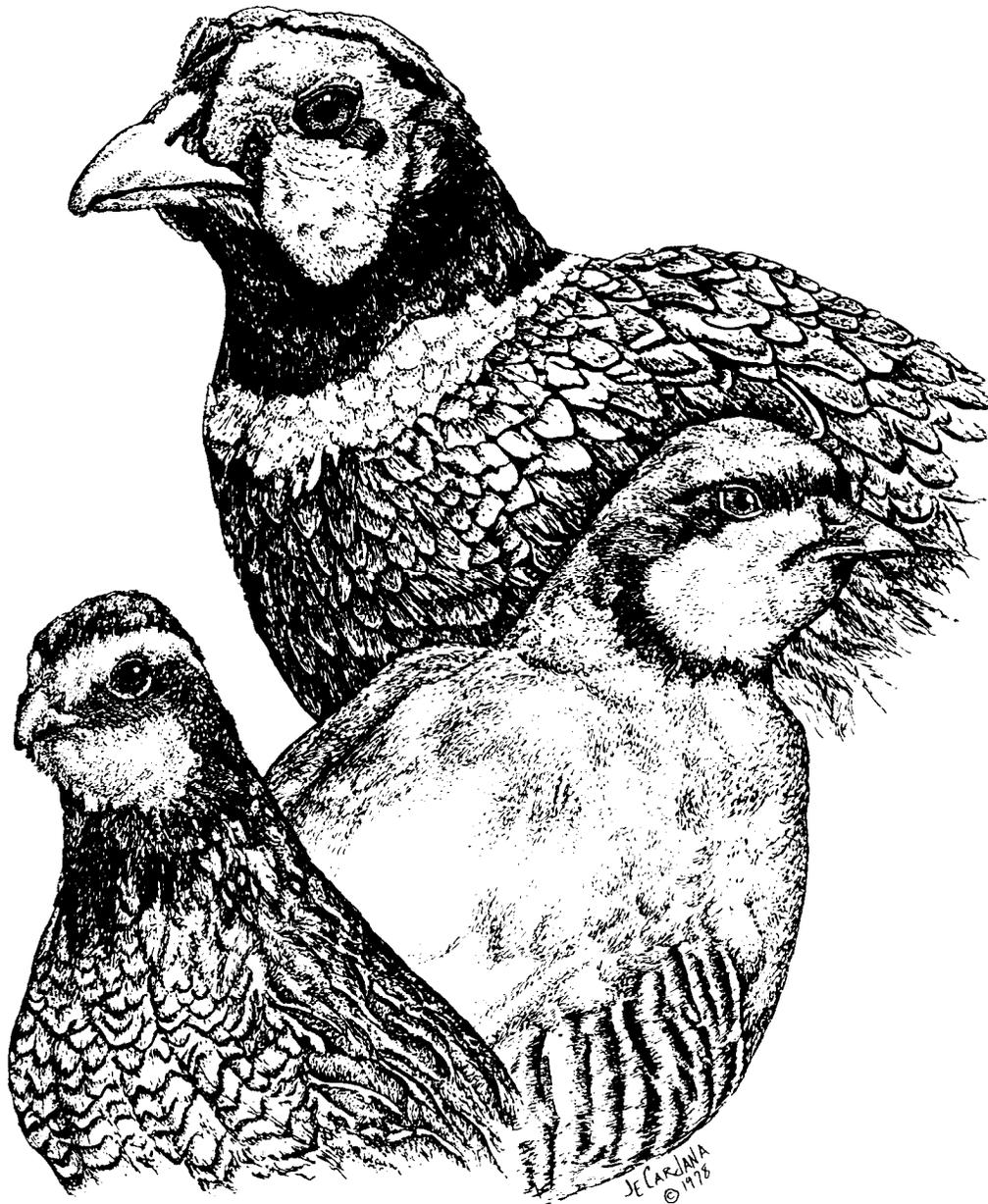


# RAISING GAME BIRDS



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Cover drawing (from top to bottom): Ring-necked Pheasant, Red-legged Partridge, and Bobwhite Quail.

# RAISING GAME BIRDS

*The authors are Allen E. Woodard, Specialist, Department of Avian Sciences, Davis; Ralph A. Ernst, Poultry Specialist, Cooperative Extension, Davis; Pran Vohra, Professor, Department of Avian Sciences, Davis; Lewis Nelson, Jr., Associate Professor, Department of Wildlife Resources, University of Idaho, Moscow, formerly Wildlife Specialist, Cooperative Extension, Davis; and Fred C. Price, Farm Advisor, Stanislaus County. The drawings are by Jeanne Cardana.*

## INTRODUCTION

There are many reasons for participating in game bird farming. It can be an enjoyable hobby, a way to fulfill a 4-H project requirement, a means of establishing or increasing local game bird populations, or a business venture.

Stocking of game birds to establish or increase a resident population for hunting has long been practiced by professional wildlife managers, landowners, and sportsmen. Such programs are successful only if the stocked birds are placed in a suitable habitat to ensure their survival and future breeding.

Since public lands available for hunting upland game birds have diminished considerably, many sportsmen are turning to licensed shooting clubs for hunting. Most clubs operate on a put-and-take basis and attempt to harvest a high percentage of stocked game birds.

Some people raise game birds as a business venture to obtain a supplementary or total income.

Whatever your reasons for entering game bird farming, consider these three important factors.

- Game birds must be regarded as a wildlife crop. Proven methods exist to help you raise and harvest a good crop. Game birds are not incidental products that produce without cultivation. You will need to devote enough time to provide the intensive care they require.

- If your motive is to establish or increase local game bird populations, it will prove useless unless the habitat is suitable for the species being stocked. No animal can survive for long in an unfavorable habitat. Because conditions vary between locations, and game birds differ in their requirements, contact your state Department of Fish and Game or your county Cooperative Extension office for habitat information.
- Every business operates on the principle of supply and demand. If you are considering game bird farming as a business venture, do so only after determining:
  - Present and potential markets and demand
  - Total costs, including initial investment, labor, transportation, taxes
  - Pricing
  - Competition
  - Contract and supply arrangements

Certain management practices will take most of the guesswork out of planning a successful game bird farming operation, whatever its size or purpose. This leaflet describes the most recent ideas in game bird husbandry.

## RULES AND REGULATIONS

The state Department of Fish and Game is responsible for management of all game birds. Consequently, the rules and regulations are designed to encourage native and certain exotic species while discouraging others.

States usually require that a person acquire a game breeder's license before obtaining and keeping game birds. Therefore, direct all questions about legal requirements for any phase of game bird raising and release to the state Department of Fish and Game.

## HATCHING

We strongly recommend that beginners start with day-old chicks or eggs purchased from a reputable game bird breeder who can guarantee a product reasonably free of disease. A list of game bird breeders is usually available from the state Department of Fish and Game.

### Hatchery and Equipment

Your need for a hatchery will depend on the size of the operation. Hatcheries should have concrete floors sloped to large drains in every room to facilitate cleaning. Walls and ceilings should be constructed of water-impervious materials.

Hatcheries should be well ventilated with a system designed to provide a uniform supply of clean air in all areas. The temperature should be maintained between 65° and 80° F (18.3° and 26.7° C). In the summer, especially in dry areas, evaporative cooling is preferred, because it increases the humidity of incoming air. Some heat will need to be provided in most locations during the colder months.

Adequate oxygen levels and carbon dioxide removal are necessary for embryo development, but the main function of ventilation is to control temperature and to dilute airborne microorganisms during the hatch. In a commercial game bird hatchery, the hatcher and equipment-cleaning area should be in a separate room with its own ventilation system so that the fluff and dust from the hatch are kept away from the incubators, clean eggs, and clean equipment. For small operations,

separation of incubator and hatcher may not be feasible.

Some machines are designed to operate better with two or three ages of eggs in one incubator. This makes cleaning more difficult, but you can still clean the interior surfaces of the machine before adding new eggs by removing a few trays at a time, and you can clean the hatcher after each use.

Some incubators have hatchers attached. In these cases, the room should be ventilated so as to keep as much of the dirty air as possible away from the incubator.

When you purchase an incubator or hatcher, select one that is well constructed. The machine must have automatic temperature control within a narrow range (within  $\pm \frac{1}{4}^{\circ}$  F or 0.15° C is best). Other essential features for a commercial operation are automatic turning of the eggs, humidity control, and forced air movement.

