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The Effect of Sloping Wire Floors on
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Masters degree in Animal Science

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THE EFFECT OF SLOPING WIRE FLOORS ON RING-NECKED PHEASANT BREEDERS

by

Stephan Paul Keto

A THESIS

Submitted to
Michigan State University
in Partial Fulfillment of the Requirements
for the Degree of

Master of Science

Department of Animal Science
1985

In memory of my beloved
grandmother

Rosaria Barone
1893-1979

"Ti Ringrazio Nonna"

ACKNOWLEDGMENTS

The author wishes to express most sincere appreciation to Dr. Cal Flegal for his advice and the opportunity to complete my graduate work under his direction. Thanks also to Dr. Allan Rahn and Dr. Fred Peabody for their assistance, encouragement and input in my studies and toward the completion of this text.

Special thanks must go to Dr. Theo Coleman who's dedication to teaching and sincere interest in his students will always be an inspiration to me.

Recognition is due to all the people I have come to call my friends. These people, fellow students, faculty and staff have through their friendship and assistance in times of need made the years here most rewarding and enjoyable.

To all my family and most especially my parents, no words here could ever repay the support, encouragement and understanding they have given me with respect to my education and future goals.

My thanks to Sharon who's skills as an interpreter were invaluable to the preparation of this manuscript.

And finally, my warmest thanks to Carol for her understanding and patience during the completion of my studies.

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ABSTRACT

THE EFFECT OF SLOPING WIRE FLOORS ON RING-NECKED PHEASANT BREEDERS

By

Stephan Paul Keto

An experiment was conducted to evaluate the feasibility of producing pheasant hatching eggs with pheasant breeders kept on sloping wire floor pens.

Breeders at a male to female ratio of 1 to 7 and a density of .18 square m per bird were housed in one of three treatment pen designs: conventional litter, 2/3 sloping wire 1/3 raised litter and full sloping wire floor pen.

There was no significant difference between treatments for egg production, fertility, hatchability, mortality or feed conversion. Broken eggs were significantly increased ($P \leqslant .05$) in the full sloping wire pen as compared to those from birds with access to litter. Final female body weights of hens on full sloping wire were significantly lighter ($P \leqslant .05$) than those of hens in either of the other treatments.

Good reproductive results are possible from pheasant breeders housed on full sloping wire pens. A means to reduce floor egg breakage by pen design or management should be investigated.

INTRODUCTION

Since the early 1970's, Michigan State University has worked closely with the Michigan Department of Natural Resources Wildlife Division on research with the Ring-neck Pheasant (Phasianus colchicus).

Studies in the area of nutrition, physiology and management both with breeders and growing stock have served to increase the knowledge of the species and the efficiency with which it can be produced.

The Michigan Department of Natural Resources wildlife facility in Mason, Michigan has, since it began producing pheasant stock, used a litter floor system for the breeder birds (Michigan DNR Program Outline, 1974). Alternatives to the litter floor pens for the production of pheasant hatching eggs were investigated in a study at Michigan State University.

The present litter floor breeder pens require large amounts of good quality wood shavings throughout the hatching season. This need for shavings is increased in the colder months when wet litter may jeopardize egg settability and health of the breeder stock. The more frequent cleaning at these times demands more labor and increases the disturbance to the breeder birds. The breeder disturbance caused by cleaning the litter floor pens at the DNR Wildlife facility has been shown to have a negative effect on egg production (Dorn, Personal Communication).

Egg collection in large litter pens can be especially poor with pheasants which do not utilize nest boxes to a great extent (Flegal and Sheppard, 1976). The labor intensive method of collecting eggs in litter pens may also produce fewer settable eggs due to human error in overlooking or crushing buried eggs (Bressler et al., 1974).

To help solve the problems of manure handling, reducing litter use, preventing excessive egg loss, improving egg collection efficiency and reduced breeder disturbance alternatives to the litter floors were investigated.

The use of wire floor cages to house poultry is common in the production of table eggs. Although less common commercially, the use of wire floor pens for high density housing of breeders has been shown feasible in experiments at Pennsylvania State University (Bressler et al., 1974); specifically, the wire floor pens used in studies at Pennsylvania State University were sloping which improved egg collection over flat wire floor pens.

In this study, carried out at the Michigan State Poultry Research Facility in cooperation with the Michigan Department of Natural Resources Wildlife Division Wildlife Facility, the feasibility of producing pheasant hatching eggs on sloping wire floor pens was examined.

LITERATURE REVIEW

The use of litter floors in breeder pens has the disadvantage of encouraging dirty floor eggs and complicating egg collection due to breakage and lost eggs (Bressler et al., 1974). The difficulty in maintaining adequate laying conditions on litter during cold or wet months, or due to problems such as water leakage, can seriously depress settability (Dorn, 1983).

The need to purchase and store large quantities of litter in a breeder operation must also be considered. Although the cost of litter may not be prohibitive, litter systems are generally more labor intensive as compared with wire floor cage systems (Toleman, 1963).

