild foods for pheasants, and agricultural practices also provided grains in cultivated fields. The farming practices employed included tilling, fertilizing, seeding and, in some cases, mowing of the planted grains. Acreage of these grain plots ranged from three to five acres. Alfalfa was planted in earlier study years, and the continued growth was harvested as rapidly as it matured, which resulted in three mowings between April and July.

Wheat and barley were made available throughout the study period in Field #4. Sporadic rains during the summer, coupled with the application of fertilizer, resulted in a rich stand of these two grains. Both the wild stock and the game farm stock fed daily in this field. Alfalfa was available to the birds in several fields and the tender leaf tips were eaten. Scattered volunteer stands of oats also were used by the birds. The most preferred wild foods during the study were mustard, beach pea, starflower bulbs, and blackberries.

Insects were plentiful on the island and supplied the bulk of animal foods. Frequently the juvenile pheasants were observed chasing grasshoppers over the Flat, and they were occasionally noticed digging insects from decayed tree trunks.

Grit was available along the shores and on some areas of the Flat where the sea had washed in masses of shells and rocks.

An adequate supply of water was present during the study, with no drought conditions existing at any time. The pheasants satisfied most of their water needs by utilizing the dew from vegetation in the early morning hours and by eating fruits as they ripened during the season. The marsh contained rain runoff water throughout the study period, but it was used infrequently by the pheasants.

Cover

In general, cover conditions on Eliza Island during 1952 seemed adequate for protection of the pheasants from predators and the elements, as well as providing suitable resting and roosting sites.

During the day when not feeding, pheasants could be found usually resting in dense stands of alders or blackberry vines, under forest branches, or in deep grasses. The more open cool forest was used often during warm

weather. Some roosts were found along the forest edge, but the majority were in the low marsh or lagoon grasses of the Flat. The entanglement of trap wire on the Flat was also used extensively for roosting by as many as 30 to 50 pheasants in one night.

Tangled masses of blackberry vines, dense stands of grasses five to six feet high, and marsh sedges offered some protection to pheasants from predators. In spite of the dense vegetation, predators did manage to flush pheasants from these coverts. Hawks succeeded in flushing the pheasants from the protective cover either by perching close to them within the coverts or by dropping to the ground beside the cover. In these cases the pheasant usually tried to fly to some other covert as quickly as possible. Pheasants flushing from protective coverts were often sighted by the observer on predator watch and were given added protection by the observer's direct attempt to collect or ward off the hawk in its pursuit.

Behavior

The behavior differences between the wild-reared and game farm juveniles were noticeable in regard to their general alertness. Wild juveniles were seldom seen and usually sneaked out of sight before the observer could approach their feeding, dusting, or resting sites. This

tendency of secretiveness was noted in the wild stock before the second game farm juvenile release.

By their general behavior game farm birds gave evidence that they were familiar with the sight of humans. They could be approached much more closely than the wild stock. Also, they would flush rather than employ the more furtive exit of the wild stock. They retained this characteristic to a high degree through most of the months following their release. With the advent of shooting in the November harvest, however, they too soon became more elusive. After the harvest began it was difficult to determine accurately by their behavior the difference between the juveniles of both stock; both were wary. The last bird taken in the harvest of Eliza Island studies, after intensive searches, might have been either a game farm or a wild-reared pheasant.

Game farm juveniles usually were found in large groups during the day while feeding, sunning, preening, and dusting in the open, showing little regard for the presence of humans. It was noted, however, that these birds appeared alert for the presence of predators and, in substantiation of this behavior, rarely was a hawk seen to make an attack on a group in the open.

There were no known losses of wild juveniles to predators during the study, but three game farm juveniles

were killed by hawks. Although it might be assumed from these figures that the wild-reared juveniles escaped predation losses due to greater wariness, this cannot be considered conclusive evidence when the ratio of wild birds to game farm stock is considered. During the survival period of July 21 to October 29, an estimated 21 wild-reared birds and 120 game farm juveniles were present for an approximate 1 to 6 ratio.

The Harvest

To conclude the 1952 project it was necessary to collect the surviving pheasants. A complete removal of pheasants from the island was desirable, also, to eliminate the chance of influencing succeeding investigations.

The harvest was accomplished by live trapping and shooting. A total of 82 juvenile birds was removed between October 29, 1952, and March 16, 1953. Three were taken by live trapping and 79 by shooting. Of the juveniles harvested, 12 were wild-reared birds and 70 were of game farm origin. The total harvest amounted to 58.16 percent of the 141 juveniles that had been on the island between July 21 and October 29, a survival period of 100 days.

Eight of the 12 wild birds were harvested on the field day, whereas only one game farm group had as many

as four taken. Group IV, with 17 birds eventually taken, had only three birds taken on this day. It is not known why the wild stock should have been so easily taken and not the supposedly more tame game farm birds.

In the 1952 survival study as well as in 1951 investigations, in order to insure equal survival comparisons over given periods all birds collected after the harvests began were considered to have survived, regardless of cause of death. This meant that although a bird may have become a victim of predation, died of an unknown cause, drowned, been live-trapped or shot after the initiation of the harvest, it was classified as harvested because it had lived through the survival period, which ended in the 1952 study on October 29.

Two hens and one cock were live-trapped between October 29 and 31, 1952. A modified Ohio pheasant trap was used, similar to that employed by Leedy and Hicks as described in McAtee (8, p.114). Chicken wire mesh was used for the two sides, which were 2 feet high, and the roof was of spiller webbing. Funnel entrances were located at two ends of the 10 by 12 foot trap. The gates within the tunnel-like entrance were designed so that a pheasant, having been guided into the trap by a trail of grain, experienced great difficulty in getting out.

At the suggestion of the Unit Leader, less effort was given to the trapping procedure in 1952 than had been employed in the program of 1951. Reason for the change in the intensity of the trapping program was to place more effort in shooting as it was thought the number of birds in the field in 1952, as revealed by observations of attendants, was not too great and that they could be effectively captured by hunting. Inventories conducted by Phillips and Black, up to October 3, placed the estimated number of birds in the field at 60, but 82 juveniles were later collected in the harvest. As shown in this census, as well as in past island studies, there was a difficulty in accurately censusing an area even on this small acreage.

Unfortunately, a variable as to a later beginning date of the harvest made survival comparisons with results of the 1951 study incomparable. The harvest in 1951 began with trapping of the first pheasants on October 1, and the harvest in 1952 began on October 29, 28 days later than the preceding year. In both years, the survival periods ended on the days that the harvests began.

The effect of the variability in harvest dates can be seen by the following analysis:

(1) In 1951, 87 juvenile pheasants were removed from the field by trapping between October 1 and 15, leaving

32 more that were harvested by shooting and predation after November 1. Of the 182 juveniles in the field during the survival period of 73 days, from July 20 to October 1, only 10 remained "unaccounted for". Dispersion from the island apparently did not affect the study to any degree since the bulk of the birds in the field were removed during this intensive trapping program in early October.

(2) In 1952 three juveniles were harvested by trapping between October 29 to November 1, and shooting accounted for 79 others after this date. The survival period of 100 days, from July 21 to October 29, was concluded with 45 birds listed as "unaccounted for" from a total of 141 birds in the field. The possibility exists that many of the "unaccounted for" birds might have been collected had the harvest begun as early as in 1951; consequently, the juvenile survival rates might have been increased. Valid comparisons between the two programs thus were made difficult by variance in harvest dates, and this variance will prevent the most accurate conclusions.