Another important consideration is the ease of washing and sanitizing the cabinet. Metal or fiberglass surfaces are best. Wood is durable and a good insulator, but it is difficult to clean and nearly impossible to sterilize. Many wooden machines can be improved by coating the interior surfaces with epoxy resin. Do not use lead-based paints; lead is toxic to chicks.

Also consider the reliability of the mechanical systems, the ease of repair, and the availability of spare parts.

### Care of Eggs

Always wash your hands thoroughly, preferably with a disinfectant soap, before handling eggs. If eggs sweat when removed from the holding room, reduce the humidity or temperature of the room where eggs are trayed. You can also increase the egg-holding-room temperature to the levels shown in table 1, depending on the length of egg storage.

TABLE 1. HOLDING-ROOM TEMPERATURE AS AFFECTED BY STORAGE TIME

Duration of storage <i>days</i>	Maximum storage temperature	
	$^{\circ}$ F	$^{\circ}$ C
1	70	21.1
2-4	65	18.3
5-10	60	15.6
Over 10	55	12.8

Set only nest-clean eggs. Cracked, thin-shelled, misshapen, or abnormal-size eggs should not be set, because they hatch very poorly and are likely to contaminate other eggs or chicks. Eggs that have been stored do not hatch as early as fresh eggs and therefore should be preset or allowed more time to hatch. Eggs stored for 2 weeks should be preset for 10 hours; those stored for 3 weeks for 18 hours.

### Fumigation

Fumigate clean eggs soon after collection and again after traying, if desired, but never between 24 and 96 hours of incubation. Effective formaldehyde gas fumigation requires a temperature of at least 70 $^{\circ}$  F (21.1 $^{\circ}$  C) and a relative humidity above 70 percent.

Formaldehyde gas can be generated by mixing 60 grams (2¼ ounces) of potassium permanganate with 120 cubic centimeters (½ cup) of a commercial, 37 percent formaldehyde solution for each 100 cubic feet (2.83 cubic

meters) of space to be fumigated.<sup>1</sup> Pour the formaldehyde over the potassium permanganate in an earthenware or enamelware container. Circulate the gas for 20 minutes with a fan, and then expel the gas from the fumigation room or cabinet.

For effective fumigation, be sure the formaldehyde gas reaches all of the eggs. Place the eggs on flats held in special racks or in incubation trays that allow adequate gas circulation.

When clean incubators or hatchers are to be fumigated, it is desirable to use two or three times more fumigant; this is particularly recommended when you are fumigating machines constructed of wood or those with wooden trays.

### Incubation

Proper incubation is not difficult, but certain procedures should be followed to ensure success. First, clean the equipment. Wash incubators and hatchers with detergent solution, then rinse and fumigate them. Soak trays in detergent solution and then scrub, rinse, and fumigate them with the incubator.

After the incubator is clean, it should be started, tested, and adjusted as necessary before any eggs are set. Operate the machine for 24 hours before setting eggs. Put a record sheet on each machine, and record the wet

TABLE 2. CONDITIONS FOR INCUBATION OF PHEASANT, PARTRIDGE, AND QUAIL EGGS

Machine type	Incubation temperature		Hatching temperature	
	Dry bulb	Wet bulb	Dry bulb	Wet bulb
Fan ventilated	99.5 $^{\circ}$ –100 $^{\circ}$ F (37.5 $^{\circ}$ –37.8 $^{\circ}$ C)	82 $^{\circ}$ –86 $^{\circ}$ F (27.8 $^{\circ}$ –28.3 $^{\circ}$ C)	98.5 $^{\circ}$ F (37 $^{\circ}$ C)	90 $^{\circ}$ –92 $^{\circ}$ F (32.2 $^{\circ}$ –33.4 $^{\circ}$ C)
Still air	102 $^{\circ}$ –103 $^{\circ}$ F (38.9 $^{\circ}$ –39.4 $^{\circ}$ C)	88 $^{\circ}$ –90 $^{\circ}$ F* (31.1 $^{\circ}$ –33.3 $^{\circ}$ C)	100 $^{\circ}$ –101 $^{\circ}$ F (37.8 $^{\circ}$ –38.3 $^{\circ}$ C)	88 $^{\circ}$ –92 $^{\circ}$ F* (31.1 $^{\circ}$ –33.3 $^{\circ}$ C)

\* Wet bulb temperature is not an accurate measure of relative humidity in still-air incubators.

1. Formaldehyde solution (formalin) is highly irritating. Follow the precautions on the container label. Wear goggles, respirator, long-sleeved shirt, and liquid-proof gloves when handling the fumigant. If the fumigant chamber is within another room, be sure the outside room is well ventilated. If the chemical solution spills on you, wash it off immediately.

and dry bulb temperatures at least twice a day. Table 2 specifies conditions for incubation of pheasant, partridge, and quail eggs.

Always follow the manufacturer's instructions for adjusting the air vents in the incubator, but remember that some ventilation is necessary at all times to ensure proper levels of oxygen and carbon dioxide.

Eggs can be set either large end up or horizontally, but never small end up. They should be turned every 2 to 4 hours during the first two-thirds of incubation or until transfer to the hatcher, but never during the hatching period. If mechanical turning is not available, turn eggs three or more times per day (starting as early and finishing as late as possible).

When eggs are set, record the date, egg source, number set, and expected transfer and hatch dates. Attach a card with this information to the setting trays, so that each set can always be easily identified.

### Examination of Eggs

Game bird eggs should be candled after 7 to 10 days of incubation and again at transfer (3 to 4 days before hatch). A strong candling light is advisable, because most species have pigmented shells that obstruct light transmission. Remove and count all eggs that are clear or contain blood rings. The eggs that are candled out (or a sample of at least 50) should be opened, examined, and classified before they are discarded.

Egg examination is most conveniently performed in a well-lighted area equipped with a sink and garbage disposal. Open eggs by breaking the large end and removing the shell and shell membranes on this end with the thumb and forefinger. Carefully open eggs that have blood rings to avoid loss of any embryo that might be present near the air cell. As the types are identified, they should be recorded.

The early candling will reveal the following types:

#### *Clears*

- True infertiles
- Fertile no development (FND)—fertiles that failed to develop
- Positive development (PD)—showing cellular development but not blood

#### *Blood rings*

- Blastoderm without embryo (BWE)—a blood ring appears but no embryo
- Early dead embryos

Assistance in identifying these types can be obtained by securing a wall chart, *How to Identify Infertile Eggs and Early-Dead Embryos*, Priced Publication 4032, for \$2.50 (California residents please add sales tax) from Agricultural Sciences Publications, 1422 Harbour Way South, Richmond, California 94804.

After the second candling, the eggs removed should also be examined. Most of these will be dead embryos, but you may occasionally find a live embryo, which should be dropped from the sample count, or one of the previously described types that was missed on the first candling. Record the latter on the record from the earlier candling and examination.

### Transfer to Hatcher

Table 3 gives incubation periods of several game birds. Transfer eggs to the hatcher 3 or 4 days before hatch—just before pipping (breaking through the shell) starts. Adjust the dry bulb temperature down  $\frac{1}{2}^{\circ}$  to  $1^{\circ}$  F ( $0.3^{\circ}$  to  $0.5^{\circ}$  C) and increase the wet bulb temperature to  $88^{\circ}$  to  $92^{\circ}$  F ( $31.1^{\circ}$  to  $33.3^{\circ}$  C); this will provide optimum hatching conditions. You may need to vary these wet bulb settings

to get the correct moisture content of the eggs. Fumigation in the hatcher is not recommended unless there is a disease problem.

TABLE 3. INCUBATION PERIODS FOR SEVERAL POPULAR GAME BIRDS

Bird	Days
Chinese Ring-necked Pheasant	23–24
Mongolian Ring-necked Pheasant	24–25
Red-legged Partridge	23–24
Hungarian Partridge	24–25
Bobwhite Quail	23–24
California Quail	23–24
Japanese Quail	17–18
Wild Turkey	28

When the hatch is completed, sort, count, and place the chicks in new chick boxes or plastic boxes that have been cleaned, sanitized, and equipped with new pads. Be sure that you have allowed enough time for the hatch to be completed and the chicks to dry, but don't keep the chicks in the hatcher longer than necessary, because they will become dehydrated. When 1 to 5 percent of the chicks are still wet, it is time to remove the hatch.