In small scale breeder pens the use of wire floors to improve manure handling and extend litter quality has been common in the past. Wire covered wood frame dropping pits were used over the years at the Michigan State University Poultry Research Farms (Coleman, Personal Communication). Feeders and roosts positioned over these pits concentrated much of the manure and allowed less frequent cleaning of breeder pens.

As recent as 1982 the use of droppings pits has received renewed interest. A Danish hatchery installed mini-droppings pits in conjunction with nest boxes to successfully reduce floor eggs (Jee, 1982).

The most extensive work to date using sloping wire floor pens in poultry houses has been done by researchers at Pennsylvania State University. The sloping wire floor plan was conceived as a system for breeders, that would take advantage of high density cage systems with respect to manure handling, egg collection and reduced floor eggs.

A summary of eight years (1963-1971) of experimental work with sloping wire floors in poultry houses was presented by Bressler et al. (1974). Originally designed for commercial layers, males were added in later work to study fertility and hatchability of eggs produced on wire.

For pullets alone, results indicate that sloping wire floors were more satisfactory than litter, flat wire, flat wood slats or sloping wood slats for the control of floor eggs. With pullets housed at 465 square centimeters per bird, over 98 percent of all eggs were laid in nests. Eggs laid on the sloping wire floor experienced 17 percent breakage indicating the importance of controlling floor eggs.

Other studies with sloping wire floor poultry house designs summarized by Bressler et al. (1974) included placement of feeders, waterers, nest boxes and proper ventilation and lighting to control the floor egg problem. Specifications for sloping wire floor pens published from this research cover design and management factors found to be important for proper performance of poultry in these facilities.

Several authors published work from the studies at Pennsylvania State University and are cited by Bressler et al. (1974) in the summary of research; in particular, experiments concerning production, fertility, hatchability and floor design effects were studied.

In a comparative study with leghorn pullets on sloping wire and litter floor pens Bressler and Maw (1966) found similar values for egg production and feed conversion. Excellent production results were reported for various stocking densities. Production of 253 eggs per pullet housed at 613 square centimeters per bird on sloping wire was reported.

Bressler _et al_. (1972) completed six years of experimental work with leghorn breeder flocks to investigate fertility, hatchability and production on two sloping wire arrangements, A-frame and V-frame designs. The production performance of breeders housed on sloping wire compared favorably with data from litter floor systems. The authors noted that with the use of roll-away nests and nest egg decoys it is possible to have less than two percent floor eggs after one month of lay. Excellent biological results with respect to fertility and hatchability were noted for breeders housed with as little as 465 square centimeters per bird. Based on the results of this work the authors recommended sloping wire floor systems for commercial light breeder flocks.

Other work with alternatives to litter floor housing have involved the use of wood slats, plastic and other types of metal floors. In addition, work with heavy breeders has been carried out.

Magruder and Nelson (1964) housed broiler breeders on total-litter and total-slat floor pens at .18 square meters and 697 square centimeters per bird, respectively. No difference was found between the two treatments for egg production, mortality or feed conversion. Broilers which were reared on litter floors and moved to slat floors at maturity showed a 17 percent incidence of bumble foot. For birds reared and housed on slat floors during the laying period only, 6 percent showed foot problems.

Bressler and Burr (1977) housed broiler breeders on 2/3 slat 1/3 litter, sloping plastic, expanded wire and sloping vinyl coated wire floor pens at various bird densities. Results from three years of studies indicated that excellent biological performance could be achieved on all floor types.

A major problem in housing the heavy broiler type breeder birds reported by Bressler and Burr (1977) was the incidence of sore feet which was most severe on the male birds. Sloping plastic, expanded metal and sloping vinyl coated metal floors resulted in less satisfactory foot condition in general than birds housed on slat-litter floors.

Carter et al. (1970) also utilized broiler breeder birds to study the effects of floor type. Birds housed on sloping wire floors and litter floor systems showed similar values for egg production, egg size, and hatch of fertile eggs. However, a significantly lower fertility rate was noted for birds housed on sloping wire. This was partially attributed to the sore foot problem experienced by the male breeder birds on the wire floors. By modifying the floor to a heavier gauge plastic coated wire, foot sores were reduced but low fertility persisted for the birds on the modified sloping wire floor.

Observation of the birds in the sloping wire floor pen revealed that continued low fertility was due to female instability during mating and interference of equipment in the pen with the mobility of the males. Carter et al. (1970) noted that it was possible to stock the breeders on wire at 929 square centimeters per bird with similar production, egg size and hatchability as birds on litter housed at .28 square meters per bird.

Fertilitv problems were also reported by Nordskog and Schierman (1965) who studied Leghorn breeders kept on wood slat, 1/2 wood slat and 1/2 litter, and full litter floor pens. Results for fertility indicated that slatted floors caused a lag in normal mating for some males as compared to males on full litter. The decreased fertility that was reported continued for 7-10 days after the onset of mating activity. After 12 days, no treatment effect was detected. By the 18th day of the experiment, only 2 percent lower fertility was evident between birds kept on slatted floors and those on all litter floors.

