CANNIBALISM CONTROL OF GROWING RING-NECKED PHEASANTS

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ABSTRACT

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By

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A series of experiments were conducted to determine the optimum lighting system and beak treatment necessary to obtain fully feathered ring-necked pheasants at eight weeks of age when housed at less than .093 m^2. per bird. Four different lighting systems were considered: red, blue, subdued white and darkness (.107 lux). Each lighting scheme contained a control, specked and debeaked group of birds.

The results of these experiments indicate that some form of light and/or beak treatment is necessary in order to have fully feathered birds at eight weeks under high density housing conditions. In nearly all cases, the body plumage of the birds exposed to the darker lighting system (red, blue and near total darkness) was superior to that of the white light system. In regards to beak treatment, more fully feathered birds were obtained by the use of specks (plastic blinders positioned on the upper beak) than on any other treatment.

The most important finding of this research was the adaptability of the interactions between the various lighting systems and beak treatments (in respect to feather score and a greater body weight gain) to a wide variety of management practices.

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INTRODUCTION

The Ring-necked Pheasant, *Phasianus colchicus*, a native of the Far East, was first introduced into the United States during the 1880's. At this time, farming was creating conditions which met many of the habitat requirements of this particular game bird. In filling this niche, the pheasant helped continue the sport of hunting on our better agricultural lands for outdoor enthusiasts who thought of game as a product of the wilderness (Allen, 1956). Game farms became common to many states as the success of the pheasant introduction was quite evident. Spreading throughout the greater part of the country, the ring-necked pheasant flourished and eventually reached its maximum population during the middle 1940's (Allen, 1956). The hunter has used those phenomenally good bird seasons (mid 1940's) as a standard, and by comparing each subsequent population, the concerned public reacted by demanding a return to the days when pheasant numbers were at a peak. However, due to many adverse and unpredictable factors, the possibility of returning to those extremely high wild population production levels seemed rather remote. The human population explosion, increased urbanization and more leisure time are just a few of the numerous detrimental pressures that accelerated the competition among hunters for this popular game bird.

In order to alleviate this situation, Michigan's Wildlife Division of the Department of Natural Resources has implemented a new pheasant "Put and Take" program that will result in the eventual release of 200,000 birds annually on state owned lands. A project of this magnitude presents many problems. Previous systems of managing game birds involved maintaining them in small portable brooder houses and enclosed outdoor flight pens at low bird densities (Smith *et al.*, 1968). A more economical and efficient method of artificial propagation initiated by Michigan State University's Poultry Science Department has been incorporated into Michigan's new pheasant program. This technique involved complete indoor housing through the initial eight weeks of life, with the chicks being subjected to extremely high bird densities in the pens. Though this system will reduce labor, feed, long term capital outlay costs and provide a means for out of season brooding and rearing, it has created very serious problems that result from severe confinement. Two of these problems are feather picking and cannibalism which are common to both poultry and game birds but more extreme among the latter.

With the above situation in mind, experiments were designed to study the performance of ring-necked pheasant chicks maintained in extremely confined environments from

28 to 56 days of age. Major emphasis dealt with the control of cannibalism, feather picking and body weight by the use of various colored lighting systems and/or beak treatments.

REVIEW OF LITERATURE

Up to the present time, most scientific research related to cannibalism control, body weight gain and feather picking has been initiated to solve numerous problems of the poultry industry. Although a number of investigations have been conducted with game birds in their natural habitats, only in recent years have studies dealt with game birds in semi-domesticated conditions. Research has normally emphasized the breeder aspect of managing pen reared pheasants. Support for this work has been limited since the commercial game bird industry is weak economically and organizationally (Adams *et al*., 1968). However, increased demands in both the release and dressed bird trade have prompted investigations for more efficient methods of production (Adams *et al*., 1968; Smith *et al*., 1968).

As previously mentioned, certain problems have become apparent when pheasants are closely confined. The first problem encountered has been feather picking or cannibalism (Smith *et al*., 1968). In the game bird industry this can result in a severe economic loss to the producer. Pheasants grown for meat that are poorly feathered dress with greater difficulty and appear less desirable, which in turn decreases the demand for these birds. Selling is made easier with good birds well dressed (Flegal *et al.*, 1972). Flegal *et al.* (1972) also stated that the game farm or shooting preserve industry must emphasize well feathered birds. Priority must be placed on quality feathering as the appearance of a fully feathered bird in its adult coloration is a basic essential in promoting an enjoyable hunting experience (Anonymous, 1970).

In the survey taken of game bird operations in the United States, Dodson (1971) found that 67% of the commercial pheasant raisers reported that cannibalism and feather picking was a major factor in management problems.

DEFINITION OF CANNIBALISM

Dealing with poultry, Rood and Davidson (1959) stated that the term cannibalism was to be considered synonymous with feather picking and such other poultry vices as toe, wing, tail and vent picking among chicks, growing pullets and mature birds. They maintained that cannibalism was usually sporadic with nearly all age groups being vulnerable to this vice.

The attraction for the red color of freshly picked sections of the body and the instinctive desire to imitate, largely accounted for the rapidity with which cannibalism spreads in a given group. This habit may again be quickly acquired by birds which had apparently forgotten the vice. This helps to explain the difficulty experienced in breaking poultry of such bad habits, and why control measures may fail when not used promptly at the very outset of an outbreak of cannibalism (Anonymous, 1954).