Comparisons of the effectiveness of predator control in 1952 to the 1951 study with no control also has been made difficult to determine because of the differences in starting dates of the two harvests. Rapacious birds had

only 73 days in which to make attacks on pheasants in the 1951 survival period, while 100 days was the period of exposure to raptors in 1952. Therefore, the 28 days in October separating the starting dates of the harvests in the two studies will have to serve as a period of conjecture on what effect predators may have had on the birds. During October, with the normal hawk migrations south, there usually resulted a high predation in each of the past Eliza Island studies. Only one known predation occurred after October 1 in 1952, with 127 juveniles in the field at this date. Of the 127, only 82 were recovered. In Hartwell's compilation of his 1951 study he lists eight predator kills occurring after the October 1 harvest date, with 129 juveniles in the field, appendix J. The bulk of these, 87, had been removed by October 15, and 10 of the 129 pheasants were never recovered. Hartwell's losses from predation occurring in October were classified as harvested pheasants because they occurred after the harvest began, which would raise the survival percentage comparisons to the 1952 results. In 1952 the one predation occurring on October 8, before the harvest began on October 29, was classified as a kill. This kill would, conversely, lower the percent of survival when compared to the 1951 program.

Considering these two main variables of beginning harvest dates and the effect of predation during this period, it is quite possible that comparative survival might have been much higher in 1952 had the harvest begun on October 1 as in 1951. A combination of an intensive trapping campaign commencing on this date followed by a shooting program quite possibly would have resulted in the taking of some of the 45 "unaccounted for" juveniles that presumably flew from the island before the late 1952 harvest began on October 29.

A hunting party of men representing members of Oregon and Washington Game Commissions, the U. S. Fish and Wildlife Service, sportsmen's clubs, and other invited guests succeeded in collecting 28 juvenile pheasants by shooting on November 1. These birds were taken to a children's institution on the mainland for consumption. An additional 49 birds were collected by shooting under a concentrated hunting period in November and December by the two graduate research assistants based on the island. Two cocks somehow managed to elude the observers until March 16, the following spring, after which date it was concluded that no other pheasants remained alive on Eliza Island from the 1952 survival study.

Appendix G presents the individual shooting records of the field day party. Of the 31 pheasants killed, three

were adults from the spring released breeding stock, the remaining birds being juveniles. Eighty-six shots at birds were missed; eight of these shots resulted in birds noticeably being crippled. The crippling loss probably was higher considering the large number of missed birds, and this may be another cause for 45 juveniles not being found. Experiences on the island have indicated that should a wounded bird burrow into grass or under a log or thickets to die it is difficult to find the carcass except by chance. Several cripples were recovered on the field day and six others in the ensuing hunting days by Phillips and Black.

RESULTS

Mortality

There were 161 juveniles on Eliza Island on July 21, 1952, the beginning date of the pheasant survival study. Fourteen of these birds were later accounted for during the study as known mortalities, 20 were deleted from the survival records, and 82 were harvested. This left 45 birds "unaccounted for". These missing birds were classified as mortalities and constituted 31.91 percent of the juvenile pheasants in the field.

Twenty mortalities of Group II (incubator hatched, brooder reared, seven weeks old) were deleted from the total of 34, appendix H. Reasons for the deletion of this group will be explained in this section. Reduced to mortality factors, the 14 remaining birds died as follows: (1) nine were classified as release deaths occurring in the first two weeks after the July 21 liberation, (2) three became the victims of avian predators, and (3) two were drowned. All of these mortalities were game farm juveniles. The fourth mortality factor in which 45 pheasants remain "unaccounted for" includes both game farm and wild birds.

Percentages of the known mortalities are presented in table 7, with the 1951 mortalities also listed here for

comparative analysis. The nine game farm release mortalities amounted to 7.5 percent of the 120 game farm birds in the field. The three game farm predations were 2.5 percent and the two drownings were 1.7 percent of the 120 birds liberated.

Fresh carcasses of birds diagnosed as dying from release shock were dissected for crop, gizzard, and intestinal analysis. Most of the crops and gizzards were empty, but some contained small seeds, grass fibers, or pebbles. Examination of the intestines for parasitic worms, which might affect survival, showed none to be present.

All carcasses of the nine release mortalities were found within a range of two hundred yards from their release sites. Most of these carcasses were found reasonably exposed in the grasses, although in some cases the birds had apparently sought protection from rain under tall Baltic grass or reed canary-grass on the Flat.

Some explanations that can be offered as to why release mortalities occur within a few days following a liberation of birds into a new area are as follows: (1) certain birds die shortly after release into a new environment because they are unable to adjust themselves rapidly enough to pass the initial shock of the liberation, (2) vitality of some birds is reduced before the

liberation by such factors as diseases, parasites, or food deficiencies to the extent that these birds die soon after release, (3) birds perish after coming directly from game farms without some conditioning, especially in regard to the use of foods in their new environment, or (4) a combination of the above factors or more involved causes result in the weaker birds that die shortly after release.

The second mortality factor, avian predation, will be discussed in the following section, "Mortality Caused by Predation".

Drowning, the third mortality factor, caused the death of two game farm birds. The drownings occurred on the Flat in a depression of three feet which formed a water pit. Dense overhanging grass bending into the hole prevented these pheasants from jumping or flying back out.

The fourth mortality factor in which 45 juveniles, 36 game farm and 9 wild birds, are classified as "unaccounted for" might be explained on the following basis. They may have flown from the island and either drowned or reached Lummi Island, approximately three-quarters of a mile away, or a few carcasses may still remain on Eliza Island. As it was known that several pheasants had successfully flown from Eliza to Lummi Island in the fall of 1950, Lummi Island was searched for missing birds from the 1952 study, but none were found.

Table 5 is a condensed record of mortalities and percent survivals of individual groups of game farm and wild-reared juvenile pheasants during 1952. In the percentage totals listed for each of the following groups of game farm juveniles five percent equals one bird, as there were 20 birds in each of the seven groups. Group II is listed only for convenience. Twenty-one were in the wild-reared group, in which each bird amounted to approximately 4.8 percent. The eight groups are listed in order of number of mortalities encountered.

Group II (incubator hatched, brooder reared, seven weeks of age, originating from the E. E. Wilson Game Management Area, Oregon) had the highest mortality during the study, with a 100 percent release loss. This group was the only one to have more than four known release mortalities in the two weeks following liberation. All carcasses of this group were found within a radius of 100 yards of their release marker.

Complete release loss of Group II may have been from the following cause. According to Mr. Don Kirkpatrick, Superintendent of the Game Farm, food given these birds and others during June at the E. E. Wilson Game Management Area was not readily eaten and was often kicked out of the feeding troughs. After complaints on food quality had been received, the State of Oregon Purchasing Division

replaced the unpalatable food by late June. The birds started eating again and putting on flesh as well as showing normal feather development. Many juvenile pheasants died on the Game Farm before replacement of the feed, which was said to have had an excessive amount of "vacatone", a substitute for raw molasses. Birds examined by Dr. E. M. Dickinson, professor of veterinary medicine and poultry specialist at Oregon State College, confirmed the suspicion of Game Farm personnel that the birds presented for examination were suffering from malnutrition.

Consequently, it was believed that Group II, received on Eliza Island on July 21, had not recovered sufficiently from the inadequate diet period in June. Lacking vitality to a high degree, the group suffered a complete release loss in the face of the cold rains which fell for two days following the liberation. Due to these factors, comparison of this group to others in a survival study would be of little or no significance. All comparative analyses in this thesis have been made with the exclusion of Group II. Rain apparently had little effect on the remaining groups after release since there were no outstanding release mortalities incurred.

Suffering the second highest number of mortalities were the youngest game farm juveniles received (Group I, hen hatched, hen reared, six weeks of age, and Group III,

incubator hatched, electric brooded, pen reared, seven weeks of age), appendix H. Reduced to mortality factors, the former group had two release mortalities, one avian predation, and eight remain "unaccounted for". The latter group sustained one release mortality, one drowning, and nine "unaccounted for". In both groups a 55 percent mortality occurred.

Group VII (electric incubated, electric brooded, eight weeks of age) had a 45 percent loss consisting of four release mortalities and five "unaccounted for". Of four groups aged eight weeks or older, this is the only group which sustained as high as four release mortalities. Nevertheless, the total loss of this particular group compared favorably with the other three groups.