For light breeders advantages of the sloping wire floor system other than reduced floor eggs, improved manure handling and good biological performance were related to in house environmental air quality (Bressler _et al_. 1974).

Quarles _et al_. (1969) studied the bacterial contamination of air and eggs from leghorn breeders housed in sloping wire and litter floor poultry houses. Although both managment systems resulted in similar fungal contamination of the air, the litter floor pens averaged nine times more airborne bacteria. Bacterial counts on the egg shells from the litter floor poultry houses were twenty to thirty times greater than on egg shells from the sloping wire floor system. The presence of coliform bacteria in embryos and chicks was related to the concentration of this bacteria in the air of the house in which they were produced.

Egg production and fertility results reported by Quarles _et al_. (1969) were similar for birds housed on the two floor types even though birds on wire were housed at three times the density of those housed on litter floors. Through the use of plastic rollaway nests in conjunction with the sloping wire floor, superior hatchability was experienced for eggs produced on sloping wire as compared to the litter system.

Carter _et al_. (1973) also reported significantly less bacterial contamination of egg shells from breeders housed on sloping wire floors as compared to eggs produced on litter/slat systems.

When undisinfected eggs of broilers housed on sloping wire were hatched and the chicks were chill stressed, less enteric bacteria were isolated on the chicks than from chicks whose parents were housed on the litter-slat floor pens.

Researchers at Michigan State University working with Ring-neck pheasants have succesfully utilized single bird sloping wire floor cages to house breeders for experimentation (Blake, 1984; Hussein, 1983; Fathy, 1982; Fuentes, 1981; Carpenter, 1980; Reynnells, 1979; Wing, 1976).

Reynnells (1979) allowed six weeks acclimation time for pheasants when housed in the 20.3 x 35.6 x 30.5 cm cages. He noted that some pheasants would not adjust to this environment and killed themselves due to starvation and/or mechanical damage due to hitting the cage top. Other than these observations, the results of these experiments do not indicate adverse effects of the wire floor confinement pens on production or health parameters of the breeder birds.

Adams *et al*. (1968) studied the effects of cage confinement and lighting on Ring-necked pheasant breeders. Birds housed in a high density sloping wire floor pen compared favorably with respect to fertility, hatchability and egg production to birds housed on sand floor pens. Feed consumption for the breeders housed on wire was shown to be slightly higher than for those birds kept on the floor.

Spiller and Jordan (1976) housed second cycle Ring-necked pheasant breeders on sloping plastic mesh floor pens to study optimum housing densities and off season production of hatching eggs. Egg production, fertility and hatchability for pheasant breeders housed on sloping plastic floors at densities as low as .18 square meters per bird compared favorably to the same parameters from records of commercial pheasant breeders using litter floor and range systems. An unacceptable decline of total eggs, settable eggs, fertile eggs and chicks per female was reported due to high egg breakage on the sloping plastic floors. A primary problem related to breakage was the reluctance of pheasant hens to use conventional nest boxes, and thus 50 percent of all eggs were laid on the wire floor. Floor eggs reported by Spiller and Jordan (1976) were subject to breakage at a rate of 25 percent.

MATERIALS AND METHODS

During the fall of 1982, prior to housing the pheasant breeders, three treatment pens were constructed in one room of a Michigan State Poultry Research house. The arrangement of the treatment pens in the 10.67 m x 11.58 m room is diagrammed in Figure 1. Each pen was 20.45 m in area.

Pen 1, shown in Figure 2, was a conventional litter floor pen as is currently used at the Department of Natural Resources Hatchery Unit for housing pheasant breeders. Pen 2, as shown in Figure 3 and Figure 4, was constructed as a 2/3 sloping wire and 1/3 raised litter floor pen. The litter floor was not sloped and was raised above the room floor 91 cm. A height of 20 cm separated the litter floor from the beginning of the sloping wire floor in this pen. A metal catch was installed at this point to prevent eggs on the wire from falling to the litter platform. At a slope of 1/12, the sloping wire floor in Treatment Pen 2 reached a height of 1.42 m above the room floor. Corner nest covers, constructed as triangular three legged platforms 20 cm high, were used in both Treatment Pen 1 and 2 (Figures 2 and 3). The purpose was to provide a darkened area that would serve to attract laying females and thus concentrate eggs. A similar corner cover is used in the DNR Hatchery breeder pens (Dorn, Personal Communication).