CAUSES OF CANNIBALISM

The causes of cannibalism in poultry are numerous. In general, they are thought to be either environmental or nutritional (Clark, 1953; Rood and Davidson, 1959).

Dodson (1971) discussed two theories on the probable causes of feather picking and cannibalism in pheasants. One school of thought claims that game birds are nervous and tempermental by nature and under artificial rearing conditions, their reactions to confinement in large numbers starts feather picking and cannibalism. The second school of thought advocates that under natural conditions, most of the bird's time and energy is spent in food and water procurement. However, under artificial situations, food and water are supplied ad lib to the birds. Thus, all the energy that would have been originally spent in food and water gathering activities is now excess energy. One of the outlets for this surplus energy is through feather picking and cannibalism. Similar statements were observed in the Pennsylvania Game Breeder's Manual (Anonymous, 1961) and the Purina Game Bird Digest (Anonymous, 1970). Reports from different poultry scientists (Bearse and Buchanan, 1935; Rood and Davidson, 1959) have also expressed theories of the same nature in their dealings with poultry.

Any factor which decreases the comfort and general welfare of growing chicks may lead to cannibalism (Sheppard *et al.*, 1972). It must be emphasized here, that earlier publications suggested many causes and listed numerous corrective measures for the control of cannibalism. However, with today's technology and modern methods of raising large numbers of confined game birds, many of these corrective procedures are outdated and very time consuming. Progress in the game bird industry advocates confined rearing which represents a 100% reversal in past game bird management recommendations (Adams *et al.*, 1968).

CANNIBALISM CONTROL

Many practices have been suggested as effective tools in controlling cannibalism and social aggression in extremely confined pheasant rearing operations. Since high density populations in poultry and game birds have been recognized as a major cause of cannibalism (Clark, 1953; Ostrander, 1971) a determination as to the degree of confinement for successfully raising large quantities of game birds must be made. Past recommendations from the Pennsylvania Game Breeder's Manual (Anonymous, 1961) suggested at least $.0465m^2$ of floor space for day old pheasant chicks, followed by gradual increases of the rearing area as the chicks grew older. Final suggestions supported a minimum of $2.325m^2$ - $3.255m^2$ per bird in the holding field if cannibalism is to be controlled. Common management practices used in the poultry industry to control feather picking are debeaking, specks and varied light coloration and intensities.

Debeaking

The results of a survey documented by Darrow and Stotts (1954) showed that the major cause of poor feathering in broiler flocks was feather picking.

The ability to produce a desired result by debeaking in broilers has been well demonstrated. Darrow and Stotts (1954), Camp *et al*. (1955) and Huston *et al*. (1956) found significant decreases in feather picking and, consequently, significant improvement in market grade when broilers were debeaked.

The debeaking of day old chicks has become an effective and popular management practice for controlling cannibalism and feather picking of chickens in the major broiler areas of the country (Douglas, 1973). Regardless of the method of debeaking followed, the most important factor is removing an adequate amount of beak at day old, or at other ages if debeaking is being done in the field. Consistency is extremely important, likewise proper cauterizing to slow down the germination layer of the bill and to retard regrowth of the bill (Douglas, 1973).

Many poultrymen and game bird breeders have established debeaking as a regular practice. There is no real agreement among poultry people as to the best procedure for debeaking birds with regard to age, method or severity (Ostrander, 1971).

Darrow and Stotts (1954) and Camp et al. (1955) found that debeaking one-half or less of the upper beak had no deleterious effect on growth rate in broilers. However, debeaking two-thirds of the beak, in most experiments, caused a significant decrease in growth rate up to at least 10 weeks of age (Camp et al., 1955; Lonsdale et al., 1957; Vondell and Ringrose, 1957).

Recommendations for debeaking practices outlined in the Pennsylvania Game Breeder's Manual (Anonymous, 1961) suggested cutting the upper mandible only and not removing more than one-fourth of the pheasant's beak. Purina's Game Bird Digest (Anonymous, 1970) appears to contradict this, as it supports the idea of burning both the upper and lower beaks square about one-fourth of the way from the tip. It specifies that if pheasant chicks are debeaked early, they may need to be debeaked again at six weeks of age. Pheasants grown for meat can be debeaked more severely than flight birds, since head appearance is usually not important. Purina (Anonymous, 1970) stated that debeaking is probably the most effective method of controlling cannibalism in game birds.

Hargreaves and Champion (1965) reported that research on debeaking has amply supported the use of milder forms of debeaking in caged layers. The severity of debeaking is usually increased as the number of birds per area is increased and as the problems with cannibalism become greater. However, the results of their experimental findings clearly suggested that there is a practical limit to the severity of debeaking that should be used in commercial caged laying operations. Debeaking beyond three-fourths the length of the beak should be avoided, as it resulted in a reduction in many of the production parameters measured and in smaller body weight gains.

Hargreaves (1965) stated that the beak is plentifully supplied with nerves, so it should not seem overly speculative to postulate that severing the beak would affect the sensitivity of the beak. If debeaking made the beak over-sensitive, the birds would have an incentive to feed less.

Ostrander (1971) reported that, in England, very few poultrymen debeak their birds. They use light control programs and carry them out so well that they have very little cannibalism.