The wild-reared group, consisting of 21 juvenile pheasants estimated to be in the field on July 21, suffered an approximate 43 percent loss, with the nine mortalities classified as "unaccounted for". This is a rather high mortality rate for wild stock. As the estimated number of wild-reared juveniles was based on eggs hatched and sight records of some of the juveniles before the game farm release, it is possible that the following conditions took place: (1) some of the 21 died at an early age and were not actually present on July 21, or (2) if the 21 were present after the second release, most

of the nine "unaccounted for" apparently left the island since no trace of them has been found. If the former were the case the mortality rate would be reduced for a higher and more normal survival rate for wild-reared stock. Hartwell, in his 1951 study, has reported a 90.5 percent survival of his 21 wild-reared juveniles, a more normal rate. There were two mortalities in his wild group, with 19 harvested at the conclusion of the study.

In both of the following groups a 40 percent mortality was experienced. Group V (hen hatched, hen reared, ten weeks of age) had two avian predations, one drowning, and five remain "unaccounted for". Group VI (incubator hatched, electric brooded, ten weeks of age) had one release mortality and seven "unaccounted for". The former group was the only one to have two losses to predators and the only game farm group in which no release mortalities were found. As both of the above groups were the oldest juveniles liberated, ten weeks of age, it is perhaps of some significance that they placed second and third in the least number of mortalities for all liberated birds.

Experiencing the least mortality, 15 percent, was Group IV with one release mortality and two "unaccounted for". This group was hen hatched, hen reared, and eight weeks of age. No substantiated reasons can be given for

the low mortality in this group, but of significance, perhaps, is the fact that the age groups of eight to ten weeks had the lowest mortalities and conversely the highest survival rates.

Mortality Caused by Predation

During the period predator control was in effect, between January 26 and October 29, 1952, five pheasant kills were found. Three were made by Cooper's hawks, one by a red-tailed hawk, and one was caused by a dog used by the research personnel, table 4. Three of the kills were juveniles from game farm groups and the other two were adult pheasants, part of the breeding stock liberated to hatch and rear wild stock. No accountable avian predation occurred in the wild-reared group.

Since the study was directed toward measuring juvenile survival only, predations on adults are not considered in the analysis. The three juveniles lost to avian predators amounted to 2.13 percent of the entire population of 141 pheasants. As is shown in table 7, however, only game farm juveniles suffered predation losses, and in relation to their release of 120 birds the loss was 2.5 percent. However, only two game farm groups suffered predation. A hen was lost in Group I (hen hatched, hen reared, six weeks of age) and a juvenile cock

TABLE 4

Record of Predator Kills of Juvenile and Adult Pheasants Between April 16 and October 29, 1952, on Eliza Island, Washington

Date Killed	Pheasant Age	Pheasant Sex	Group Origin	Predator
4-16	adult	male	breeding stock	Cooper's hawk
6-29	adult	female	breeding stock	Dog
8-11	juvenile	male	V	Cooper's hawk
8-19	juvenile	?	V	Cooper's hawk
10-8	juvenile	female	I	Red-tailed hawk, probably
Total kills during predator control period 5				

was lost in Group V (hen hatched, hen reared and ten weeks of age). A second loss in this group was of undetermined sex, appendix H.

During 1951 and 1952 most of the pheasant kills were found either by sighting the hawks going to or from the carcasses or by finding scattered feathers and skeletal bones. In the case of owls, portions of the pheasants were observed in the pellets. A majority of the kills on Eliza Island usually were found along the forest edge or in lone stands of alders or blackberry vines.

Cooper's hawks had started their attacks on juvenile pheasants by August 9. On August 11 the first witnessed kill was seen from the barn tower. A Cooper's hawk pursued and caught a young cock pheasant in flight and dragged the bird down through a six foot entanglement of blackberry vines. The last cries of the pheasant were heard as the observer quietly approached the area. From a distance of 20 feet rocks were thrown to the inside of the vines in an attempt to flush out the hawk within shooting range. The rocks had no effect, and an approach was made to within five feet of the hawk. At this point the hawk could be seen through the vines tearing the feathers and flesh from the pheasant's neck. The hawk was shot and found to be a juvenile male Cooper's, figure 5.

Examination showed the pheasant's skin was punctured on top of the skull, with a blood clot beneath and surrounding the injury. Exposing the skull below disclosed a tiny puncture entering the bone. Presumably this was made by a sharp talon since the hawk's bill would have left a much larger hole. Einarsen (3, p.3, unpublished) recorded this same type of observation on Eliza Island of a Cooper's hawk killing a pheasant. A second Cooper's hawk kill of a juvenile pheasant occurred in late August but did not show the puncture on the skull. Due to deterioration of the carcass, however, this examination may

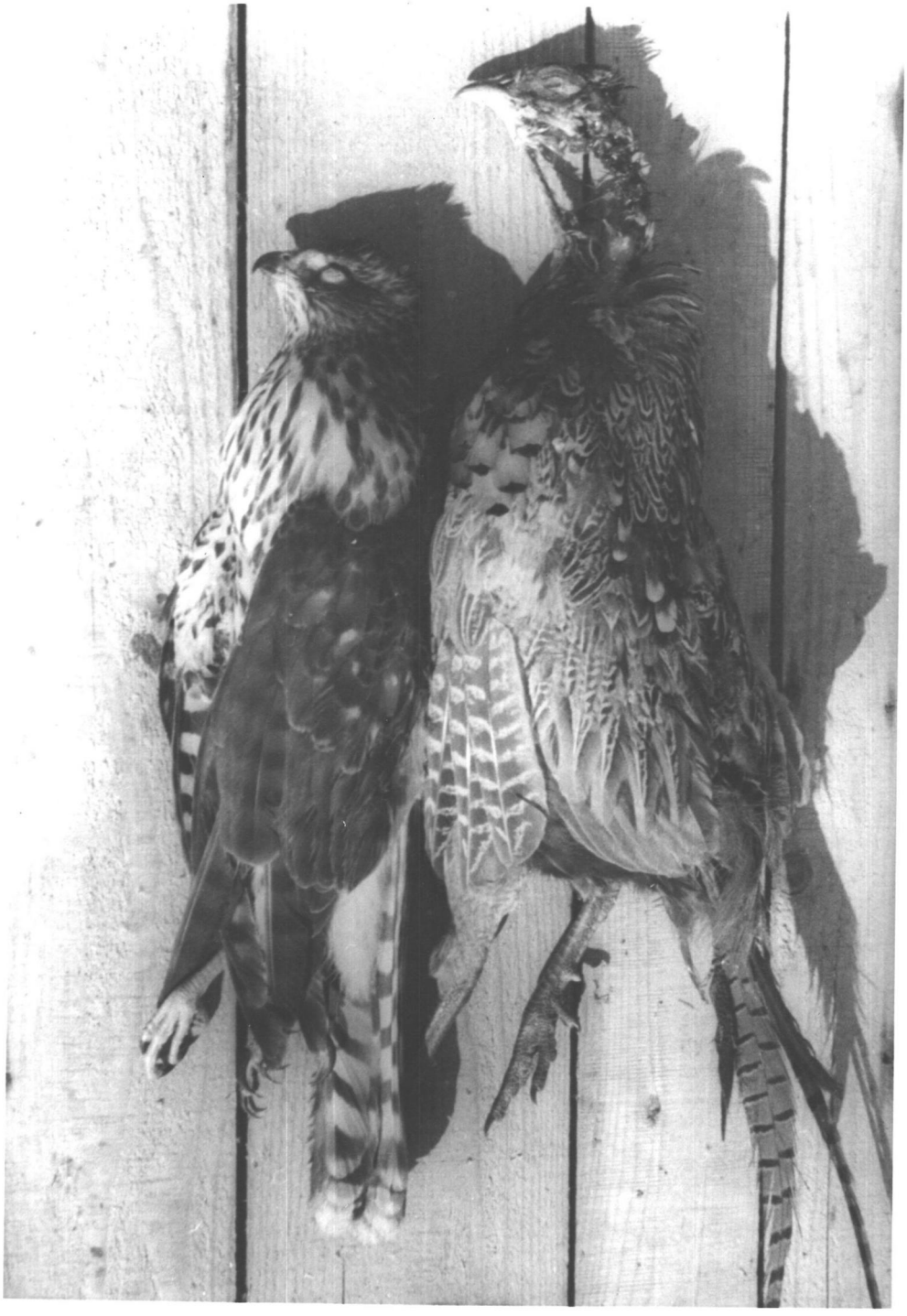

Figure 5. Juvenile Cooper's hawk and its victim, a juvenile cock pheasant. Note condition of neck region where feeding first started.

have been incomplete, with a small puncture impossible to detect.