Pen 3, shown in Figure 5, was constructed as a full sloping wire floor pen. The pen was sloped at a ratio of 1/12--the lowest point being at the collection doors at the front of the pen. At the lowest and highest point above the room floor the pen floor height measured 91 c and 1.42 m, respectively. A black plastic hood extended the width

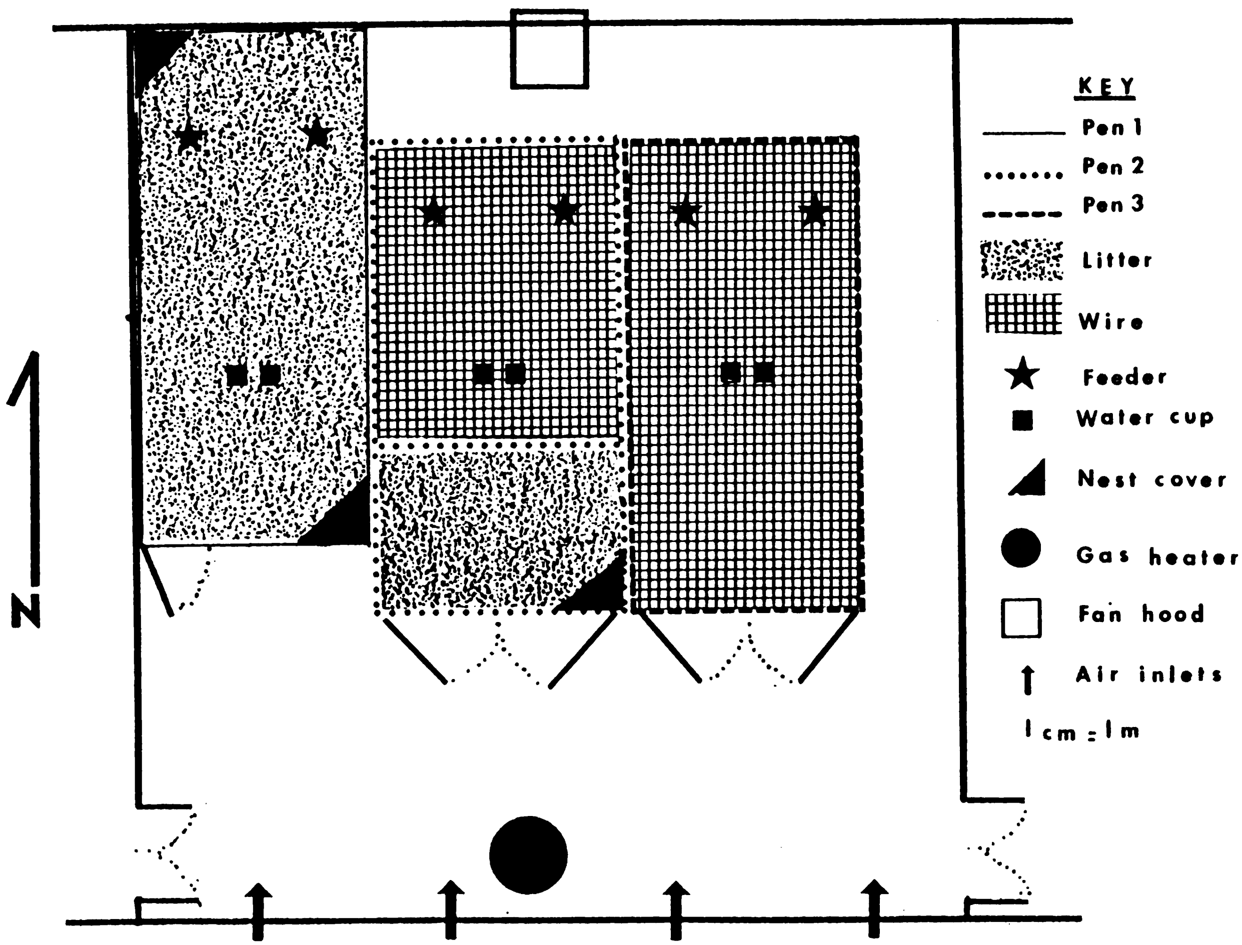

Figure 1. Arrangement of litter, 2/3 sloping wire, 1/3 litter and full sloping wire floor pens at the University Poultry Research Farm.

Figure 2. Treatment Pen 1, Litter Floor Pen

Figure 3. Treatment Pen 2, 2/3 sloping wire, 1/3 raised litter. View from inside pen.

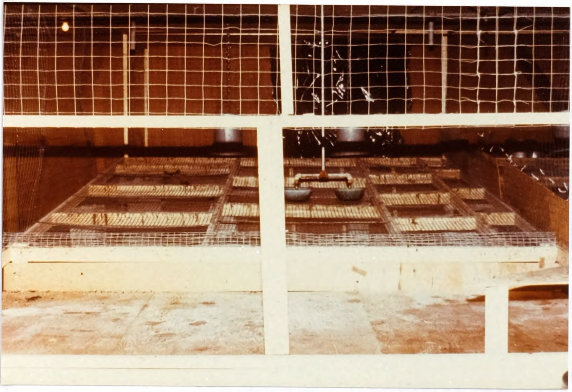

Figure 4. Treatment Pen 2, 2/3 sloping wire, 1/3 raised litter floor pen. View from outside pen.