Light Intensity and Coloration

Intensity and color of light appeared to influence the quality of broilers grown in windowless housing according to Wabeck *et al*. (1972). They reported that birds reared under natural daylight showed a 0.2 pound better average weight than those in the other treatments (2.69, 5.37, 10.75 and 21.50 luxes). The best weights for any of the birds reared under artificial lights were for those receiving the one lux treatment. Incandescent lights at the lower intensities, however, did appear to control feather picking and decrease the condemnation level. Another interesting aspect of their research demonstrated that birds reared under fluorescent lamps having shorter wave lengths (ultraviolet and blue) of radiant energy were heavier than birds grown under longer wave lengths (red and yellow).

The use of light in the broiler house varies with the individual growing program (Parkhurst, 1967). One of the satisfactory routines calls for a light intensity of two luxes at the feeder height for the first two weeks. The lights can then be dimmed or reduced to as little as 1.07 lux at the feeder height. The lower intensity (1.07 lux) has a tendency towards tranquilizing the birds and controlling the degree of feather picking (Parkhurst, 1967). In game birds, this is also true, as intense lighting and long day length promote flightiness and increased cannibalism (Anonymous, 1970).

Guhl (1953) studied the effect of limited light on bird behavior. He reported that chicks would start feeding when the light intensity was 10.75 luxes, and would begin to pick one another when it was 21.50 luxes.

In a study involving egg laying chickens, Ostrander (1971) recommended not more than 10.75 luxes of light at the feed trough. Egg production levels were maintained, while feather picking was minimized at this light intensity.

Bacon (1971) summarized the results of the experiments conducted at the Ohio Agricultural Research and Development

Center by explaining that tom turkeys were grown at four different light intensities (32.25, 10.75, 1.07 or .107 luxes) starting at three weeks of age. The best weight gains from 4 to 14 weeks of age occurred with the lowest light intensity. This pattern was essentially maintained until the end of the 16 to 18 week interval. At this time, the .107 lux intensity group became greatly inferior to the other three groups in interval weight gain. Based on this and earlier research, light intensity after 14 weeks of age until marketing at 22 weeks should be increased to 1.07 lux for growing tom turkeys.

The effect of light on feathering has been known since 1931 when it was reported that feather picking was substantially reduced among chickens in battery brooders through the use of ruby-colored lights (McWard _et al_., 1974).

McWard _et al_. (1974) discussed a 1968 study of the effect of colored fluorescent lights on growth, cannibalism and subsequent egg production of White Leghorns. The results showed that cannibalism was markedly reduced by the use of red light. Seventy to 90% of the 12-week old pullets in this study subjected to green and white light displayed some feather picking.

Woodard _et al_. (1969) reported that female Coturnix Quail brooded under green and blue light had lower body weights at five weeks than did females kept under red or white light.

Ringer and Sheppard (1960) reported that domestic poultry do not see as well in the blue, violet and green range of the light spectrum as at the red end. The selective light stimulation of commercial layers results because there are oil droplets in the retina of the eye which filter out or absorb more of the blue, green or violet light rays, thereby preventing activation of nerve impulses to the hypothalamous.

Ringer and Sheppard (1960) stated that sunlight provides an ample amount of the orange and red light rays; however confinement of birds in windowless housing means that light must be supplied artificially. Incandescent bulbs emit enough red light rays to support maximum egg production. Earlier research by Rood and Davidson (1959) showed that a red light environment controlled feather picking as it caused the blood on the birds to appear nearly colorless or black.

Specks (Blinders)

Another method of cannibalism control is by the use of specks. Specks fit over the beak with a plastic or metal pin attached through the nostril. These act as blinders, allowing the bird to see to the right or left, up and down but not straight ahead (Flegal *et al.*, 1972).

Cesmoski (1975) reported that specks can be applied faster and are a more permanent means of cannibalism control than debeaking.

Kuhl Manufacturing Corporation (Anonymous, 1975) claims that specks have become the most popular type of anti-pick device used throughout the country.

An extension bulletin (Anonymous, 1954) reported that specks should be applied before picking has become a habit. It recommended placement of this device on pullets as young as 10 weeks old.

Scientific literature with respect to body weight gain with the use of specks is not available.

Crowding generally starts to become a problem with pheasant chicks at four weeks of age and older (Flegal _et al._, 1972). It was at this stage that the research for this particular thesis began by using several techniques commonly employed by the poultry industry to control cannibalism. As previously mentioned, these control measures are: debeaking, specks or blinders, and varied light coloration and intensities.

OBJECTIVES

The objectives of this project were:

1. To determine the best lighting technique to obtain fully feathered birds at the end of a four week (28-56 days of age) confinement period.
2. To compare the effectiveness of various beak treatments to control feather picking or cannibalism.
3. To compare the effects of light and beak treatments on weight gain.

EXPERIMENTAL PROCEDURE

Modern indoor research facilities were provided for the experiment by Michigan State University's Poultry Science Department from December 2, 1971 to March 27, 1972.

All experimental chicks were hatched on a weekly basis. Simultaneous hatching of all groups would have provided more uniformity throughout the experiment but due to the small size of the breeder flock, this was not possible.

PRE-EXPERIMENTAL TREATMENT

All chicks were brooded in environmental controlled housing. The brooding area consisted of four 3.05 m. x 4.88 m. concrete floor pens, which were covered by a layer of pine wood shavings.