Record and break out all unhatched eggs as previously described. Give particular attention to the moisture (dry-down) condition and the embryo position (normal is head under right wing). There are usually some abnormal embryos with missing parts, duplications, or abnormal parts in this group. If there are significant numbers with the same abnormality, be sure to note this.

Keep a record of the results of each hatch, including the information from candling and egg examination as well as the number of chicks obtained. These records are useful in pinpointing problems when hatches are poor. Reasonable goals for most game bird eggs are 96 percent true fertility, 93 percent candled fertility, 87 percent hatch of eggs set, and less than 3 percent cracked and unsettable eggs.

## Sanitation

After removing the chicks, thoroughly clean the hatcher and trays. The hatching trays can then be returned to the hatcher and the entire unit fumigated using the procedure described on page 5.

Sanitation is always 90 percent cleaning. Disinfectants are valuable in maintaining a sanitary hatchery, but they will not compensate for a poor cleaning job. Following is a good washing procedure:

1. Empty refuse.
2. Soak in detergent solution, if necessary, to loosen dirt.
3. Wash with hot water and detergent.
4. Rinse.
5. Disinfect (steps 4 and 5 may be combined if disinfectant is nontoxic).

An equipment washing area should be provided near the hatcher(s). A reasonable arrangement for a small hatchery would be as follows:

- Room A—egg processing and traying area, egg holding room, egg fumigation cabinet, incubators, clean equipment storage area.
- Room B—hatcher(s), chick holding area, equipment washing area, outside door to refuse collection area.

## BROODING

Artificial brooding of domestic poultry and game birds has been so successful that natural brooding has become obsolete. There are basically two types of brooding in common use: cool-room brooding and warm-room brooding. In the former, birds are provided a heat source with an adjacent area held at a lower temperature. This system has several advantages including faster feathering in the chicks and easier temperature regulation. With

warm-room brooding, a heating system maintains the entire house or room at the desired temperature.

### Heat Sources

Many types of heat sources can be used successfully for brooding. These include heat lamps, hot water or steam pipes, or stoves that use natural gas, liquid petroleum (LP) gas, fuel oil, coal, wood, or electricity (fig. 1). Stoves using LP gas or natural gas are the most popular because of their economy and convenience. We recommend the hover-type gas brooder, because it is more economical to operate than the pancake type. With a hover brooder, which has more depth, less heat is lost into the room, and the cooler room temperature stimulates fast feathering in chicks.

With cool room brooding, the temperature of the hover area is usually adjusted to 95° F (35° C) during the first week, and then the temperature is decreased approximately 5° F (2.8° C) per week until the room temperature is reached. Measure these temperatures at bird height near the edge of the brooding stove.

The best guide to temperature adjustment is to watch the chicks' behavior. If the temperature is too low, they will huddle under the stove. If they avoid the heated area completely, the temperature is too high.

With warm room brooding, chicks can be started at a room temperature of approximately 90° F, and, again, this should be decreased as they become older.

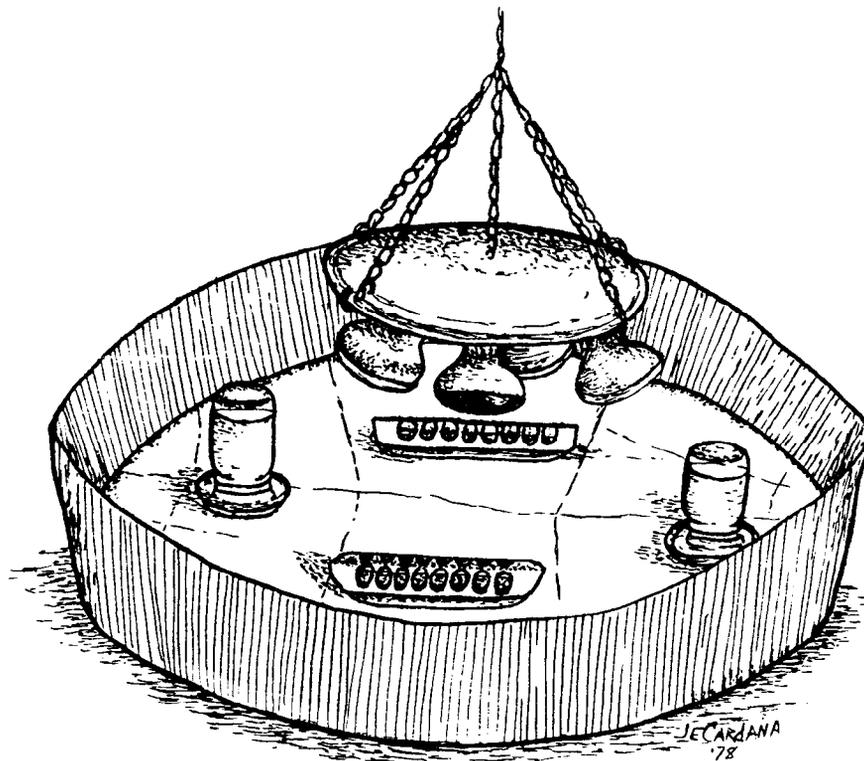


Fig. 1. Electric lamps encircled by 18-inch draft shield. Note position of fountains and feeders.

## Light and Ventilation

It is important that brooding pens be properly lighted during the first week so that young chicks will learn to eat and drink. Use continuous light with an intensity of 2 or more foot-candles (dekalux)<sup>2</sup> during the first week; after that, the light may be reduced to 12 hours per day or natural daylight.

Brooder houses or rooms containing starting batteries need to be well ventilated to remove moisture and ammonia. If you smell ammonia or observe wet litter in the pen, ventilation is marginal or inadequate. Fans and uniform slot air intakes provide good ventilation in houses with high bird density.

## Brooding Methods

Battery brooding has attractive features for some growers. Batteries are particularly suited to small groups of chicks that need to be raised separately (fig. 2). They are easily cleaned, and the chicks are easy to inspect. With larger hatches, battery brooding requires more labor than floor brooding, and chicks must be moved to other pens after 2 or 3 weeks.

For floor brooding, the first step in preparing a pen for new chicks is to thoroughly clean the area, including the walls and ceilings, and clean all of the equipment that will be used in the brooding pen. Then disinfect the brooding area and the equipment using an effective disinfectant. For instructions on disinfection, ask for Leaflet 2627, *Cleaning and Disinfecting Poultry Equipment and Poultry Houses* from Agricultural Sciences Publications, 1422 Harbour Way South, Richmond, California 94804.

After the pen is disinfected and thoroughly dry, place 3 or 4 inches of clean litter in the pen. Shavings, peanut hulls, rice hulls, sugar

cane fiber, ground corn cobs, or chopped straw are excellent litter materials. Sawdust and sand, although sometimes used, are less desirable. Litter should be free of molds and toxic materials.

Now place the heating unit in position and cover the floor in this area with rough paper so that chicks can walk on it easily. A brooder ring 15 to 20 inches (37.5 to 50 cm) high, made of corrugated cardboard or half-inch (1.25 cm) mesh hardware cloth, should be placed around the heat stove to form a circle approximately 18 inches (45 cm) from the edge of the stove. (For quail, finer mesh hardware cloth would be needed.) The solid corrugated cardboard ring is preferred, because it protects chicks from drafts.

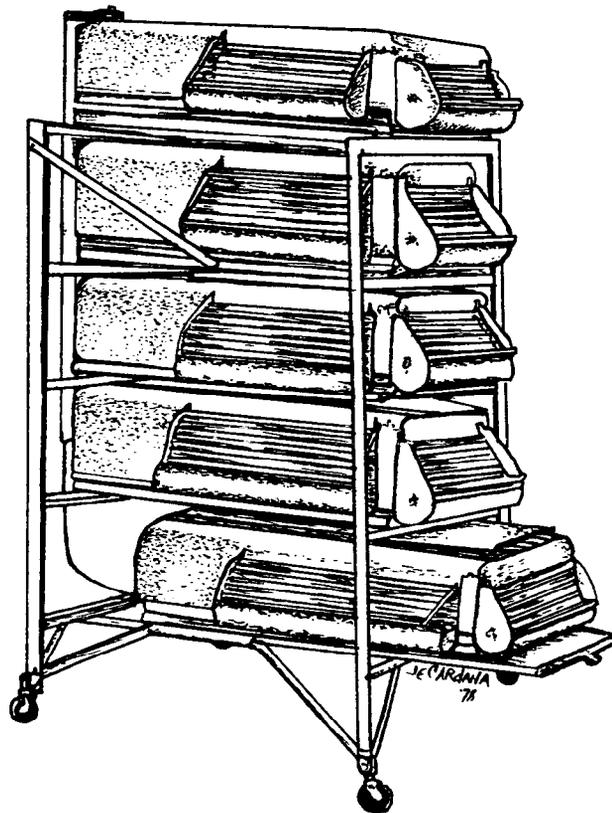


Fig. 2. Five-deck battery brooder with outside feed and water services. Small pint waterers should be used for the first few days of brooding.