Figure 5. Treatment Pen 3, full sloping wire floor pen. View from inside pen showing plastic nest hood.

of Pen 3, which was 3.35 m, and 1.22 m over the pen floor and attached to the front of the pens directly above the entrance doors. The end of the hood extended over the floor and was attached by rope and pulley to the ceiling of the room. By manipulating the ropes from outside the pen the hood could be lowered to within 30 centimeters of the wire floor. When lowered, this hood provided a darkened area similar in purpose to the corner nest platforms in Treatments 1 and 2.

A solid wall divider 45 cm high and 6.1 m long was installed between Treatment Pens 2 and 3 to prevent interaction of males in adjoining pens. This divider was not necessary between Treatments 1 and 2 as a minimum height of 91 cm separated the birds in these pens.

The floor frame constructed of 2.54 x 5.08 cm lumber used to support the wire mesh floor was supported by cinder block columns as shown in Figure 6. These supports were positioned so that clear spans of lumber were not longer than 2.45 cm.

The wire mesh floor used was 14 ga 2.54 cm x 3.81 cm welded wire mesh stapled to the lumber frame. To reinforce the wire and prevent sagging that would prevent eggs from rolling to the base of the pen slope, iron rods were positioned under the wire expanses as shown in Figure 7 and anchored to the lumber floor frame.

The general specifications for the three treatment pens are included in Appendix A and were modified for pheasant breeders from specifications published by Bressler et al. (1974) for Leghorn breeders in sloping wire floor poultry houses.

Ventilation was provided by a thermostatically controlled 61 cm single-speed fan fitted with a light control hood which serviced the

Figure 6. View from below sloping wire floor showing lumber frame and cinder block support columns.

Figure 7. View from above sloping wire floor showing feeders, waterers and metal rod floor reinforcements.

entire room. The thermostat was adjusted daily to provide maximum air flow under the prevailing climatic conditions. Air inlets located at the south side of the room, opposite the fan, were adjusted for summer and winter ventilation, accordingly, during the course of the experiment, which ran from February to June of 1983. During the months of February and March, insulation material was placed in all but one of the five air inlets to reduce the extent of the cold air entering the room. One gas hover brooder stove was installed nearest the open air inlet to provide supplemental heat when necessary to prevent freezing of the water pipes. Temperatures were maintained above 7°C during the course of the study.

The pheasant breeders, 288 hens and 42 cocks, were randomly selected from a group of birds on range at the Department of Natural Resources Rearing Unit. All the birds came from eggs hatched during the spring of 1982 and, at the start of the experiment, were approximately 40 weeks of age.

Hens were housed at the University facility two weeks before the cocks. The hens were maintained during this period on ten hours light (10:L, 14:D) and fed *ad libitum* a 13 percent protein pelleted maintenance diet (Appendix B). Prior to their random assignment in one of the three treatment pens, all the hens were weighed and leg banded. In addition, the primary feathers of one wing were cut to minimize flying and plastic blinders (specs) were fitted over the beak of each bird and secured through the nostrils as an aid to controlling cannibalism (Shellenbarger, 1976; Flegal and Sheppard, 1976). At the time males were housed, hens in all three pens had come into production and were laying at an average hen housed percent production of 18.25.

Prior to housing with the hens the cocks were subjected to increasing natural daylight in outdoor pens, and fed ad libitum a 13 percent protein pelleted maintenance diet (Appendix B). All males were weighed and leg banded. As with the hens, the primaries of one wing were clipped and plastic blinders (specs) were affixed to the beak of each cock. Using nail clippers, the spurs and rear toenails of each male were clipped. This was done to reduce the injury to females which sometimes occurs during mating (Dorn, personal communication).

The males were randomly assigned to one of the three treatment pens. Upon housing in the experimental facility the male to female ratio was one to seven and the density was .18 square meters per bird. All birds were housed two weeks prior to the first egg collection and were started on a 17 percent protein pelleted breeder diet ad libitum (Appendix B).

Lighting was provided by nine red colored 40 watt incandescent bulbs to reduce cannibalism while still stimulating production (Shellenbarger, 1976; Rood and Davidson, 1959; Ringer and Sheppard, 1960). A 15 hour lighting schedule was utilized (15:L, 9:D) and light was provided by use of a time clock from 0630 to 2130 throughout the laying period.

In addition to the red bulbs, three reostatically controlled 40 watt incandescent white bulbs were utilized to provide proper illumination for egg collection and loss egg counts.

Water was supplied by two self filling plastic water cups in each pen. Feed was transported from the Department of Natural Resources Hatchery in bulk and weighed into large containers, each holding 60 kg of feed, for use in the individual pens. Feeding was accomplished manually and feed was weighed back weekly to determine feed consumption. It was necessary to enter only Treatment Pen 1 to fill the tube feeders as both Treatment 2 and 3 could be fed using a 20 cm diameter 1.8 m long metal pipe to reach to the feeder from outside the pen.

Cleaning of litter and below wire portions was done every 28 days or as necessary, as in the case of water leaks. To cover the floor in Treatment 1, five bags of .10 cubic meter kiln dried wood shavings were used each time. The raised litter floor in Treatment 2 required two bags of .10 cubic meter kiln dried wood shavings at cleaning. Manure below the wire portions was removed manually with the use of a long-handled rake.