The Cooper's hawk is a diligent feather-picker and seldom breaks any bones. A young juvenile pheasant in which the bones have not ossified to a great extent may, however, have some of the smaller bones severed. The neat feather picking and general lack of bone breaking is in contrast to the habits of the red-tailed hawk. The red-tail usually tears out groups of feathers, and the larger bones are often broken in its rather untidy eating habits.

The only recorded juvenile pheasant kill by a red-tailed hawk during the control period was on October 8. In reference to killing blows, the back above the tail was exposed and talon marks were visible. Skin on top of the head was torn loose and the base of the skull was exposed. No punctures were visible but the skull was bloody. As the kill was very fresh when found, only a portion of breast meat had been removed and there were no bones broken.

No evidence of kills by sharp-shinned hawks were found in 1952, although feints by them at pheasants were observed occasionally in the fall.

Two horned owls were collected during the 1952 study. Normally this species of owl, along with the Cooper's hawk and the red-tailed hawk, would offer the most serious

threat to pheasant survival on Eliza Island, based on research records on the island since 1947.

Marsh hawks made many low cruising flights over the Flat and occasionally hovered over pheasants. Song birds were their main prey when they managed to make a kill, although in previous studies on Eliza Island marsh hawks did take a few pheasants.

Duck hawks, Western pigeon hawks, and bald eagles never were observed to pursue or kill pheasants on the island during 1952. Tall snags were used as perches by the pigeon hawks and eagles; and although it would seem they were able to observe pheasants moving below, their diet apparently did not include pheasants. Due to its small size a pigeon hawk normally would attack small or medium-sized song birds, for a pheasant presumably was too large for its capabilities. Bald eagles were the only predators which frequented the island that were not collected in the control campaign.

Crows were numerous in the early spring, but they were prevented from nesting or from stealing pheasant eggs by constant harassing and control. Their main diet appeared to be carrion found along the beaches. During nesting season in the spring these birds were observed inland more frequently, searching for eggs or young of birds. No form of predation on pheasants by crows was observed in 1952.

Survival

The 1952 fall harvest showed that of 141 juvenile pheasants 82 had survived for a period of at least 100 days on Eliza Island, from July 21 to October 29. Two game farm males managed to escape until March 16, 1953. The juveniles harvested at the end of this study, 70 game farm birds and 12 wild-reared, represent a survival of 58.16 percent, table 9.

On a basis of release ages or rearing methods no exact determination can be drawn as to which individual group survived best. The only outstanding group was Group IV (hen hatched and reared, eight weeks of age), table 5. It had the highest survival rate, with 17 birds harvested, or 85 percent survival. It is interesting that the birds harvested from this group, male and female, had the greatest weights of any of the other groups, appendix F. Three males weighed at least three pounds; seven others weighed more than two pounds, thirteen ounces; and all females weighed above two pounds. The lightest one in this group was a male taken on March 16, 1953, weighing two pounds, seven ounces. This low weight may have been brought on by the difficulty of finding plentiful feed during the winter. No significant relation between

survival and weight when harvested can be seen in the other groups.

It would be difficult to point conclusively to the best release age and type of rearing method for use in game management plans. However, by combining those groups with similar release ages and rearing methods, more substantial numbers of birds would be involved and a more reliable summarization could be made. The best surviving groups, then, in view of the various conditions of rearing juvenile game farm pheasants might be summed up as follows:

Release Ages Comparison: Birds aged eight to ten weeks at release; Groups IV, V, VI, and VII; survived best with 55 percent or higher individual group survivals. On the other hand, the ages six to seven weeks, Groups I and III, showed the lowest percentage survival of 45 percent for each group.

Rearing Methods Comparison: Birds reared by use of domestic hens in the age groups from eight to ten weeks, Groups IV and V, survived somewhat better than did the mechanically-incubated and brooded comparable age groups, Groups VI and VII. Actually the percentages of survival were close enough in these four groups, with 55 percent or higher harvested, that no major conclusions can be drawn safely. Group IV, with 85 percent survival, were the only juveniles to show a high and marked ability to

TABLE 5

Survival Records of Game Farm and Wild Juveniles Between July 21 and October 29, 1952, on Eliza Island, Washington

Origin	Age Class	Number Released	Number Harvested	Mortality Numbers	Percent Survival
Group IV Hen hatched Hen reared	8 wks.	20	17	3	85
Group V Hen hatched Hen reared	10 wks.	20	12	8	60
Group VI Incubator hatched Electric brooded	10 wks.	20	12	8	60
Wild Reared	7-9 wks.	21*	12	9	57
Group VII Electric incubated Electric brooded	8 wks.	20	11	9	55
Group III Incubator hatched Electric brooded	7 wks.	20	9	11	45
Group I Hen hatched Hen reared	6 wks.	20	9	11	45
Group II Incubator hatched Brooder reared	7 wks.	20	0	20	0
TOTALS		161	82	79	

* Based on observed nests and young

TABLE 6

Survival Records of Game Farm and Wild Juveniles Between July 20 and October 1, 1951, on Eliza Island, Washington

Origin	Age Class	Number Released	Number Harvested	Mortality Numbers	Percent Survival
Wild Reared	7 wks.	21*	19	2	90.5
Hen hatched Hen brooded Field reared	6 wks.	20	15	5	75
Incubator hatched Electric brooded Pen reared	8 wks.	20	14	6	70
Hen hatched Hen brooded Pen reared	8 wks.	20	14	6	70
Hen hatched Hen brooded Field reared	8 wks.	20	13	7	65
Incubator hatched Electric brooded Pen reared	10 wks.	20	13	7	65
Incubator hatched Brooder reared (Hot water heat)	8 wks.	20	12	8	60
Hen hatched Hen brooded Field reared	6 wks.	20	10	10	50
Incubator hatched Electric brooded Pen reared	6 wks.	20	3	17	15
Undetermined juveniles harvested**			6		
TOTALS		181	119	62	

* Based on observed nests and young
** Birds lacking definite group identification

escape the hazards of accident and predation until harvest time.

In the six to seven weeks of age class, Group I was reared by domestic hens and Group III was mechanically reared, with each having a 45 percent survival.

Wild-reared juveniles seven to nine weeks old, with an estimated 57 percent survival, did not do as well as might be expected from wild stock. The 12 wild juveniles harvested were the only wild stock recovered from an estimated 21 in the field in late May and early June. It is possible that on July 21, when they were placed on a comparison basis for survival study, the total 21 did not actually remain with some possibly having been lost at an earlier age. If this were the case the survival compared to actual numbers present would be higher and more in line with expectations from vigorous wild stock.

Comparisons to the 1951 Study

Comparison of 1952 mortalities and survivals to those of the 1951 study were made with consideration of the following variations: (1) A total of seven groups (141 birds) in 1952 were being compared to nine groups (181 birds) of the 1951 study, (2) due to the 1951 harvest beginning on October 1 and the 1952 harvest beginning on October 29, the survival periods for the two studies were

73 days and 100 days, respectively, and (3) ages and rearing methods of each particular group were not exactly duplicated in the two years.

Since the sample numbers of pheasants were quite small, comparisons between individual game farm groups in regard to their ages and methods of rearing will not be made. A study by Phillips during 1953, similar to the 1951 and 1952 studies, may provide enough information for individual group analysis.

Mortality Comparison

Release mortalities found in 1951 totaled 23 birds which amounted to 14.4 percent of the release of 160 game farm pheasants, table 7. Nine found during 1952 resulted in a mortality rate of 7.5 percent of a game farm release of 120 birds. These figures probably are very close to the number of release mortalities that actually occurred.