2. A foot-candle is a measure of light intensity equal to the light 1 foot away from a standard candle; approximately equal to one dekalux.

Start the stove and adjust it to the correct temperature at least 1 day before chicks are to be placed under the heating unit. Place feed troughs and water fountains in the brooder ring, and fill them before chicks arrive. Allow at least 20 inches (50 cm) of eating space per 100 chicks. Some feed should also be placed in egg flats or box covers during the first 3 to 5 days to encourage chicks to eat.

Be sure to provide plenty of waterers—at least two 1-gallon (3.78-liter) fountains per 100 chicks—so that chicks will be able to find water quickly. Use watering devices of the right size to prevent chicks from falling into the water reservoir. For quail, it may be necessary to cover the water trough with hardware cloth or to place pebbles in the trough so that chicks can escape when they fall into the water.

Most healthy chicks that die during the first week do so because they fail to learn to drink. It is a good practice to dip the beak of each chick into the water as you remove it from the box and place it in the pen.

Always check young chicks after dark to be certain that none are huddled away from the heat. A light under the stove can help keep chicks under the stove at night.

## GROWING GAME BIRDS

The basic principles and techniques for growing birds apply equally to most species of game birds. The successful breeder innovates to fit the needs of the specific operation.

### Cages and Pens

Chukars and quail can be grown successfully in all-wire cages kept inside a building. About 1 square foot (0.023 square meter) per bird is adequate for chukars and ½ square foot (0.046 square meter) for quail.

Outside pens for growing or holding breeder stock should be constructed to permit good drainage of water from sprinklers or storms. Pens for growing birds may be of several different sizes, but their actual construction is much the same. Pens used in large commercial production are usually arranged side by side with the ends opening into a central service aisle, which is also covered to prevent escape. The support posts are 4- by 4-inch (10- by 10-cm) redwood or treated wood placed on 8- or 10-foot (2.4- or 3.0-meter) centers. Occasionally 2- by 4-inch (5- by 10-cm) support posts are used alternately with the 4- by 4-inch (10- by 10-cm) posts.

To provide protection from the wind, the lower walls of pens should be boarded to a height of 20 or 24 inches (50 or 60 cm). The outside perimeter is made predator- and rodent-proof by burying a piece of wire netting 12 inches (30 cm) wide to a depth of 8 inches (20 cm) with the remaining 4 inches (10 cm) turning outward. Pens are commonly enclosed on the top and outsides with 2-inch (5-cm) wire mesh. Two-inch (5.0-cm) wire mesh can be used for partitions between pens.

Commercial game bird growers use pens of various sizes. The number of birds put into the pen depends on pen size and on ground cover (vegetation) available. Twice as many birds can be grown in pens with adequate ground cover as in pens without any ground cover (table 4).

TABLE 4. SUGGESTED PEN SIZE AND BIRD DENSITY

Species	Pen size		Bird density <i>sq ft/bird</i>
	Width <i>ft</i>	Length <i>ft</i>	
Pheasant	50 or 100 (15 or 30 m)	150 (45 m)	15* (1.35 sq m)
Chukar	50 or 100 (15 or 30 m)	150 (45 m)	10 (0.93 sq m)
Quail	50 (15 m)	150 (45 m)	4 (0.37 sq m)

\* Double the space required for each species if growing pens do not have adequate vegetative cover.

The space requirements for growing ornamental pheasants are greater than for other pheasants because of their timid behavior and elaborate feathering. More protection is provided for exotic pheasants, such as the Firebacks, Argus, Peacock Pheasants, and Long-tailed Pheasants. One arrangement used for exotics is a shed-type house with inside partitions that are continuous with outside runs of 10 by 20 feet (3 by 5 meters).

### Cover Crop

A good cover crop helps in obtaining optimum growth and good feathering in game birds; a ground cover or herbaceous growth provides shade and protection. For many ornamental pheasants and some grouse, a selection of different conifer species placed throughout the pens is desirable.

For large or small operations, a number of wild annual grasses serve as excellent ground cover. Some annual weeds, such as pigweed,

lambsquarter, millet, mustard, or vetch, grow as volunteer crops and, if properly watered and maintained, can provide excellent cover (fig. 3). Perennials, such as alfalfa, sweet clover, or fescue, require more attention than do most annuals and support fewer birds.

### Waterers and Feeders

Waterers must provide a continuous supply of fresh, cool drinking water. Range and bowl founts are popular types used on commercial game farms (fig. 4). It is desirable to have a screened platform or dry well filled with rock beneath the fount to prevent puddling (fig. 3).

Feeders of many designs are used successfully on game farms; the size and type used depend on the farming operation. A good management practice is to keep all feeds covered. Many range feeders are designed with a sloping cover that keeps the feed or grain dry during bad weather (fig. 5). Open trough feeders can be used for grit and shell.

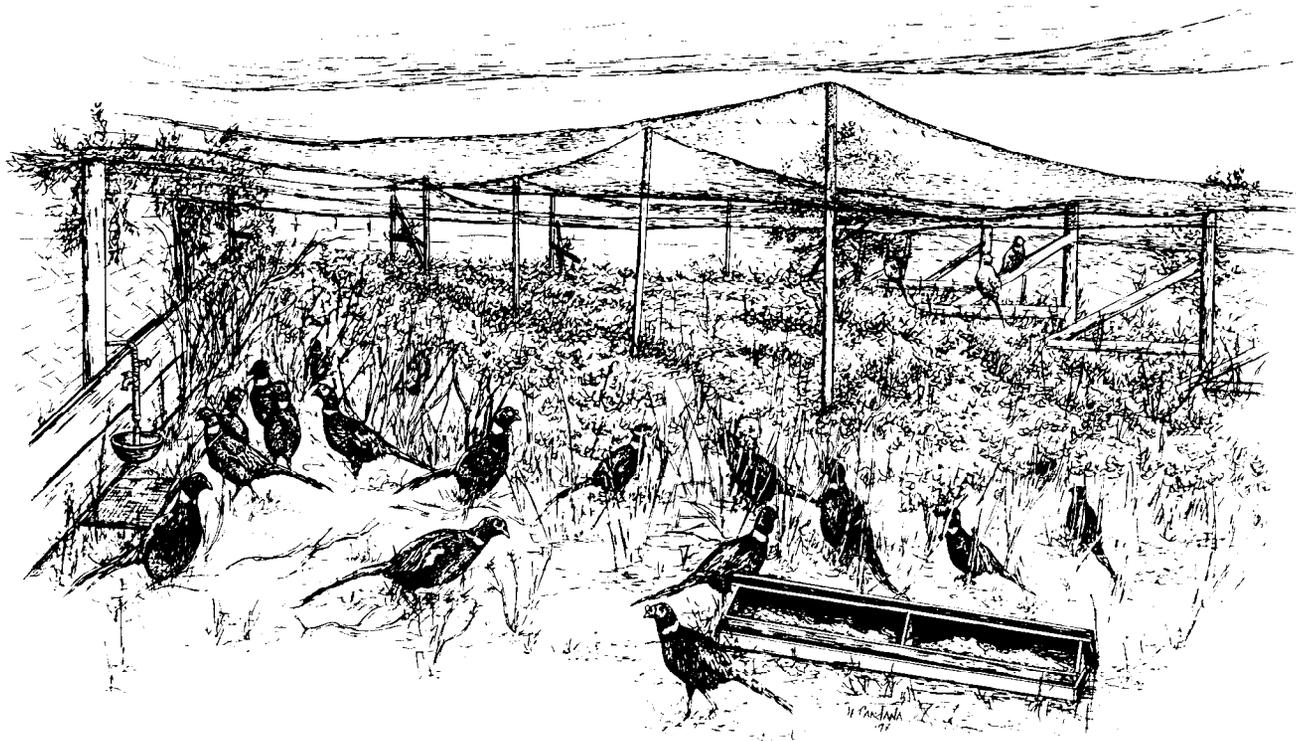


Fig. 3. Growing pen containing a good natural cover crop. Note waterer with screened platform.