The decision to clean the manure from below the wire floors, in Treatments 2 and 3, each 28 days rather than once over the course of the study, was based upon the need to make egg loss through the wire more accountable. The actual depth or condition of the manure would not warrant this frequent cleaning under non-experimental conditions (Personal Observation).

Eggs were gathered daily and marked with date and treatment pen number. Egg collection in Treatment Pen 1 required a full search of the litter floor. Concentrations of eggs were found along the walls and below the corner nest platforms. Treatment Pen 2 was entered only in the litter area. This was done after all eggs in proximity to the entrance door were collected while the collector was still outside the pen. The majority of eggs could be reached while the collector was positioned at the center of the litter floor. Eggs still on the wire and not concentrated at the wire catch were moved to this point by use of a long handled wooden scraper. Treatment Pen 3 was not entered to collect eggs. Those not concentrated at the base of the pen nearest the entrance doors were moved to this point by use of a 3.5 m long wooden scraper.

All eggs were examined for cracks at point of collection and again prior to setting. At collection time, the intensity of the reo-statically controlled lights was increased and a thorough search of the litter in Treatment 1 and 2 and the manure below the wire floor in Treatment 2 and 3 was made for broken eggs. These were recorded and removed to prevent recounting.

After collection the eggs were loaded on flats holding 30 eggs each and were transported to an egg cooler where they were held for no longer than seven days at 10-15.5°C and 70-80 percent relative humidity as recommended by Dorn (1976).

Each week for 12 weeks eggs were sorted by pen, examined for cracked eggs and sanded clean if necessary. Additional cracked eggs found at this time were added to the total cracked eggs observed at collection and the totals re-calculated. Eggs were placed in Jamesway pheasant setting trays 200-230 eggs per tray large end up.

The 2-2.5 percent unbroken "blue" shelled eggs collected were set as well eventhough they have significantly lower hatchability (Hulet *et al*., 1978). The purpose was to get accurate records on fertility. Over the course of the study total blue eggs set did not exceed 2.5 percent for any setting.

Eggs on setting trays were placed in Jamesway 252 single stage incubators and controlled for temperature, humidity, turning and air exchange according to manufacturers guidelines for pheasant eggs (Appendix C). Eggs were incubated for 20-21 days at which time trays were removed for transfer.

At transfer each egg was examined individually with a hand held candling light to identify infertiles and early deads. Due to the dark shell color of many pheasant eggs, when it was questionable as to the fertility status of an egg, that egg was considered fertile and placed in the hatcher. Infertile eggs removed at candling were all broken out and by close observation of the germinal disk, blood, or small embryos they were classified as fertile or non-fertile and recorded. Other general observations of the eggs made at this time included hairline cracks and body checks.

Eggs showing embryo development were then transferred from the incubation trays by treatment pen and placed in hatching trays with a maximum of 200 eggs per tray. These were then placed in another Jamesway 252 hatcher where temperature and humidity were regulated for hatching (Appendix C).

Hatching trays were removed on the 24th day of incubation and hatched chicks were counted by treatment and placed in chick boxes for transport to the Department of Natural Resources Rearing Unit. Dead or weak chicks which had hatched were not added to the chick count when calculating hatchability; these were recorded separately at hatching.

All unhatched eggs were broken out and classified as pipped eggs with live embryos, pipped eggs with dead embryos, or unpipped eggs with live or dead embryos. Eggs showing no germ development were classified as infertiles and recorded.

At the conclusion of 12 weeks of production the adult breeders were terminated by cervical dislocation and re-weighed. The approximate age of both males and females was 54 weeks.

Records for egg production, broken eggs and mortality were recorded daily. Feed consumption, settable eggs, fertile eggs, chicks hatched and summary of unhatched eggs were recorded weekly.

Management activities such as feeding, cleaning and egg collection were done at the same time each day and consecutively for each pen to standardize records and reduce disturbance to the breeder birds.

Daily and weekly data were summarized for each treatment using a standard analysis of variance. Treatment means were analyzed using a Bonferroni T statistic for a small number of non-orthogonal contrasts with balanced data (Gill, 1978). Percent data were transformed according to Gill (1978) prior to analysis.

RESULTS AND DISCUSSION

Egg Production

Egg production parameters for the three treatments during the 84 days eggs were collected for setting are presented in Table 1. Total eggs, which include both settable and broken eggs recorded for each treatment show no significant differences between the three treatments. Hens in Treatment Pen 3 averaged 10 percent lower production than hens in either Treatments 1 or 2. When expressed as eggs per hen housed, hens in Treatment 3 produced 5.3 and 4.4 less eggs per hen when compared with the hens in Treatment 1 or 2, respectively.

The 1983 breeder production performance summary for pheasants housed at the DNR Hatchery is presented in Appendix D_1. For 83 days of production hens in pens one through four produced in the range of 44.91 to 51.84 eggs per bird which is 54.11 to 62.46 percent hen housed production. Average hen housed percent production for the three treatment pens in this experiment was 54.15, 53.18 and 47.82 percent for Treatments 1, 2 and 3, respectively.