A circular chick guard confined the chicks to the heat source throughout the first week of their existence (see Figure 1). Three infrared light bulbs per brooder were used as the heat source. The bulbs were individually removed, and the brooders gradually raised as the age of the chicks increased. Acclimation to cold temperatures was necessary, if the chicks were to survive the transition from the brooder to the experimental area. All chicks received 24 hours of light per day from the heat lamps from one to 28 days of age.

FIGURE 1.--Brooder room management techniques.

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*Five day old pheasant chicks confined to heat source. Note infrared light bulbs.

Feed was provided manually throughout the entire brooding period. (See Appendix A for feed formula used from day one to 28 days of age.) The birds experienced a gradual transition from hand to automatic waterers by ten days of age.

EXPERIMENTAL

The building used throughout the experiment was divided into seven separate sections (see Figure 2). Each section was partitioned into four 3.05 m. x 4.88 m. floor pens. All experimental concrete floor pens were then modified with poultry wire mesh, to approach the desired testing density of .069 m^2. per bird. Actual figures ranged between .0595 m^2. and .0874 m^2. per bird, while the average pen density was .0697 m^2. (see Figure 3).

Of the four light colors evaluated, one was assigned to each of the four sections used during the testing period. The individual sections received four light bulbs (one per pen) of the same wattage and coloration before the various tests were conducted.

All groups of birds were exposed to one of the following lighting systems:

Red Light: One red clear glass 60 watt incandescent light bulb per pen. This resulted in a production of 2.58 luxes (Noonon, 1972).

Blue Light: One painted blue glass 60 watt incandescent light bulb per pen. This resulted in a production of 1.29 luxes (Noonon, 1972).

Figure 2.-- Illustration of (M.S.U.) poultry housing (6) used from day one to 56 days of age.

Brooding Area	Dark	Blue	Red
1. one week of age	a. Dark control	a. Blue control	a. Red control
2. two weeks of age	b. Dark speck	b. Blue speck	b. Red speck
3. three weeks of age	c. Dark debeak	c. Blue debeak	c. Red debeak
4. four weeks of age	d. Empty pen (Brooder stove)	d. Empty pen (Brooder stove)	d. Empty pen (Brooder stove)

White

a. White control
b. White speck
c. White debeak
d. Empty pen
(Brooder stove)

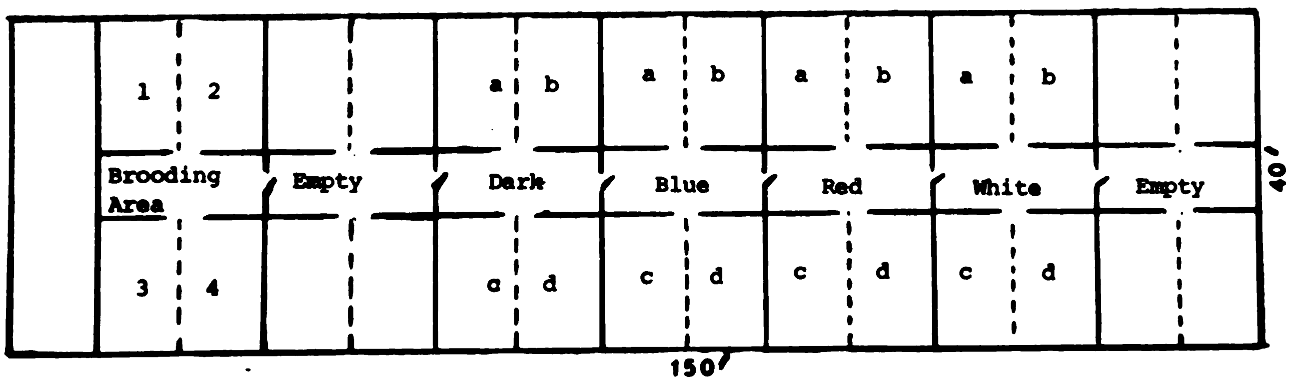

FIGURE 3.--Seven week old experimental pheasant chicks at a density of .0697 m2. per bird.

Subdued White Light: One clear glass $7\frac{1}{2}$ watt incandescent light bulb per pen resulted in a production of .86 luxes (Noonon, 1972).

Near Complete Darkness: Total foot candle production was due to the light seepage from the ventilators or brooder stove pilot and burner assembly. Actual measurement resulted in .107 luxes (Noonon, 1972).

All light measurements were taken by use of a Western model 603 light meter.

All groups were exposed to a standard treatment just prior to their placement into the experimental pens. This consisted of wing banding and clipping of the primary flight feathers at 28 days of age. It was at this time, the various methods of beak treatment (specked or debeaked) were administered and the initial check for evidence of feather picking was conducted. Body weight gain was determined by weighing each chick at four, six and eight weeks of age. The control (no beak treatment) groups within each light color were the initial birds subjected to the testing environment, followed by the specked and debeaked groups at weekly intervals.

Throughout the testing period, the confined rearing area room temperature fluctuated between -3.85° C. and +7.2° C. One LP gas brooder stove was assigned to each section. It was placed with all new groups entering a given light color for a seven day period. Eventually it was moved to the remaining empty pen in each section in an attempt to maintain the confined rearing room temperature above freezing.

Each lighting scheme was maintained on a 10½ hour day length (7:00 a.m. to 5:30 p.m.) by use of a time clock, with the exception of the near complete darkness groups. In all trials with the latter mentioned light treatment, birds were subjected to 24 hours per day of a continuous darkened environment.