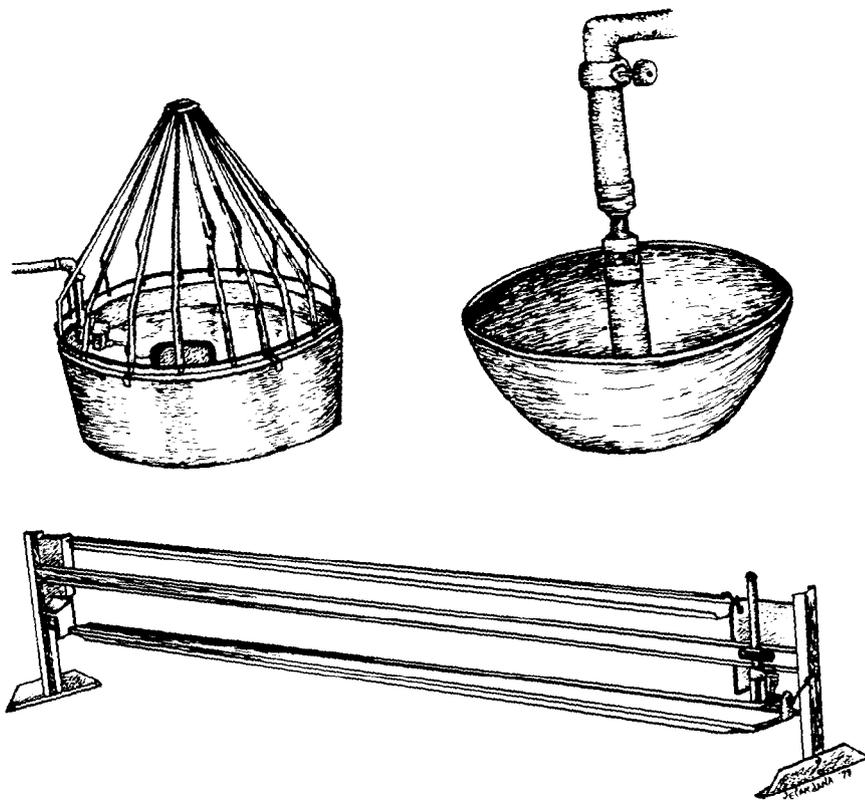


Fig. 4. Different types of automatic waterers used in grower pens.

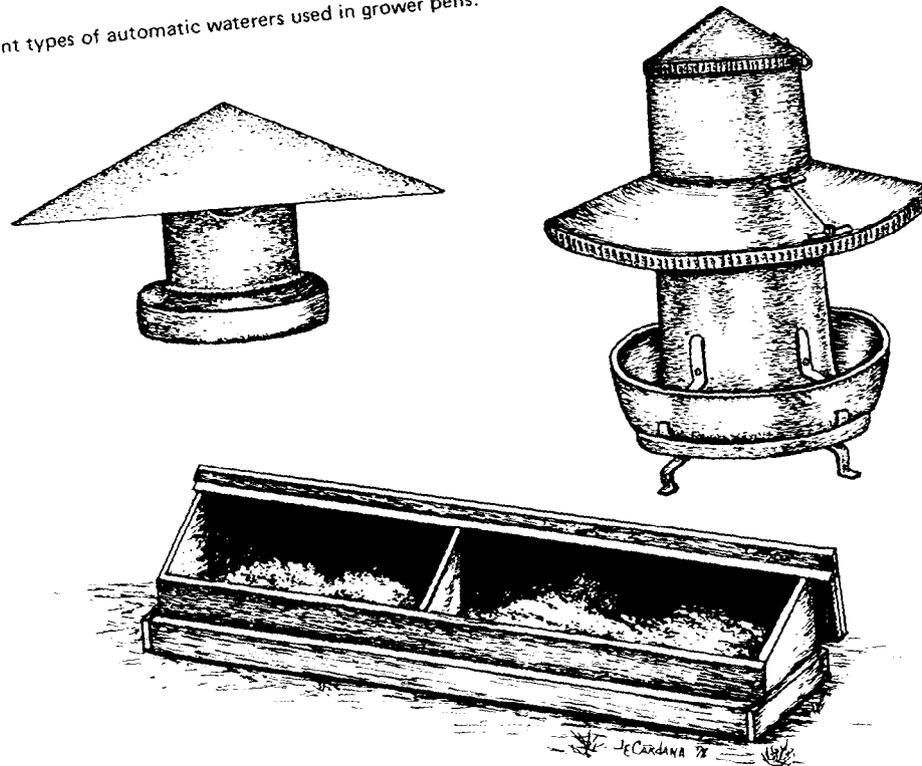


Fig. 5. Different types of feeders used in grower or breeder pens. Bottom feeder has hinged top.

## MANAGEMENT OF BREEDER STOCK

To establish a good foundation stock, it is important that the original eggs or stock come from a pullorum-free source. The potential breeder stock should be free of abnormalities (blindness, crooked toes, or malformed beak, neck, or leg bones). The birds should have good body conformation and the size and color pattern characteristic of the species.

### Cages and Pens

Pheasants perform satisfactorily when housed in wire colony cages. A mating ratio of ten hens to one cock is recommended in a colony pen measuring 2 feet (0.6 m) wide by 6 feet (1.8 m) long by 1½ feet (0.45 m) high.

With modifications, a pen for growing birds (see pages 10 to 11) can be used for breeders. A good rule of thumb is to maintain about 25 to 30 square feet (2.3 to 2.8 sq m) per bird. With additional effort, the pen can be seeded with a perennial, such as alfalfa, to provide cover for the breeding stock.

### Equipment

The same types of feeders and waterers used in the growing pens can be used for the breeders. Adequate covers on the feeders are highly recommended, especially during the wet spring months.

Nest boxes placed in protected areas within the pen greatly reduce the incidence of dirty eggs and prevent bacterial contamination. A wooden nest box 2 feet (0.6 m) wide by 6 feet (1.8 m) long by 1 foot (0.3 m) high, either subdivided into three compartments or constructed as one single walk-through unit, will serve about 24 hens. Place artificial eggs in the nests well in advance of the laying season to encourage the hens to use the nest rather than to lay eggs randomly on the ground. Low shelters placed about the pen

serve as shades and escape sites for hens chased by over-aggressive males.

### Care of Eggs

Proper handling and care of eggs are extremely important in maintaining hatchability. Store hatching eggs in a cool room maintained at about 50° to 60° F (10° to 15.6° C) and 70 percent relative humidity (see table 1). Following are recommendations for proper care of potential hatching eggs:

- Keep nest areas dry.
- Collect eggs a minimum of three times daily.
- When gathering eggs, avoid over-filling the basket.
- Do not spray insecticides or larvicides around breeder pens or the egg holding room.
- Eggs with slightly soiled shells can be cleaned with a light abrasive (sandpaper) material and fumigated soon after gathering (see page 5). Do not use heavily soiled eggs for hatching. Lightly soiled eggs can also be washed. The proper washing technique is described in Leaflet 2629, *Hatchery and Hatching Egg Sanitation*. This publication can be obtained by writing to Agricultural Sciences Publications, 1422 Harbour Way South, Richmond, California 94804.
- Eggs to be set within 14 days should be stored large end up in open egg flats. Eggs to be held longer than 14 days should be placed in flats, sealed in new plastic bags after a 24-hour cool down, and turned at least twice per day.

### Lighting

Game birds can be induced to lay at any time of the year provided they have been exposed to day-lengths of less than 12 hours for a minimum of 6 weeks before they are given stimulatory light. A series of incandescent

lights placed above the breeder pens or pole-mounted outdoor lamps (for example, quartz iodide) can furnish the light necessary to stimulate early egg production. A time clock can be used to control the duration of light.

Some growers use a step-up lighting program; that is, the light-day is increased to 14 hours per day and, once the birds reach peak production, the light increment is increased by 15 minutes per week until a maximum of 17 hours of light per day is attained. Never decrease the light intensity or the number of light-hours per day when egg production is desired.

Hens can be recycled to lay by first restricting the light to 8 hours per day following the regular season. Eight weeks later, expose the birds to a stimulatory light regime of 14 or more hours per day. Hens begin to lay about 18 to 21 days after given stimulatory light.

Always light males 2 weeks before females to ensure good, early fertility, because males respond more slowly to a stimulatory light regime.