A graph of hen housed percent production for the three treatments and the 1983 DNR flock results, computed on a weekly basis, is presented in Figure 8. Peak production for the DNR flock reached 72.55 percent while peak hen housed production for Treatment 1 was 68.15 percent, Treatment 2 was 70.98 percent and Treatment 3 was 64.24 percent.

Though not significant, the differences in high and low hen housed production within the three experimental treatment pens was 6.33 percent

Table 1. Egg production parameters for Ring-necked pheasants housed on litter, 2/3 sloping wire or full sloping wire floors[1]

	Litter	2/3 Wire	Full Wire
Total Eggs	4367	4288	3856
Eggs/Bird	45.49	44.67	40.17
Hen Housed Production %	54.15	53.18	47.82
Hen Day Production %	55.66	54.03	49.16
Hen Housed Peak Production %	68.15	70.98	64.24
Total Broken Eggs	495[a]	373[a]	1364[b]
Broken Egg/Bird	5.16[a]	3.89[a]	14.21[b]
Broken Eggs %	11.34[a]	8.70[a]	35.37[b]

[a,b]Values in the same row with different superscripts are significantly different ($P \leq 0.05$).

[1]During 84 day laying period.

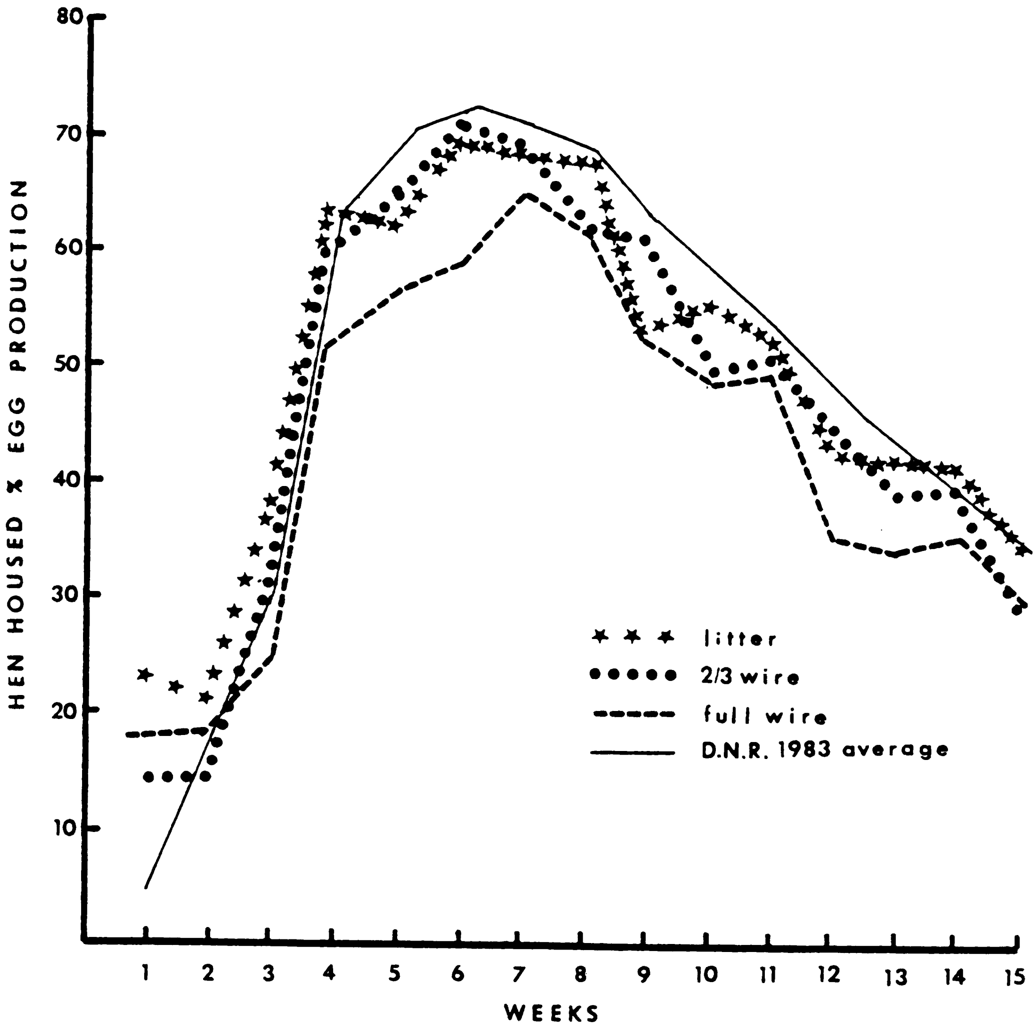

Figure 8. Hen housed egg production curves for pheasant breeders housed in experimental treatment pens and the DNR 1983 flock average.

between pens 1 and 3. The peak production difference was greatest between pens 2 and 3 and was 6.74 percent.