Buss (1, p.86) cites a 10 percent release mortality for a liberation of 100 game farm eight-weeks-old birds on August 27, 1937, in Wisconsin. Table 8, taken from Buss, lists release mortalities ranging from one to six percent after the liberation of five groups of eight to ten-week-old English and Chinese pheasants in mid-July and August. The total release was 1,336 cocks and hens, comprising

TABLE 7

Comparison of 1951-1952 Juvenile Pheasant Survival
And Individual Mortality Factors on Eliza Island, Washington

Year	Survival Mortality Factors	Number Juveniles Wild Reared	Number Juveniles Game Farm	Survival & Mortality Percents Wild Reared	Survival & Mortality Percents Game Farm	Total Number Wild and Game Farm Birds	Survival & Mortality Percents Total Birds
	Survived	19	100	90.5	62.5	119	65.75
	Release mortalities	0	23	0	14.4	23	12.71
1951	Predation	0	23	0	14.4	23	12.71
	Other mortalities	2	4	9.5	2.5	6	3.31
	Unaccounted for	0	10	0	6.2	10	5.52
	TOTALS	21	160	100.0	100.0	181	100.00
	Survived	12	70	57.1	58.3	82	58.16
	Release mortalities	0	9	0	7.5	9	6.38
1952	Predation	0	3	0	2.5	3	2.13
	Other mortalities	0	2	0	1.7	2	1.42
	Unaccounted for	9	36	42.9	41.7	45	31.91
	TOTALS	21	120*	100.0	100.0	141	100.00

* Group II not included; 20 release mortalities deleted

TABLE 8

Figures Taken From Buss (1, p.97), Wisconsin, Summarizing Release Mortalities and Survivals Based on the Shooting Returns of the Number of Males Released

Pheasant Varieties	Age at Release	Date of Release	Number Released M	Number Released F	Number Released Total	Percent Found Dead M&F	Percent Survival (Shooting return based on number of males released)
(1941)							
English	8 wks.	July 17	390	212	602	1	35
English	10 wks.	Aug. 4	103	75	178	2	26
(1942)							
Chinese	8 wks.	July 16	140	142	282	6	26
English	8 wks.	July 16	52	66	118	6	25
English	10 wks.	Aug. 13	74	82	156	2	23

five separate groups. Only one percent were lost from the largest group of 602 birds. Higher losses, from two to six percent, occurred in released groups having 282, 178, 156, and 118 juvenile pheasants.

In Hartwell's 1951 Eliza Island study, 23 juveniles were taken by avian predators for a 12.71 percent loss, whereas only three predations, or 2.13 percent, occurred in 1952. The attempt at predator control in 1952 apparently was the main difference in holding predation to such a low percentage as compared to the results of the 1951 investigation.

Mortalities listed under the title of "other", caused by an accident such as drowning, were six birds in 1951, or a 3.31 percent loss. A total of two birds was lost in 1952, or 1.42 percent.

"Unaccounted for" birds in 1951 totaled 10, or 5.52 percent of 181 pheasants afield. Of 141 birds afield in 1952, 45 birds were "unaccounted for", or 31.91 percent. Listed as probable causes for such a high number of lost birds in 1952 were dispersal flights from Eliza Island; some carcasses still unfound on the island; and the possibility that of the estimated 21 wild-reared birds not all were present on July 21, 1952, when comparisons were started.

Total mortality for 1951 was 34.25 percent, 62 juveniles, of 181 birds afield. In 1952 it was 41.84 percent, 59 juveniles, of 141 birds in the field. Total of all birds recovered for the two studies, including both mortalities and harvested birds, was an excellent 95 percent in 1951, and 68.09 percent during the 1952 period. The main difference in recovery percentages between the two studies was the result of having 45 "unaccounted for" birds in the latter year.

Survival Comparison

Table 9 presents the comparative success of survival of juvenile pheasants in relation to the two main types of

game farm rearing for the studies of 1951 and 1952. Wild-reared group survival is also compared.

During 1951 the wild-reared group, 21 birds seven weeks old, had a 90.5 percent survival as against only 57 percent survival of the 21 birds, aged seven to nine weeks, in the 1952 study.

In 1951 a survival of 65 percent was recorded for four groups of game farm juveniles, 80 birds hatched and reared by domestic hens. Three groups, 60 birds, reared under the same conditions during 1952 had a 63.3 percent survival. The 1951 mechanically-hatched and reared juveniles, 80 birds, showed a survival of 52.5 percent; while similar 1952 stock of 60 birds showed a 53.3 percent survival. The birds reared by use of domestic hens show similar percentages of survival in the two years, while the contrast between this method and mechanical rearing is easily noticeable in both years. In 1951 the domestic hen method showed a 12.5 percent more successful survival than the mechanical method, and the comparable 1952 rate was 10 percent.

Therefore, as is shown in both studies, rearing by domestic hens apparently leads to somewhat greater survival than does rearing by mechanical methods. This slightly higher percentage of survival, however, may be outweighed by the economy and adaptability of the hatching

and rearing systems which use mechanical methods. The trend of previous Eliza Island studies likewise indicates no great superiority of either system. The studies show that basically the older pheasant, eight to ten weeks, has the best chance of survival.

TABLE 9

1951-1952 Mortality and Survival Comparisons, by Rearing Methods, of Game Farm and Wild-Reared Juvenile Pheasants on Eliza Island, Washington

Year	Origin	Age at Release	Date Released	Number Released	Mortality	Harvest	Percent Survival
1951	Hen hatched Hen reared Pen-field reared	Four groups 6 and 8 wks.	July 20	80	28	52	65
	Incubator hatched Electric brooded Pen-brooder reared	Four groups 6, 8, and 10 weeks	July 20	80	38	42	52.5
	Wild Reared	One group 7 weeks	In field on July 20	21 (est.)	2	19	90.5
1952	Hen hatched Hen reared	Three groups 6, 8, and 10 weeks	July 21	60	22	38	63.3
	Incubator hatched Electric brooded Pen reared	Three groups 7, 8, and 10 weeks	July 21	60	28	32	53.3
	Wild Reared*	One group 7-9 weeks	In field on July 21	21 (est.)	9	12	57

* Possibility of estimate for July 21 numbers being high

SUMMARY AND CONCLUSIONS

1. The 1952 summer study was designed to measure the mortality and survival of game farm and wild-reared juvenile pheasants. The game farm groups were compared on a survival basis according to their ages at release and methods of rearing. Avian predator control was attempted. A comparison was made to a similar survival study in 1951 in which there was no predator control.

2. Approximately 160 acres, Eliza Island, Washington, was used as the research project area. The range habitat here is somewhat similar to parts of western Oregon and western Washington for which areas the investigation was performed.

3. Two pheasant releases were made: (1) On April 8 and 9, five adult hens and two cocks were liberated which after breeding produced an estimated 21 wild-reared juveniles; and (2) seven groups of 20 birds each, 140 game farm birds, were released on July 21. Ages ranged from 6 to 10 weeks. Three of these groups were hatched and reared by domestic hens, and four were mechanically hatched and brooded.

4. Daily field notes were taken during the study, and methods of field work employed were: (1) "semi-gridding", (2) observing from the barn tower, (3) checking

pole trap lines, and (4) visiting hawk preference areas. Predator control was employed daily in the field work.

5. Observations were made to determine the degree of alertness between wild-reared and game farm juveniles. The former were found to be more furtive in their actions and game farm birds, apparently due to their daily associations with game farm personnel, were slower to become alarmed at the observer's presence. With the advent of the harvest both groups became wary, making it impossible to distinguish between them.

6. From all appearances the weather did not cause any ill effects on the pheasants except on July 22 when a deluge of rain fell upon the newly released juvenile birds, which may have contributed to excessive mortalities in one unfit group.

7. Food was ample during the study, with a dense stand of cultivated wheat and barley available to the birds besides numerous wild feeds. There was no noticeable lack of water. Cover also was adequate throughout the study.