### FEEDING GAME BIRDS

It is not essential to buy special game bird diets. Game birds thrive on poultry diets that are properly balanced in energy, amino acids, vitamins, and minerals, similar to the diets given in table 5. Game bird or poultry diets are usually available in 50- or 100-pound (22.7- or 55.4-kg) sacks.

Game birds can be fed diets in the form of mash, crumbles, or pellets. Pellets and crumbles are made from mash and are more expensive. Pellets are usually fed to adult birds. There is little advantage in feeding pelleted diets to game birds, but they are less dusty to handle.

TABLE 5. COMPOSITION OF GAME BIRD DIETS

Item	Starter	Grower	Breeder
	%	%	%
Alfalfa meal	7.5	5.0	5.0
Corn, ground	28.0	52.0	56.7
Meat and bone meal	8.0	0.0	0.0
Sorghum, ground	10.0	0.0	0.0
Soybean meal (45% protein)	28.0	27.5	14.7
Wheat, ground	15.0	0.0	0.0
Wheat middlings	2.0	0.0	0.0
Wheat bran	0.0	12.0	16.8
Limestone, ground	0.0	1.0	4.1
CaHPO <sub>4</sub> · 2H <sub>2</sub> O	0.0	1.5	1.5
Salt, iodized	0.7	0.4	0.5
DL-methionine	0.3	0.1	0.2
Premix*	0.5	0.5	0.5
<u>Calculated analysis</u>			
Protein, %	23.4	19.8	15.1
Metabolizable energy (kcal/kg) (or kcal/2.2 lb)	2,720	2,660	2,570
Ca, %	1.0	0.94	2.15
Total P, %	0.76	0.76	0.74
Available P, %	0.52	0.45	0.44

\* Premix should contain: in mg per kg (or per 2.2 lb) diet—MnSO<sub>4</sub> · H<sub>2</sub>O, 40; ZnO, 60; vitamin B<sub>12</sub>, 0.005; menadione sodium bisulfite, 2; riboflavin, 6; niacin, 40; calcium pantothenate, 20; folacin, 0.5; antioxidant, 100; antibiotic, 10; in IU—vitamin A, 5000; vitamin D<sub>3</sub>, 1500; vitamin E, 20. An equivalent commercial premix can be used, but follow the directions of the supplier.

TABLE 6. GROWTH RATE AND FEED CONSUMPTION OF SOME GAME BIRDS (MIXED SEXES)\*

Age <i>wk</i>	Ring-necked pheasant		Chukar partridge		Japanese quail	
	Cumulative weight	Cumulative feed consumed	Cumulative weight	Cumulative feed consumed	Cumulative weight	Cumulative feed consumed
	<i>grams</i>	<i>grams</i>	<i>grams</i>	<i>grams</i>	<i>grams</i>	<i>grams</i>
1	41	59	32	32	23	32
2	82	154	54	90	45	65
3	136	286	100	220	73	114
4	195	450	159	368	95	180
5	264	614	210	527	109	255
6	350	865	250	730	118	335
7	436	1,160	320	970	127	445
8	523	1,455	370	1,200	132	570
9	591	1,750	405	1,430	136	715
10	690	2,090	435	1,660	136	860
11	775	2,520	480	1,910	136	1,020
12	840	2,955	515	2,200	141	1,195
13	920	3,385	527	2,490	141	1,365
14	1,000	3,860	545	2,720	145	1,480
15	1,065	4,320	550	2,945	145	1,605
16	1,100	4,820	568	3,135	145	1,735
17	1,135	5,320	577	3,325	150	1,865
18	1,140	5,820	590	3,520	150	2,020

\* 454 grams = 1 pound.

Never feed laying rations to day-old game birds, because such diets contain high levels of calcium, which can be harmful to the growing chicks. Also, do not feed grain to day-old chicks. After the birds are about 4 weeks old, a part of the diet can be in the form of grain if grit is made available.

The simplest way to feed game birds is to buy a game bird or turkey starter ration containing about 26 to 28 percent protein and feed it for the first 6 weeks. From 7 to 14 weeks of age, feed a game bird or turkey grower diet or a chicken starter diet containing about 20 percent protein. From the age of 15 weeks until market, feed a game bird, chicken, or turkey growing diet containing about 15 percent dietary protein. When fed such diets, most game birds grow at the rates indicated in table 6.

A turkey starter mash with 28 percent protein can be used as a diet for small flocks of game birds as shown in table 7. Breeding birds need a good breeder ration containing about 15 to 16 percent protein. To mix your own game bird diets, use the formulas given in table 5.

TABLE 7. DIETS FOR SMALL FLOCKS OF GAME BIRDS\*

Age	Ratio of turkey starter mash to grain
0 – 4 wk	Mash only
5 – 8 wk	4 to 1 (80 lb or kg mash to 20 lb or kg grain)
9 – 12 wk	3 to 2 (60 lb or kg mash to 40 lb or kg grain)
13 – 16 wk	2 to 3 (40 lb or kg mash to 60 lb or kg grain)
17 wk to market	1 to 3 (25 lb or kg mash to 75 lb or kg grain)

\* Feed pasture or green chop free choice, if available, from 4 weeks to market. Feed grit free choice to all birds. For breeders, feed 1 part mash to 1 part grain plus free-choice oyster shell, grit, and green chop (if available).

Place grit and mash in separate containers. The size of grit depends upon the size of the bird. The grit should be insoluble in dilute hydrochloric acid. Fine gravel is an acceptable substitute for purchased grit.

Do not store feed for more than 6 weeks at any time, especially in the summer. Protect the feed from rodents and insects. We suggest

storing small amounts in metal garbage cans with tight lids. Growers of large flocks will need bulk feed tanks. Keep feeders clean and dry to prevent any mold growth.

## DISEASE CONTROL

Most diseases affecting game birds are caused by microorganisms or viruses spread from bird to bird directly or indirectly. Some infections are airborne; others are transmitted by insects, rodents, free-flying birds, and other animals. Diseases can also be spread by mechanical means, such as tools, debeakers, chick boxes, and motor vehicles. Droppings or litter from a previous flock of birds can be a reservoir of disease-producing organisms. The greatest threat to any game bird operation is disease. For this reason, you should enforce the following good management practices at all times:

**Avoid introducing live birds.** Live birds are a principal means of bringing disease organisms to susceptible birds. Even though a bird may appear perfectly healthy, it may have had a disease, recovered, and then become a carrier of the disease. If new stock must be introduced, the only relatively safe way is by means of hatching eggs or day-old baby chicks.

**Buy chicks from known sources.** Purchase day-old chicks from a breeder with a reputation for producing disease-free stock.

**Separate age groups.** Ideally, each species of game bird should be raised separately to eliminate disease and parasite problems. When raising two or more age groups on the same premises is unavoidable, separate the groups as far as possible. During the work day, care for the youngest birds first. Chicks are more susceptible to diseases than older birds.

**Dispose of dead birds properly by:**

- **Incinerator.** Cremation is the most satisfactory form of dead bird disposal; the dead birds should be cremated daily. Because some incinerators have caused problems with odors and smoke, check health department regulations. Some county health departments require after-burners on incinerators. A satisfactory commercial incinerator can be purchased from most poultry supply companies. Homemade incinerators are adequate if properly designed. The fuel is usually gas or oil.
- **Disposal pits.** Pits should be at least 6 feet (1.8 m) deep and have a timber or reinforced concrete top. They should be boxed or cribbed to prevent cave-in, and be covered with a minimum of 12 inches (0.3 m) of packed earth. The opening should be at least 8 inches (20 cm) in diameter and have a tight-fitting lid.
- It is common practice to have commercial drillers drill disposal pit holes with rotary equipment. These pits are 30 inches (75 cm) in diameter and 25 to 40 feet (7.5 to 10 m) deep. They should not be within 150 feet (45 m) of a domestic well.
- **Direct burial.** Some game bird producers bury dead birds in a trench 2 feet (0.6 m) wide and 3 or 4 feet (0.9 to 1.2 m) deep. Each day, the dead birds are put into the trench and covered with at least 12 inches (30 cm) of firmly packed soil.
- **Rendering truck.** Sometimes arrangements can be made with a nearby rendering plant to pick up dead birds.

**Treatment of disease.** Should the birds appear unhealthy and mortality occur, isolate the sick birds immediately. Send a representative sample of sick live birds and some dead birds to the diagnostic laboratory closest to you. Most laboratories charge a small fee for the examination.