All lighting systems contained a control (no beak treatment), a specked (plastic blinders positioned on upper beak, see Figures 4-5) and a debeaked (¼ of upper mandible, see Figure 6) group of birds. Thus a total of twelve individual combinations were considered. Trial sizes ranged between 50-114 birds.

Feed (turkey starter-28% protein, see Appendix B), grit (medium crushed granite) and water (Johnson cup automatic foundations) were provided ad libitum. Litter (wood shavings) was used continuously throughout the course of the experiment.

Following the completion of the four week confinement period, each bird received a final weight check and a thorough examination was conducted to determine the degree of feather loss. As a result of this check, all birds were assigned a final feather score (for explanation of feather score, see Appendix C). These results were then statistically analyzed by using the following methods:

FIGURE 4.--Front view of specked experimental pheasant chick (28 days old).

FIGURE 5.--Side view of specked experimental pheasant chick (28 days old).

FIGURE 6.--Debeaked (¼ of upper mandible) experimental pheasant chick (28 days old).

1. The statistical design was a 2 x 3 x 4 factorial with unbalanced replication.
2. Method of analysis used was a weighted analysis of means.
3. Mean comparisons were performed by using a Bonferonni t-test (see Tables 2 and 4).

RESULTS

FEATHER SCORE

The results of the incidence of feather loss are presented in Table 1. The information in Table 1 indicates that a significant difference in mean feather score ($P < .05$) exists due to sex, beak treatment and light. The interaction between treatment and light was also significantly different ($P < .05$).

Considering sex only, the mean feather score (MFS) for all the females involved in the experiment was 1.46 while the MFS for the males was 1.05 (increased severity of feather loss parallels higher feather score values). The statistical findings suggested that the females suffered the greatest amount of feather loss, but failed to determine whether it was the males or females who were doing the picking.

Comparison of MFS by Individual Light Systems

Due to the significant interaction effects between light and beak treatment, comparisons between the various methods of beak treatment, with regard to feather score, will be made within a single light color only, at a given time.

Darkness. By examining Table 2, it is very apparent that the debeaked group of birds displayed a significantly higher MFS than the control or specked groups, when confined to a nearly darkened environment. This was not an anticipated result. The feather score of the debeaked birds represented a possible discrepancy due to management conditions (wet litter) that normally increase feather picking problems. No significant difference existed between the specked and control birds within this lighting system.

Red Light. The data presented in Table 2 showed that a significantly higher MFS existed for the control group, in comparison to both the debeaked or specked birds, when red light was used. Differences between the mean values of the debeaked and specked birds in the red light system were not significantly different.

Blue Light. In the blue light system, evidence of any significant difference between the debeaked and specked groups was non-existent (see Table 2). However, the MFS(s) for the previously mentioned groups were both significantly higher than the control group.

White Light. Again from Table 2, the statistical data resulted in a significantly higher MFS value for the debeaked birds over both the control and specked groups. Finally, within the white light system, the control individuals had a significantly higher MFS than the specked birds.

Comparison of MFS Due to Beak Treatment

Because of the significant light-beak treatment interactions, comparisons between the various four lighting systems, with regard to feather score, will be made within a single method of beak treatment.

Control Groups. The data gathered as a result of the interaction of the four various lighting systems with the control method of beak treatment are clearly defined in Table 2A.

The birds in white light had a significantly higher feather score than the red, dark and blue lighting systems. Moving from the greatest to the least amount of feather loss, it was evident that the birds confined to the red light also had a significantly higher MFS value over the dark and blue environments. No significant difference existed among birds in the latter two light systems.

Debeaked Groups. Within this method of beak treatment, each of the four light systems were significantly different than the others. The group of birds that expressed the highest MFS resulted from the white light-debeaked treatment interaction.

Specked Groups. The birds in white light, once again, had the highest MFS. However, they were only significantly different from the group in the red light system. The values for the birds in the blue light were also significantly higher than the values for the birds in the red environment (see Table 2A). From this point on, no MFS significant differences existed between any of the lighting systems.

BODY WEIGHT GAIN

A second major objective of this research was to determine which lighting system and beak treatment resulted in the greatest gain in body weight of the chicks throughout a four week (28-56 days of age) confinement period. Data presented in Table 3 shows that sex, treatment and the light-treatment interaction(s) had a significant effect ($P < .05$) on the rate of body weight gain.

The mean value for weight gain of all the females that participated in the experiment was 291.2 grams, while the mean weight gain value of all the males was 396.2 grams. The difference between the two figures exceeds 100 grams and therefore provides credibility to the statement of significance ($P < .05$) regarding body weight gain between male and female 28-56 day old confined pheasant chicks.

The effect of beak treatments in reference to body weight gain cannot be evaluated independently, but must be considered simultaneously with the light-beak treatment interactions.

Data from Table 4 showed that within the dark and blue experimental light environments, the control groups had a significantly higher body weight gain mean than either the debeaked or the specked groups. The debeaked birds also attained a significantly higher weight gain value than the specked individuals exposed to the aforementioned light colors.

In the red and white light environment, no significant differences, in respect to body weight gain existed between the debeaked and control birds. However, both groups (control and debeaked) of birds showed mean weight gain figures significantly higher than those of the specked birds.