8. Predator control covering the period from January 26 to October 29, 1952, resulted in the removal of 34 predaceous birds by shooting and trapping. Vigilance was maintained at certain hours of the day when hawks were most active, along with observations from a stationary

platform. Shooting of 27 predaceous birds was the result of using these systems.

9. Release mortalities occurring shortly after liberation were nine, or 7.5 percent of 120 game farm juveniles. Group II, suffering a 100 percent release mortality, was deleted from the 1952 research analysis. It was believed this group, received at Eliza Island on July 21, had not recovered sufficiently from an inadequate diet at the Corvallis Game Farm in June. Lacking vitality to a high degree, this group suffered a complete release loss in the face of the cold rains which fell for two days following the liberation. Twenty-three release mortalities, of 160 birds afield, were found in Hartwell's previous summer study, resulting in a 14.4 percent loss.

Losses by accidents, two birds, amounted to 1.42 percent in 1952. Six birds died from these causes during Hartwell's 1951 study, totaling 3.31 percent.

10. Losses from predation for the 100-day survival period, July 21 to October 29, were three juvenile game farm pheasants, totaling 2.13 percent of the 141 birds afield. Cooper's hawks killed two of the juveniles and a red-tailed hawk took the third. Records in 1952 indicated a marked reduction of avian predations as compared to those recorded in the 1951 study, even though more hawks were in evidence around Eliza Island during 1952.

In 1951, 23 juveniles of 182 birds afield were taken by avian predators for a 12.71 percent loss. The latter study survival period was conducted from July 20 to October 1, a total of 73 days. Had it been 100 days as in 1952, perhaps even a higher predation loss might have occurred.

11. Dispersal of the released pheasants to the three points of the island became most noticeable after September 2, and by mid-October large numbers were being seen on North and South Points. Two different groups, 11 and 5 pheasants, were observed to fly off the island on October 20 and 31. All returned after a short flight over the water.

Forty-five juveniles were "unaccounted for" in the study, and it is believed the majority of these attempted to fly from the island. Previous study dispersal records in other years and the fact that the island has been systematically searched for live and dead birds lends support to the thought that this is possible, though unproven. Other possible causes for the 45 "unaccounted for" birds are that some carcasses are still unfound on Eliza Island or that not all the estimated 21 birds of the wild stock lived until July 21.

12. Total mortalities for 1952 were 59 juveniles, or 34.25 percent of 141 birds afield. In 1951 the total

mortalities were 62 birds, or 41.84 percent of the 181 birds afield.

Total recovery of both mortalities and harvested birds in 1952 was 68.09 percent, while Hartwell recovered 95 percent in his 1951 study. The large number of "unaccounted for" birds in the 1952 study accounts for the marked difference between total recoveries in the two investigations.

13. The 1952 harvest accounted for 82 of the 141 juvenile pheasants afield on July 21 of that year. This represented a collective game farm and wild group survival of 58.16 percent. These birds survived at least 100 days or more.

Of the 181 juveniles afield on July 21, 1951, 119 birds were harvested, with a resultant group survival of 65.75 percent. These birds survived a period of at least 73 days or more.

14. No individual group comparisons were made in the studies, due to the small numbers involved in each group. However, those groups with similar release ages and rearing methods were combined for more reliable analysis as they involved larger numbers.

Similar release ages in 1952 showed birds aged eight to ten weeks at release survived best, with 55 percent or higher individual group survivals. Game farm groups aged

six to seven weeks showed the lowest percentage survival, with 45 percent for both groups. The wild-reared group, composed of birds seven to nine weeks of age, had a 57 percent survival.

Similarly reared groups in 1952 showed that those reared by domestic hens in the eight to ten weeks class had the highest survival, with 60 percent and 85 percent surviving in two groups. A third group reared by domestic hens which were released at six weeks of age had only a 45 percent survival. Two groups in the eight to ten weeks class reared by mechanical means had 55 percent and 60 percent survivals, and a third group mechanically reared had a 45 percent survival. These birds were seven weeks of age at release.

15. A comparison of 1952 survival numbers to those in the 1951 study was made by combining the various groups into two categories according to age at release and type of rearing method.

The wild-reared group of 21 birds, aged seven weeks, during 1951 had a 90.5 percent survival as against 57 percent survival of the 21 birds, aged seven to nine weeks, in the 1952 program. Both groups compared favorably with the best surviving game farm groups, although the former year's wild group would be considered the more normal survival percentage for birds reared in the wild.

The combined studies show that basically older pheasants, eight to ten weeks of age at release, have the best survival rates.

In 1951 and 1952 rearing by domestic hens showed 12.5 percent and 10 percent, respectively, more successful survival than rearing by mechanical methods. This analysis was based on the release of 280 game farm juveniles aged six to ten weeks of age during the two years.

Rearing by domestic hens, therefore, resulted in somewhat greater survival than rearing by mechanical methods during the two studies. The slightly higher percentage of survival, however, may be outweighed by the economy and adaptability of the mechanical hatching and rearing systems. The trend of previous Eliza Island studies likewise indicates no great superiority of either system.

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APPENDIX A.

Scientific Names of Plants Listed in Text

Common Names	Scientific Names
Western Yew	*Taxus brevifolia* Nuttall
Douglas fir	*Pseudotsuga taxifolia* (Lambert) Britton
Grand fir	*Abies grandis* Lindley
Giant cedar	*Thuja plicata* Don
Grass family	Graminaceae
Saltgrass	*Distichlis spicata* (L.) Greene
Orchard-grass	*Dactylis glomerata* L.
Barley (domestic) . .	*Hordeum vulgare* Linnaeus
Wheat (domestic) . . .	*Triticum* sp. Linnaeus
Oats (domestic) . . .	*Avena* sp. (Tournefort)
Reed canary-grass . .	*Phalaris arundinacea* L.
Downy brome-grass . .	*Bromus tectorum* L.
Baltic rush	*Juncus balticus* Willdenow
Willow	*Salix* sp.
Red alder	*Alnus rubra* Bongard
Mustard	*Brassica* sp. L.
Rose family	Rosaceae
Himalaya berry	*Rubus thyrsanthus* Focke
Wild blackberry . . .	*Rubus vitifolius* Constance and Rollins
Western serviceberry .	*Amelanchier florida* Lindley
Pea family	Legumnaceae
Alfalfa	*Medicago sativa* L.
Gray beach pea	*Lathyrus littoralis* (Nuttal) Endlicher
Oregon maple	*Acer macrophyllum* Pursh
Douglas maple	*Acer glabrum* Torr. var. *Douglasii* (Hooker) Piper
Madrone	*Arbutus menziesii* Pursh
Broad-leaved star-flower.	*Trientalis latifolia* Hooker

APPENDIX B.

Scientific Names of Birds Listed in Text

Common Names	Scientific Names
Cooper's hawk	*Accipiter cooperii* (Bonaparte)
Sharp-shinned hawk . . .	*Accipiter striatus* ssp. Snyder
Red-tailed hawk	*Buteo jamaicensis* ssp. Cassin
Pigeon hawk	*Falco columbarius* ssp. Linnaeus
Duck hawk	*Falco peregrinus* ssp. Tunstall
Marsh hawk	*Circus cyaneus hudsonius* (Linnaeus)
Horned owl	*Bubo virginianus* ssp. Ridgway
Northwestern crow	*Corvus caurinus* Baird
Bald eagle	*Haliaeetus leucocephalus* ssp. (Audubon)
American goldeneye . . .	*Bucephala clangula americana* Bonaparte
Robin	*Turdus migratorius* ssp. L.
Common redwing blackbird.	*Agelauis phoenicens* ssp. L.
Oregon junco	*Junco oreganus* ssp. Townsend
Song sparrow	*Melospiza melodia* ssp. Wilson

APPENDIX C.

Scientific Names of Reptiles and Amphibians Listed in Text

Common Names	Scientific Names
Alligator lizard	*Elgaria coerulea*
Garter snake	*Thamnophis* spp.
Pacific tree frog	*Hyla regilla*
Western toad	*Bufo boreas*

APPENDIX D.