Treat the sick birds as prescribed by the veterinarian. In acute outbreaks of disease, water medication is preferred over medication in the feed, because sick birds will often drink when they will not eat.

**Vaccination.** There is no general rule for vaccination of game birds for specific diseases. Generally, the need for vaccination is determined by the kinds of diseases prevalent in your area. The purpose of a vaccine is to introduce a mild form of a disease into the bird and allow the body to produce antibodies against the organisms, thus building up an immunity. Bacterins (bacterial vaccines) do not produce infections, but will stimulate antibody production.

**Other sanitation recommendations.** Preventive disease control is a crucial part of a successful game bird program. Many problems can be avoided if certain management practices are enforced:

- Brooder houses and growing pens should be off limits to all visitors.
- Train employees to recognize the danger of spreading diseases from farm to farm.
- Thoroughly clean and disinfect all equipment and housing between groups of birds.
- Control predators and rodents, because they may be carriers of disease and external parasites.
- Test breeder stock annually for pullorum as a safeguard against future chick mortality.

Recognition of common groups of diseases and how they can be prevented or controlled is an important part of a good disease control program.

### Parasitic Diseases

**Coccidiosis.** Coccidiosis is a destructive protozoan disease that can occur in all species of game birds. It is predominantly a disease of

young chicks and is characterized by symptoms of weakness, ruffled feathers, and unthriftiness. Droppings may be bloody. Affected birds are listless and show little interest in feed or water. As the disease advances, moderate to high mortality can be expected. Maintain dry litter and use a good coccidiostat in the feed or water to permit development of immunity in young growing chicks.

**Blackhead.** Blackhead is a destructive protozoan disease of pheasants, chukars, and grouse. It may spread directly through contact with contaminated feces or indirectly through the infected egg of the cecal worm, *Heterakis*. Infected birds appear droopy, stop feeding, and have a yellowish-brown stool that is watery and foamy. Acutely involved chukars may die very quickly without developing the “blackhead” syndrome. Several effective drugs are available to prevent or control blackhead.

**Worms.** Worms are often found in game birds at necropsy. Earthworms, slugs, snails, beetles, and other insects are involved in the spread of many parasitic diseases. The best protection against worms is to avoid wet spots around waterers and feeders and to provide well-drained, sloping pens. Phenathiazine and piperazine effectively control some worms.

### Acute Infectious Diseases

**Erysepelas** is a bacterial disease that occurs most often in adult pheasants during the fall. Many deaths may occur before any symptoms are seen. Most affected birds are visibly sick for only a short period before death. General symptoms include weakness, listlessness, loss of appetite, and sometimes a yellowish or greenish diarrhea. Avoid the use of areas previously occupied by swine, sheep, or turkeys.

**Fowl cholera** generally strikes during the laying season or in mature birds late in winter,

and causes very high death loss. It can be introduced onto the farm by wild birds, rodents, and other animals. Treatment consists of prompt cleanup of dead birds and use of antibiotics.

### **Viral Diseases**

**Newcastle** is a very contagious viral disease, primarily of avian species, including most game birds. Among game birds, Newcastle is transmitted via fecal contamination, eggs, and offal of infected birds. In infected birds, the disease may be manifested by coughing, hoarseness followed by degrees of leg and wing paralysis, tremors, and twisting of the neck. There is no known effective treatment for Newcastle.

**Marble spleen disease** is a viral disease commonly found in pen-raised pheasants and is characterized by deaths with or without noticeable signs of illness. The most consistent internal symptoms are severe edema (fluid in tissues), enlarged grayish-tan mottled spleens, and inflammation of the lungs. There is no known treatment for this disease.

**Quail bronchitis** is a severe respiratory disease of quail caused by a virus-like agent. The disease affects young quail and is characterized by rapidly spreading respiratory signs (wheezing, coughing, and sneezing) and mortality ranging from 10 to 100 percent over a period of several weeks.

**Fowl pox** is a viral infection of most game birds characterized by many lesions (sores) on the skin and mucous membranes of the mouth and upper respiratory tract. Captive pheasants are probably similar to chickens with regard to severity and course of pox infections.

When exposure to these viruses is likely, for example, in areas of high chicken populations, vaccination is recommended. It is advisable to consult a veterinarian or poultry farm advisor before planning a vaccination program.

## **CONTROL OF CANNIBALISM**

Cannibalism is found frequently in most chicken-like species of birds kept in captivity. This vicious habit may start as a mild form of feather or toe picking and develop into a full-scale attack on the flesh of other birds. As a consequence, the game bird industry suffers major economic losses each year. Birds of all breeds and ages are subject to outbreaks of cannibalism. The pheasant is more prone to cannibalize than are other species of game birds. Some factors contributing to cannibalism include:

**Overcrowding.** High-density housing brings the birds in close contact with one another. Picking may start as a result of boredom, idleness, and lack of adequate feeder space.

**Temperature.** Too high a brooding temperature may cause birds to become irate and pick one another.

**Light.** Bright brooder lights increase activity and picking. Less picking occurs when chicks are brooded under natural daylight or artificial light of low intensity (0.5 foot-candle or less at the feed troughs).

**Age.** Cannibalism occurs in all age groups. Toe, beak, and feather picking are more common among baby chicks; vent, wing, and head picking are forms usually found in older birds.

**Sanitation.** Poor brooder-house ventilation and sanitation may induce certain irritations of the eyes and nostrils, which become prime targets for picking. Keep litter dry to prevent fecal buildup on the toes of young birds; such buildup can result in loss of toes.

**Equipment.** Poorly designed feeders and waterers with sharp edges can cause injuries that serve as picking points.

**External parasites.** Lice or mite infestations can cause itching, irritation, and picking of feathers.

**Territorial aggression.** Most males become very aggressive during courtship and mating. Conditions of overcrowding in range or small mating pens intensify picking.

**Nutrition.** The incidence of cannibalism is usually higher in flocks fed rations high in energy and low in fiber. Adding fiber in the form of oats may help reduce picking.

Cannibalism can occur under the most favorable management conditions, so daily observation of the birds' behavior is essential to detect a problem. Following are management practices that will help minimize problems with cannibalism:

- Provide adequate shelter and ground cover.
- Have adequate floor or pen space for the birds.
- Provide adequate feeder space and waterers.
- Eliminate obstacles from floor or pen that may cause injury.
- Remove dead, sick, or weak birds from the flock immediately.
- Do not introduce a few new birds into an established population.

- Avoid frightening the birds.
- Do not make sudden changes in texture of feed.
- Avoid sudden changes in temperature when moving young birds from brooder house to range.
- Use proper mechanical devices or methods for control of cannibalism:
  - Lighting: Use dim red or white light in brooder house.
  - Specs: Reduce picking and egg eating (fig. 6).
  - Hoods: Several types of hoods can be used during the growing, holding, and breeding period (fig. 6).
  - Bits: Reduce picking by preventing closure of beak.
  - Debeaking: Proper removal of no more than one-third of the upper bill can greatly reduce injury due to picking (fig. 6). Commercial hot-blade debeakers used for chickens work equally well for game birds. Heavy nail clippers can be used to cut and shape the bill.

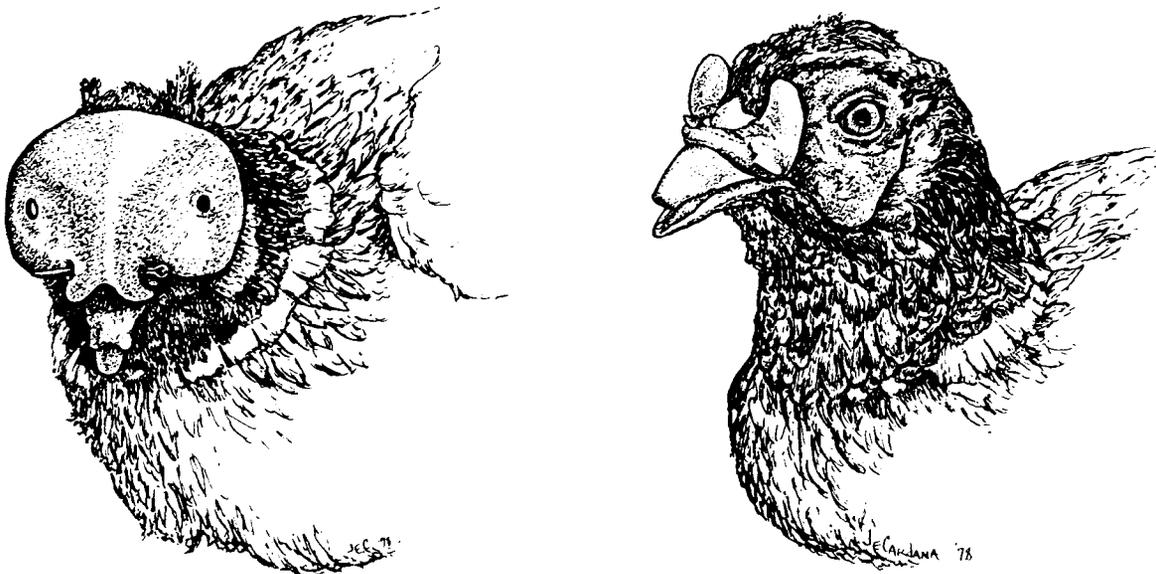


Fig. 6. Adult male pheasants fitted with hood and with specs.