During the experiment, the following pertinent observations were made with no statistical support:

1. Mortality due directly to cannibalism was non-existent.
2. Birds raised in near total darkness appear to assume the adult coloration (plumage) at an earlier age.
3. A pale appearance is common to the skin regions of the bird (face patches, shank and feet) when raised in a darkened environment.

DISCUSSION

A listing of the four light systems in a descending order of ability to prevent or reduce feather loss is not feasible. A statement of this nature could only be made when light and beak treatment are considered simultaneously. Data presented in Table 2 lists the statistically analyzed results of all the light-beak treatment interactions. From a practical viewpoint, only a feather score exceeding a value of 2.50 would warrant further management considerations (see Appendix C). Again from Table 2, it is apparent that only the birds confined to the white light system, with a numerical score above 2.50, produced obvious signs of serious feather loss. It would appear, from the results of this research, that light color functions play a larger role than light intensity, as a management tool used to control cannibalistic activities of confined 28-56 day old ring-necked pheasants. As previously mentioned, the red and blue light experimental pens were supplied with larger watt bulbs and higher light intensities were maintained than the white light. However, the statistical data (Table 2 and 2A) verified the white lighting system's inferior ability to control feather loss, even with certain beak treatment interactions. Earlier research is sparse and contradictory.

Skoglund *et al*. (1966) found that white light intensities of 161, 645 and 1290 lux at feeder height, exerted no influence upon the incidence of feather picking in broilers. Guhl (1953), Parkhurst (1967) and Wabeck *et al*. (1971) all maintained that the lower light intensities (1.07 lux) have a greater tendency toward controlling the degree of cannibalism.

It is interesting to note thal all three of the darker lighting systems (red, blue and near total darkness) produced values below the critical feather score of 2.50. If these results are applicable to large scale management operations a great deal of flexibility will be available to use in confinement rearing practices. Earlier researchers such as Rood and Davidson (1959) and McWard *et al*. (1974) substantiated the importance of darker light colors. Finally, it is evident that the blue and near total darkness light systems-beak treatment interaction results were similar, even though direct comparison between the two light colors could not be made. This would support previous publications by Ringer and Sheppard (1960) and personal communications with Bauer (1973) that birds cannot see well in blue light, as it is perceived as a darkened condition by pheasants.

The effect of beak treatment (specked, debeaked and control) within a given lighting system, when attempting to obtain fully feathered birds at the end of 56 days of age, is quite apparent.

Data presented in Table 2A indicates that when no method of beak treatment (control) was imposed upon confined pheasant chicks, it would be safe to incorporate the use of the dark, red or blue light system to minimize feather loss. Conversely the implementation of all white light incandescent bulbs, with no form of beak treatment, would not be desirable as an effective control measure against the outbreak of cannibalism.

It can be seen from Table 2A that the degree of feather loss was just as great, if not greater, in the debeaked method of treatment as compared to the control groups. The highest light-treatment MFS was derived from the birds with the white debeaked interaction. This was not an anticipated result. Due to previous research publications, it was logical to assume that the white light-debeaked treatment would function as a more positive preventative against feather picking than the white light-control treatment. Camp *et al*. (1955) reported that debeaked broilers had significantly better feathering and market grade than non-debeaked control birds at nine weeks of age. Darrow and Stotts (1954) stated that debeaking did reduce feather picking, over non-debeaked individuals, when only 1/3 to 1/2 of the upper beak was removed. Admittedly, other reasons for the high MFS obtained were certainly possible. In this research, even though only ½ of the upper beak was removed, the actual debeaking process along with the rough handling that normally accompanies this practice, adds to the social stress. McDaniel (1971) reported that social interactions were more frequent in growing poultry that had been debeaked as compared with the non-debeaked birds. This could possibly substantiate the results received in this research.

The data presented in Table 2A verified that many significant differences did exist among the four light systems, when birds were specked. All the light system-specked treatment interaction MFS values were well below the arbitrarily established value of 2.50. Though specks were time and labor consuming to place on each individual bird, they were easily removed and the end product justified the previous efforts. Obviously, if a game bird manager can control cannibalism by the use of colored and low intensity lighting systems, a great amount of time, labor and money can be saved by not placing the plastic blinders on each individual bird.

The light system and beak treatment interaction that provided the lowest MFS did not necessarily result in the best body weight gain. Specked groups, regardless of light system used (see Table 4), showed the lowest mean body weight gain (MBWG) over the four week confinement period. In all cases, regardless of the associated light system, the controls had higher values (MBWG) than the debeaked groups, while the debeaked birds produced a higher MBWG than the specked groups. This outcome appears to support earlier research (Hargreaves, 1965).

TABLE 1.--The significance of various factors on feathering of the ring-necked pheasant.

Source	DF	SS	MS	F
(A) Sex	1	36.6976	36.6976	25.164*
(B) Beak Treatment	2	132.3320	66.1660	46.642*
(C) Light System	3	503.8830	167.9610	117.722*
AB	2	3.0612	1.5306	1.079
AC	3	11.5635	3.8545	1.915
BC	6	301.4244	50.2374	35.413*
Error	913	1295.2115	1.4186	

*Significance ($P < .05$)

TABLE 2.--Comparison of mean feather scores of growing ring-necked pheasants by individual light systems.