Weather Conditions Prevailing on Eliza Island During 1951

Month	Temperature Max.	Temperature Min.	Precipitation In Inches	Number Days Precipitation	Inches Snow
Jan.	46	20	4.21	18	2.5
Feb.	51	30	3.55	13	35
Mar.	52	24	1.91	12	
Apr.	60	38	.73	5	
May	63	44	1.95	9	
June	76	50	.33	4	
July	76	51	.08	1	
Aug.	70	52	.40	4	
Sept.	68	48	1.87	8	
Oct.	62	40	4.33	21	
Nov.	56	35	2.55	18	
Dec.	50	16	2.51	19	17
TOTALS			24.42	132	54.5

Weather Conditions Prevailing on Eliza Island During 1952

Month	Temperature Max.	Temperature Min.	Precipitation In Inches	Number Days Precipitation	Inches Snow
Jan.	52	21	1.29	20	8
Feb.	52	32	1.85	22	
Mar.	52	36	2.84	24	
Apr.	59	38	2.21	17	
May	64	41	3.11	17	
June	64	46	1.60	12	
July	70	50	.62	6	
Aug.	74	51	.62	12	
Sept.	70	50	.70	6	
Oct.	60	43	1.49	9	
Nov.	56	33	.53	10	
Dec.	55	33	2.55	19	
TOTALS			19.41	174	8

APPENDIX E.

Adult Breeding Stock During 1952 Study on Eliza Island, Washington

No.	Bands	Sex	Number Of Eggs	Date Hatch	Number Hatch	Survival
1	59823 59824	Cock	----	----	----	Harvested 11-5-52
2	59825 59826	Cock	----	----	----	Killed by Cooper's hawk 4-6-52
3	55701 55702	Hen	?	?	?	Found dead 8-13-52; believe did not nest. No predation.
4	55705 55706	Hen	18	5-26	10	Harvested 11-1-52
5	55707 55708	Hen	7 (laying)	----	None	Killed by dog. Egg developing in oviduct.
6	55709 55710	Hen	11	5-20	Approx. 7	Unaccounted for
7	55711 55712	Hen	?	5-30	Approx. 8	Harvested 11-1-52

INCREMENT:

Total eggs seen 36
Total hatched seen 25
Chicks died 4*
TOTAL CHICKS compared for survival . . 21

* Not included in survival comparison as they were under one week of age at time of death.

ADULTS:

Total survived 3
Predation 2
Died (Not predation) . . . 1
Unaccounted for 1
TOTAL 7

APPENDIX F.

Weights of Juvenile and Adult Pheasants From 1952 Harvest on Eliza Island, Washington

Origin	Date Harvested	Sex	Weight* Lbs/Oz.	Band Numbers	
GROUP I	10-29	female	NW	6864	6863
Band series	11-1	female	2- 3	6856	6855
6835-6878	11-1	female	1-15	6877	6878
	11-1	male	2-14	6873	6874
	11-5	male	2-15	6840	6839
	11-5	male	2- 9	6848	6847
	11-11	male	2-11	6857	6858
	11-15	female	2- 5	6845	6846
	11-26	male	2-13	6841	6842
GROUP II	-----	------	----	----	----
Band series					
5051-5097					
GROUP III	11-1	female	2- 2	6827	6828
Band series	11-1	male	2-12	6791	6792
6789-6834	11-1	male	2- 9	6801	6802
	11-1	male	2-10	6803	6804
	11-4	male	2-13	6813	6814
	11-11	male	C, NW	6833	6834
	11-19	female	2- 1	6819	6820
	11-21	male	3- 1	6816	6815
	1-5-53	male	2-11	6809	6810
GROUP IV	10-29	female	NW	6899	6900
Band series	11-1	female	2- 2	6910	6909
6879-6922	11-1	male	2-14	6886	6885
	11-4	male	3- 0	6891	6892
	11-8	male	2-13	6881	6882
	11-15	female	2- 4	----	6905
	11-20	female	C, NW	6894	6893
	11-21	female	2- 2	6918	6917
	11-25	male	2-13	6920	6919
	11-26	male	2-14	6879	6880
	11-29	male	3- 2	6912	6911
	12-1	male	3- 0	6903	6904
	12-1	female	2- 1	6916	6915
	12-3	male	2-15	6908	6907
	12-3	male	2-13	6884	6883
	12-13	male	2-15	6888	6887
	3-16-53	male	2- 7	6897	6898

* C - indicates "cripple"
NW - indicates "not weighed"

APPENDIX F. (Continued)

Weights of Juvenile and Adult Pheasants From 1952 Harvest on Eliza Island, Washington

Origin	Date Harvested	Sex	Weight* Lbs/Oz.	Band Numbers	
GROUP V	11-1	female	2- 0	6934	6933
Band series	11-1	female	1-15	6947	6948
6923-6966	11-1	female	2- 4	6946	6945
	11-1	male	3- 0	6958	6957
	11-1	male	2-15	6951	6952
	11-1	male	2-15	6931	6932
	11-4	male	2-15	6927	6928
	11-5	female	1-13	6923	6924
	11-19	male	2-10	6954	6953
	11-24	female	2- 3	6940	6939
	11-28	male	2- 8	6926	6925
	12-3	male	2-11	6949	6950
GROUP VI	11-1	female	2- 0	6740	6739
Band series	11-1	female	1-15	6707	6708
6701-6744	11-1	male	3- 1	6721	6719
	11-1	male	2-12	6720	6722
	11-5	female	1-15	6736	6735
	11-8	male	3- 0	6710	6709
	11-21	male	3- 1	6702	6701
	11-26	male	2-14	6714	6713
	11-26	female	2- 5	6724	6723
	11-29	male	2-13	6716	6715
	12-13	female	1-11	6730	6729
	3-16-53	male	2- 6	6703	6704
GROUP VII	10-30	male	2- 7	6764	6763
Band series	11-1	female	2- 0	6786	6785
6745-6788	11-1	male	2-13	6758	6759
	11-3	female	1-14	6768	6769
	11-5	male	2-14	6746	6745
	11-13	female	2- 0	6756	6757
	11-21	male	2-14	6770	6771
	11-26	male	2-10	6781	6782
	11-29	female	1-10	6772	6773
	12-2	male	C, NW	6778	6777
	2-24-53	female	C, NW	6765	----

* C - indicates "cripple"
NW - indicates "not weighed"

APPENDIX F. (Continued)

Weights of Juvenile and Adult Pheasants From 1952 Harvest on Eliza Island, Washington

Origin	Date Harvested	Sex	Weight* Lbs/Oz.	Band Numbers	
WILD REARED	11-1	female	1-14		
	11-1	female	1-13		
	11-1	female	1-13		
	11-1	female	1-11		
	11-1	female	1- 9		
	11-1	female	1-13		
	11-1	male	2-13	65296	
	11-1	male	3- 2		
	11-3	male	2- 7		
	11-8	male	2- 6		
	11-19	female	C, NW		
	12-10	male	2- 8		
BREEDING ADULTS	11-1	female	1-10	55711	
	11-1	female	1-12	55706	55705
	11-5	male	2- 8	59824	59823

* C - indicates "cripple"
NW - indicates "not weighed"

APPENDIX G.

The Field Day Harvest.

Pheasants Missed, Crippled, and Killed by Field Day Group on November 1, 1952, Eliza Island, Washington

Shotgun Gauge	Shot	Birds Missed	Birds Crippled	Birds Killed
20	7½	3	0	3
16	7½	6	0	4
12	5	6	0	2
12	6	4	0	0
12	6	1	0	3
12	7½	2	0	0
12	6	1	0	0
20	7½	5	0	1
16	6	3	1	2
12	6	8	3	1
12	6	3	0	1
12	8	10	0	2
12	7½	9	2	1
20	6	4	1	2
12	5	6	0	6
16	?	15	1	3
TOTALS		86	8	31*

* Three adults from spring-released breeding stock are included in this total; remainder were juveniles.