## RODENT AND PREDATOR CONTROL

Norway rats and house mice are universal pests. They are best controlled by exclusion rather than removal, but they seem to be able to invade even the best and tightest of brooder houses and feed storage rooms in time.

Control of rats and mice by poison baits can be difficult because of the competition offered by an abundance of attractive feeds. In such cases, traps must be used, and this can be slow, never-ending work. Because of their great differences in living and eating habits, rats and mice are controlled by different techniques and even different poisons. A common error is to consider rats and mice as one problem and try to solve it with one control effort. This usually fails.

There are many poisons that, if properly used, can control rat and mice populations. Contact your local agricultural commissioner, Cooperative Extension farm advisor, the state Department of Fish and Game, or the state Department of Food and Agriculture to find out which poisons and poisoning techniques are recommended.

Trapping rats or mice is more an art of *where* than *how*. There are many good baits; almost any food that can be placed on the trigger is effective. Runway setting without bait is sometimes more effective. For both rat and mouse traps, an enlarged bait pan made from cardboard or light screen wire greatly improves results. It is important to set traps across the paths used by rats and mice—next to walls and between obstacles. Boxes or sacks may be used to form obstacles to force the rodent to pass over the trigger. Two or more traps set close together work well where there are many rats and mice or where there are trap-shy individuals. Use plenty of traps if you are going to trap at all. If travel is overhead, rat or mouse traps can be fastened to

pipes, walls, or rafters. It is not necessary to clean or boil the traps or handle them with gloves; rats and mice are accustomed to human odors.

In dealing with predators, exclusion is perhaps even more important than in protection against rodents, because even one visit by a fox, mink, raccoon, bobcat, or skunk can be very costly in birds killed. Enclosed flight pens, if properly constructed, should do the job (see page 10). However, the mesh ordinarily will not exclude weasels or snakes and certainly not rats and mice.

Damage to birds can result from fright if a predator outside the wire panics them, even if no entrance is made for direct killing. Therefore, some reduction of predators in the surrounding area may be necessary.

Skunks seem to be everywhere and are an important nuisance. In attacking bird flocks, skunks usually kill only one victim, and the predator can usually be identified by its clumsy mauling of the bird.

Opossums also maul their victims and also do a messy job of smashing eggs in pens if they get at them.

Weasels are very neat killers, usually biting the bird through the skull, the back of the neck, or under the wing. They don't stop with one, though; they may kill many birds in one night and place them in a neat pile.

Rats, too, are ruthless killers and, like the weasel, often pile their victims in a corner. They usually kill by slitting the bird's throat and are very slick at not disturbing the entire flock. Rats usually eat more from the carcass than do weasels, often pulling the bird partly into their burrows. Young birds and eggs will disappear completely.

Foxes do not usually kill a great number of birds at one time, and they carry off their victims.

Raccoons eat the heads off as many birds as possible, and they are persistent. Raccoons are clever and very strong, excellent hunters.

Feral (wild) dogs and cats are a menace to any ground-dwelling wild birds. The cats are more likely to be a problem if there is sufficient heavy cover in which they can hide.

For all these predators, if control is deemed necessary, the most selective method is shooting. Trapping with steel traps is effective if it can be done without endangering bird dogs or other nontarget animals, and if the operator has the right traps and knows how to use them. In many cases, a live trap is easier for an inexperienced trapper to use, and it is safer. Animals accidentally caught can be released unharmed.

## PROCESSING GAME BIRDS

The procedure for processing fowl is described in U.S. Department of Agriculture Farmers Bulletin No. 2262, *Small Poultry Flocks* (1977), and in more detail in *Poultry Products Technology*, second edition, 1976 (Avi Publishing Company, Westport, Connecticut). The procedures used to process fowl can be modified and used for most game birds. The size of equipment and degree of mechanization will depend upon the number of birds to be processed. Following is a procedure for processing game birds.

### Slaughter

Hang the bird by its feet on the killing rack, sever the jugular vein behind the lower jaw, and allow the blood to drain. This method removes from 34 to 50 percent of the total blood of the body.

### Picking

To remove the feathers, immerse the bird for 60 to 90 seconds in water heated to sub-

scalding—about 140° F (60° C). Test ease of feather removal by pulling a few tail or wing feathers. Remove feathers by hand or machine immediately after subscalding. A tub type of picking machine equipped with rubber fingers on the side and bottom of the drum is preferred over the reel type of picker that requires the operator to hold each bird when removing the feathers. After the feathers are removed, scrub the carcass thoroughly to remove soiled areas and also to reduce the number of surface microorganisms.

### Evisceration

Remove feet at the hock joint. Remove the oil gland on the tail: start 1 inch (2.5 cm) forward of the gland, then cut to the end of the tail. Cut the head off. Split the neck skin, starting from the shoulders and going to the end of the neck, and pull skin from the neck. Remove the trachea (windpipe) and esophagus (gullet) with the crop, and cut off the neck. Cut around the vent and gently pull until a few inches of the intestines are out. About half-way between the tip of the breast and vent make a crosswise cut about 3 inches (7.6 cm) long. Pull the vent and intestine through the cut and remove the viscera. Remove the heart, liver, and gizzard (giblets) and place them in a clean container for further processing. Remove all other organs, especially the lungs, making certain the body cavity is clean.

### Packaging

Wash the carcass and giblets thoroughly. Chill in ice water kept at 40° F (4° C) for several hours. Remove from the water, and drain. Place giblets in a small plastic bag, or wrap them in wax paper and place them inside the carcass. Tuck the legs of the carcass under the strip of skin left by the crosswise cut below the breast. Place the carcass in a plastic bag, draw out as much air as possible, and tie the bag with a wire tie. Air can be forced out of

the plastic bag with a vacuum pump or by submerging the bag in water until it covers the carcass without entering the bag.

The dressed birds can be placed in containers and covered with crushed ice or dry-packed with CO<sub>2</sub> snow (dry ice) for shipment to market. (*Caution: Do not handle dry ice with your bare hands; it freezes the skin quickly.*)

### Meat Quality

The quality of game bird meat may mean different things to different people. The present-day consumer judges quality on the basis of tenderness, moisture, and flavor. The old method of developing a "gamey" taste in game birds was to allow the bird to hang with feathers and viscera intact for several days. Federal and state regulations no longer permit birds to be "aged" in this manner, if the operation comes under the conditions where inspection is required.

Two factors affecting the quality of game bird meat are scalding and aging temperatures. The freshly cleaned carcass should be placed for several hours in slush ice (for chilling) and refrigerated. Aging time for adequate tenderization of the meat should be about 18 to

24 hours. Thereafter, the meat can be cooked or frozen.

### Spoilage

The processor must produce a wholesome product through proper handling and storage. Spoilage of game bird meat is due mainly to the development of microorganisms. Only a few species of psychrophilic (cold-loving) organisms cause spoilage in the meat. Freshly killed poultry contains approximately one to ten thousand microorganisms per square centimeter (1 square inch = 6.45 square cm). Spoilage in poultry usually occurs when the number of bacteria reaches one to ten million per square centimeter. The first sign of spoilage is off-odor. Certain organisms also cause flavor changes as their numbers exceed the safe level. To help sanitize processing plants, some processors use chlorinated water to clean equipment and chill the birds.

### Laws

Laws regulating the processing and sale of game bird meats differ among states. Therefore, you should check with your state Department of Agriculture (food inspection) and local agencies for requirements on the processing of game bird meats.

## COOPERATIVE EXTENSION

## UNIVERSITY OF CALIFORNIA

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