	Dark	Red	Blue	White
Control	.46b	1.88a	.33b	2.92b*
Debeaked	1.69a	.40b	1.00a	3.56a*
Specked	.62b	.06b	.86a	1.22c

Within the vertical columns, numbers with similar letters are not significantly different, while numbers with dissimilar letters are significant at the ($P < .05$) level.

*Evidence of serious feather picking becomes pronounced when the MFS exceeds a critical value of 2.50.

TABLE 2A.--Comparison of mean feather scores of growing ring-necked pheasants due to beak treatment.

	Dark	Red	Blue	White
Control	.46c	1.88b	.33c	2.92a*
Debeaked	1.69b	.40d	1.00c	3.56a*
Specked	.62ab	.06b	.86b	1.22a

Within the horizontal columns, numbers with similar letters are not significantly different, while numbers with dissimilar letters are significant at the ($P < .05$) level.

*Evidence of serious feather picking becomes pronounced when the MFS exceeds a critical value of 2.50.

TABLE 3.--The significance of various factors on body weight gain of ring-necked pheasants.

Source	DF	SS	MS	F
(A) Sex	1	2,318,560.32	2,318,560.32	304.62*
(B) Beak Treatment	2	968,976.00	484,488.00	63.65*
(C) Light System	3	42,550.50	14,183.50	1.86
AB	2	5,533.60	2,766.80	.36
AC	3	39,472.05	13,157.35	1.73
BC	6	112,558.72	18,759.79	2.46*
Error	913	6,949,089.29	7,611.27	

*Significance ($P < .05$)

TABLE 4.--Results of light system-beak treatment interaction on mean body weight gains (grams) of growing ring-necked pheasants.

	Dark	Red	Blue	White
Control	392.2a	357.4a	408.6a	368.6a
Debeaked	344.2b	350.6a	352.8b	368.0a
Specked	293.0c	295.6b	302.4c	290.8b

Within the vertical columns, numbers with similar letters are not significantly different, while numbers with dissimilar letters are significant at the ($P < .05$) level.

SUMMARY AND CONCLUSIONS

The results of this experiment demonstrate that:

1. Colored and low intensity lighting systems may be the easiest and most economical management tool available, to control feather picking, when game bird managers practice confinement rearing methods.
2. The specked method of beak treatment maintained feather loss at a tolerable level in all four lighting systems. This was even true when associated with white light.
3. In reference to body weight gain, the results of this experiment tend to support the control birds (no restrictive method of beak treatment) as the best technique to achieve the greatest gain in body weight during the 28-56 days of age confinement period. The debeaked groups were at an intermediate level, with specked birds showing the least amount of body weight gain, regardless of light system used.
4. The most important and practical piece of information that resulted from this research,

stresses the interactions between the various lighting systems and beak treatments. If the experimental results, from this research, are applicable to large scale private, commercial or public pheasant rearing operations, a degree of flexibility may have been provided. Specifically, a game bird manager may not want the heaviest chicks possible at the end of this period. Optimum body weight gain may be advantageous to the meat market operators, while functioning as a hindrance to shooting preserve personnel, who prefer the smaller bodied, faster flying and well plumaged flight birds. Therefore, people in the game bird industry may have the option of selecting a given lighting system or beak treatment which would most closely suit their management plans and objectives.

To conclude, the techniques employed in this research add support to the feasibility of instituting severe confinement practices (less than .093 m^2. per bird) as an effective method of rearing large numbers of pheasant chicks from 28 to 56 days of age.

APPENDICES

APPENDIX A

TABLE 5.--Composition of pre-experimental ration*

Ingredients	Lbs./ton
Corn	795.5
Soybean meal, 50%	855
Alfalfa meal, 19%	60
Fish meal, 60%	100
Meat and bone meal, 50%	50
Whey, dried	50
Fat, stabil .A-V.	10
Salt, iodized	5
Dicalcium Phos.	
24Ca. 18 phos.	35
Limestone	20
Premix, R-3	7.5
Aurofac 10	10
Carbosep	2
Coccidiostat	
Biotin	4 oz.
	2000#

*M. S. U. Turkey Pre-Starter-68 (30% protein), Manufactured by King Milling Company, Lowell, Michigan

APPENDIX B

TABLE 6.--Composition of experimental ration*

Ingredients	Lbs./ton
Corn	888
Soybean meal, 50%	762
Alfalfa meal, 17%	60
Fish meal, 60%	100
Meat and bone meal, 50%	50
Whey, dried	40
Fat, stabil .A-V.	30
Salt, iodized	8
Dicalcium phos.	
24Ca. 18 phos.	35
Limestone	20
Premix, R-3	5
Carbosep	2
Coccidiostat	
Biotin	4 oz.
	2000#

*M. S. U. Turkey Starter-68 (28% protein), Manufactured by King Milling Company, Lowell, Michigan

APPENDIX C

EXPLANATION OF FEATHER SCORE ASSESSMENT

Following the completion of the four week confinement period, each bird received a final weight check and a thorough examination was conducted to determine the degree of feather loss. As a result of this check, all birds were assigned a final feather score. The actual rating ranged between zero and seven, though larger scores were possible. The higher values represented the very poorly plumaged birds with an extremely bare-backed condition. As the assigned numerical score decreased, feather quality improved. Any broken pin feathers or damage to feather follicles, which resulted in the formation of encrusted areas on the skin, regardless of how insignificant, received a minimum score of one. This pertained to all the feather tracts on the bird's body (see Figure 7). The actual score, for any given bird, was dependent upon the total number of individual feather tracts that produced evidence of plumage loss (see Figures 8-14).