APPENDIX H.

FINAL COMPILATION OF JUVENILE RING-NECKED PHEASANT SURVIVAL STUDY
BETWEEN JULY 21 AND OCTOBER 29, 1952

GROUPS*	Total number released	Release mortalities			Avian predations			Drowned		Dog - Predation		Other mortalities		Live trapped		Shot		Total harvest	Accountable number mortalities	Unaccounted for	Total birds recovered	Per cent surviving
		M	?	F	M	?	F	M	F	M	F	M	F	M	F	M	F					
Group I	20	1	1	0	0	0	1	0	0	0	0	0	0	0	1	5	3	9	3	8	12	45%
Group II	20	10	6	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	20	0%
Group III	20	0	0	1	0	0	0	1	0	0	0	0	0	0	0	7	2	9	2	9	11	45%
Group IV	20	0	0	1	0	0	0	0	0	0	0	0	0	0	1	11	5	17	1	2	18	85%
Group V	20	0	0	0	1	1	0	1	0	0	0	0	0	0	0	7	5	12	3	5	15	60%
Group VI	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	5	12	1	7	13	60%
Group VII	20	1	0	3	0	0	0	0	0	0	0	0	0	1	0	5	5	11	4	5	15	55%
Wild Reared	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7	12	0	9	12	57%
Total number juveniles	161	13	7	9	1	1	1	2	0	0	0	0	0	1	2	47	32	82	34	45	116	
		29			3			2						3		79						
Adults	7	0		0	1		0	0	0	0	1	0	1	0	0	1	2	3	3	1	6	
Totals - all birds	168	13	7	9	2	1	1	2	0	0	1	0	1	1	2	48	34	85	37	46	122	
		29			4			2		1		1		3		82						

*

Group I - Hen hatched-hen reared-six weeks of age-Whidbey Island Game Farm
Group II - Incubator hatched-brooder reared-seven weeks of age-E. E. Wilson Game Mgt. Area
Group III - Incubator hatched-electric brooded-pen reared-seven weeks of age-Whidbey Island Game Farm
Group IV - Hen hatched-hen reared-eight weeks of age-Whidbey Island Game Farm
Group V - Hen hatched-hen reared-ten weeks of age-Whidbey Island Game Farm
Group VI - Incubator hatched-electric brooded-ten weeks of age-Whidbey Island Game Farm
Group VII - Electric incubated-electric brooded-eight weeks of age-Whidbey Island Game Farm
Wild Reared - Hatched on Eliza Island during the spring of 1952

APPENDIX I.

PHEASANT MORTALITIES OCCURRING BETWEEN APRIL 10 AND OCTOBER 1, 1951

CATEGORY	Origin	Age in weeks	Number released or present on July 20	Mortalities occurring soon after liberation (shock) F	M	Remaining birds after release mortalities	Per cent lost as release mortalities	Cooper's hawk kills before July 20 F	M	Cooper's hawk kills July 20 to October 1 F	M	Per cent lost by avian predation July 20-Oct.1	Mortalities caused by other factors F	M	Total mortalities by sexes F	M	Total mortalities both sexes	Per cent known mortalities from all causes
HH-HB-FR (enclosure)	W	6	20	1	0	19	5			2	0	10.5	0	0	3	0	3	15
HH-HB-FR (enclosure)	W	8	20	1	0	19	5			2	0	10.5	0	0	3	0	3	15
HH-HB-FR (open fields)	A	6	20	3	2	15	25			0	1	6.6	0	2	3	5	8	40
IH-EB-PR	W	6	20	4	3	13	35			3	3	46.0	0	1	7	7	14	70
IH-EB-PR	W	8	20	0	1	19	5			0	0	0	0	0	0	1	1	5
IH-EB-PR	W	10	20	1	2	17	15			2	0	11.7	0	0	3	2	5	25
IH-BR (hot water heat)	C	8	20	2	1	17	15			2	0	11.7	0	0	4	1	5	25
HH-HB-PR	C	8	20	1	1	18	10			0	2	11.0	0	1	1	4	5	25
Totals - game farm juveniles			160	13	10 / 23	137	14.4			11 / 17	6	10.6	0 / 4	4	24 / 44	20	44	27.5
Wild reared juveniles			21			21		0	1			0	2	0	2	0	2	9.5
Undetermined juveniles										3	3	2.1			3	3	6	
Totals - all juveniles			181			158				14 / 23	9	12.7	2 / 6	4	29 / 52	23	52	28.7
Adults - game farm 5F, 3M			7			7		1	0	0	1	0	0	0	0	1	1	
Totals - all pheasants			188			165		1 / 2	1	14 / 24	10	12.8	2 / 6	4	29 / 53	24	53	28.2

HH-hen hatched; HB-hen brooded; FR-field reared; IH-incubator hatched; EB-electric brooded; PR-pen reared; BR-brooder reared.

W - Whidbey Island Game Farm A - Camp Adair Game Farm C - Corvallis Game Farm

APPENDIX J.

HARVEST RESULTS AND MORTALITIES (SURVIVAL) AFTER OCTOBER 1, 1951

CATEGORY	Origin	Age in weeks	Number released or present on July 20	Number live trapped - both sexes F	Number live trapped - both sexes M	Number shot - both sexes F	Number shot - both sexes M	Cooper's hawk kills after October 1 F	Cooper's hawk kills after October 1 M	Great horned owl kills after October 1 F	Great horned owl kills after October 1 M	Total harvest, including kills after October 1 F	Total harvest, including kills after October 1 M	Total harvest (survival)	Total recovery during entire study (sexes) F	Total recovery during entire study (sexes) M	Total recovery	Total unaccounted for	Per cent recovered	Per cent survival including unaccounted for birds	Total number of kills throughout study F	Total number of kills throughout study M
HH-HB-FR (enclosure)	W	6	20	7	4	3	1	0	0	0	0	10	5	15	13	5	18	2	90	75	2	0
HH-HB-FR (enclosure)	W	8	20	4	8	0	1	0	0	0	0	4	9	13	7	9	16	4	80	65	2	0
HH-HB-FR (open field)	A	6	20	5	2	0	3	0	0	0	0	5	5	10	8	10	18	2	90	50	0	1
IH-EB-PR	W	6	20	1	2	0	0	0	0	0	0	1	2	3	8	9	17	3	85	15	3	3
IH-EB-PR	W	8	20	9	4	1	0	0	0	0	0	10	4	14	10	5	15	5	75	70	0	0
IH-EB-PR	W	10	20	6	4	1	1	1	0	0	0	8	5	13	11	7	18	2	90	65	3	0
IH-BR (hot water heat)	C	8	20	6	4	1	1	0	0	0	0	7	5	12	11	6	17	3	85	60	2	0
HH-HB-PR	C	8	20	8	4	0	1	1	0	0	0	9	5	14	10	9	19	1	95	70	1	2
Totals - game farm juveniles			160	46 / 78	32	6 / 14	8	2 / 2	0	0	0	54 / 94	40	94	78 / 138	60	138	22	86	58.7	13 / 19	6
Wild reared juveniles			21	2	7	3	7	0	0	0	0	5	14	19	7	15	22	?	?	90.5		
Undetermined juveniles								3	1	0	2	3	3	6	6	6	12	12				
Totals - all juveniles			181	48 / 87	39	9 / 24	15	5 / 6	1	0 / 2	2	62 / 119	57	119	91 / 172	81	172	10	95	65.3	19 / 32	13
Adults - game farm			7	1	1	0	1	0	0	0	0	1	2	3	2	3	5	3	62	37.5		
Totals - all pheasants			188	49 / 89	40	9 / 25	16	5 / 6	1	0 / 2	2	63 / 122	59	122	93 / 177	84	177	13	93	64.9	20 / 34	14

HH - hen hatched; HB - hen brooded; FR - field reared; IH - incubator hatched;
EB - electric brooded; PR - pen reared; BR - brooder reared.
W - Whidbey Island Game Farm A - Camp Adair Game Farm C - Corvallis Game Farm