One of the practical problems encountered in confinement rearing of pheasants is the inability of younger birds to withstand the stress of a cold rain, should it occur, during the first 48-72 hours after their movement from an indoor to an outdoor environment (Scott *et al.*, 1955). This problem is compounded when birds are bare-backed. The energy needed for body maintenance is undoubtedly increased because of the lack of feathers. As a result, feather picked birds fail to shed water and become more susceptible to chilling in wet weather (Elder, 1954; McWard *et al.*, 1972). Because the back area (spinal feather tract) is so crucial to the birds survival, it was expressed in a range of values that fluctuated between one and three.

From a practical viewpoint, only a feather score exceeding a value of 2.50 would warrant further management considerations.

FIGURE 7.--Diagram of dorsal and ventral views of the major feather tracts of Phasianus colchicus.

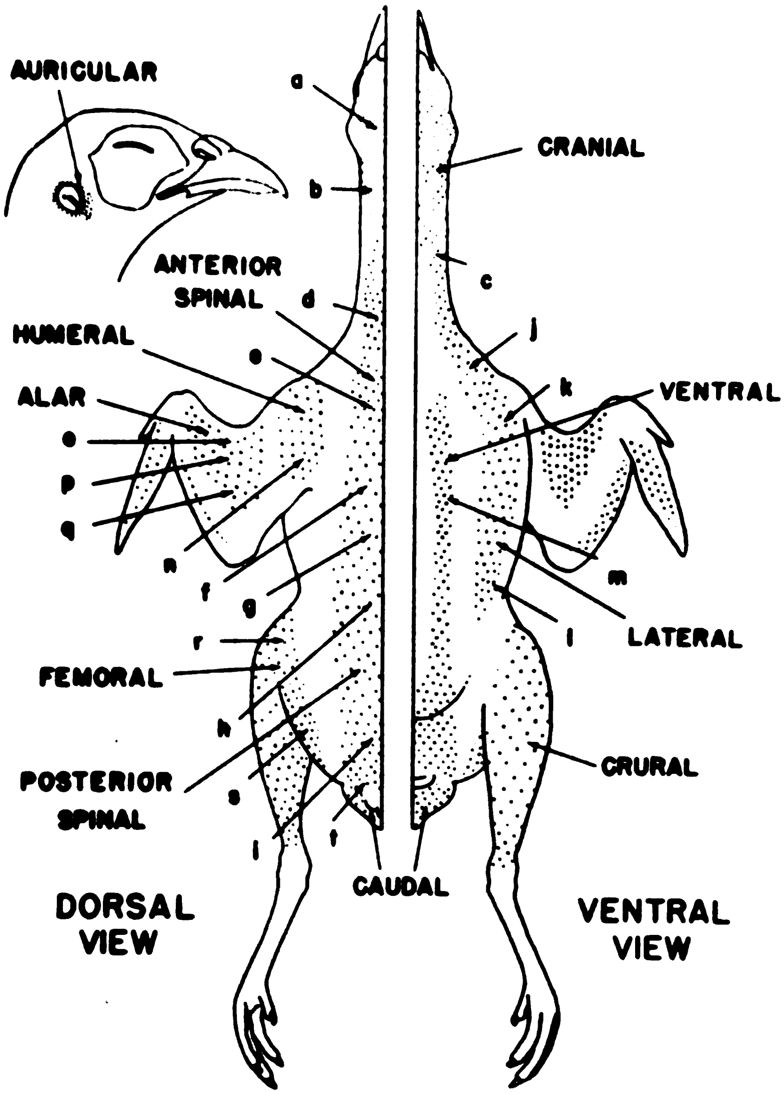

Fig. 3. Diagram of dorsal and ventral views of the major feather tracts of *Phasianus colchicus*. Feathers from specific areas in the feather tracts were employed. The areas, indicated by letters, are as follows: CRANIAL TRACT, (a) dorsal, (b) lateral neck, (c) neck collar; SPINAL TRACT, (d) dorsal lower neck, (e) upper back, (f) mid-back, (g) lower back, (h) upper rump, (i) lower rump; LATERAL TRACT, (j) ventral lower neck, (k) anterior breast, (l) posterior breast; VENTRAL TRACT, (m) mid-breast; HUMERAL TRACT, (n) posterior; ALAR TRACT, (o) lesser coverts, (p) median coverts, (q) greater coverts; FEMORAL TRACT, (r) lower femoral, (s) upper femoral; CAUDAL TRACT, (t) upper tail coverts. The drawing at the upper left demonstrates position of the auricular tract

Original diagram illustrated by Westerskov, 1957.

FIGURE 8.--Confined experimental male pheasant with no evidence of feather loss.

FIGURE 9.--Spinal tract (back) illustrating a feather score of one.

FIGURE 10.--Spinal tract (back) illustrating a feather score of two.

FIGURE 11.--Spinal tract (back) illustrating a feather score of three.

FIGURE 12.--Alar tract (wing web) illustrating a feather score of one.

FIGURE 13.--A feather score (FS) assessment (right wing) of two (Alar tract FS = 1, Humeral tract FS = 1).

FIGURE 14.--Feather score assessment for the left primary coverts = 1.

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