The average hen housed production for the DNR flock was 6.52 percent above the production recorded for all birds in this experiment and peak production difference averaged 4.76 percent. Maximum difference for hen housed production between the five DNR breeder pens for the 1983 season was 8.35 percent.

A survey of production results reveals wide variations in production performance of breeder hens. In studies at Michigan State aimed at improvement of egg production in pheasant hens Wing (1976) reported for the year 1970-1976 production performance ranging from 32.9 percent to 54.0 percent hen housed. Carpenter (1980) in further work with selected pheasants showed average production reached 65.8 percent by 1979 and selected hens produced from 78.08 to 84.80 percent hen housed. By 1982 Fathy (1982), working with these lines of high production pheasant hens, reported production in selected pheasants from 93.8 to 107.2 eggs per hen housed during a 120 day production period.

Blake (1984) working with the effects of ahemeral light/dark cycles on pheasants found the hen day production of birds exposed to a 24 hour light cycle to be 55.2 percent while birds on 22 and 26 hour light cycles produced at 58.4 and 61.8 percent, respectively.

Spiller and Jordan (1976), who housed pheasant breeders on sloping wire floors, reported that hen housed egg production of birds housed at .18 square meters per bird averaged 45.71 percent hen housed and peak production at 72.3 percent hen day.

Other authors have reported various production results: Woodard (1971) 50.55-54.28 percent hen housed; Reynnells (1979) 58.3-70.5 percent hen day; and Hussien (1983) 40.9-81.2 percent hen housed.

Results by Sheppard and Flegal (1973) with three strains of pheasants indicate a wide variation in egg production potential of the pheasants tested. Individual hens laid from 0 to 218 eggs over the ten month study .

Standard production goals expressed as percent hen day or percent hen housed production on curves for commercial layer and breeder flocks commonly vary as much as 5-10 for any period of production (DeKalb, H & N, Cobb, 1985). Egg production curves for pheasants in the three treatment pens (Figure 8) show variations similar to what is expected by the above listed breeders of high production commercial poultry.

The values for hen housed and hen day production reported in this study compare favorably with production performance of pheasant breeders reported by other authors although the values for pheasant egg production in the literature support the wide variation in egg production that occurs between and within the pheasant populations studied.

As compared to the birds housed at the DNR Hatchery, pheasant hens in this experiment showed similar egg production. Differences in hen housed production between pens of breeders housed at the DNR are similar to the range of production performance observed between treatment pens in this experiment.

Broken Eggs

Broken eggs recorded over the 84 day laying period are presented in Table 1. Both Treatment 1 and Treatment 2 showed similar numbers of total and broken eggs per bird, as percent of total production eggs lost to breakage was 11.34 percent and 8.70 percent for Treatment 1 and 2, respectively. It should be noted that dirties accounted for less than 1 percent of all eggs discarded in this experiment.

By far the most significant ($P \leqslant .05$) result was the number of broken eggs in the full sloping wire pens as compared to either of the other treatment pens. A total of 14.21 broken eggs per hen was recorded on the full sloping wire floor pen, which translated to 35.37 percent of production lost to breakage. At the DNR Hatchery the percent of all eggs discarded, which includes dirty, broken and "blue" shelled eggs, was 15.02 percent for the 1983 season (Appendix D_1).

Number of broken eggs reported in Treatment 3 of this experiment was significantly higher when compared to the other two treatments and was observed to be excessive compared to the 15.02 percent discarded eggs at the DNR Hatchery. Similar results were reported by Spiller and Jordan (1976) with pheasants housed on sloping wire floors. Breakage for all eggs was calculated at 15.9 percent of production, and for eggs not laid in the available nest boxes breakage was in excess of 25 percent.

Blake (1984) housed pheasant hens in single sloping wire floor cages where eggs would roll out of reach of the hen. Records for loss eggs indicates between 4.98 and 6.26 percent cracked and shelless eggs were common.

Data for eggs produced by birds on sloping wire is most often with breeders accustomed to nest box use, primarily, broiler and leghorn breeders.

Bressler and Burr (1977) calculated the egg breakage for eggs from broiler breeders on sloping plastic floors. Eggs not laid in the nest boxes accounted for 2.4 to 2.8 percent of production; these floor eggs experienced a breakage of 30.8 to 46.5 percent.

Bressler et al. (1974) worked with commercial laying pullets on sloping wire floors. Reports show that although less than 2 percent of the eggs were laid on the floor these eggs experienced breakage at a rate of 17 percent.

Settability

Settability data for eggs from the 84 days of production are presented in Table 2. Total eggs settable and percent settable figures indicate the effect 35 percent broken eggs in Treatment 3 had on these parameters.

While settability for eggs from Treatment 1 and 2 averaged 88.7 and 91.3 percent, respectively, over the course of the study, a significantly lower average settability of 64.6 percent was experienced in Treatment 3.

The settability figures include an average of 2 to 2.5 percent unbroken blue shelled eggs. These eggs which are normally discarded at the DNR Hatchery due to poor hatchability (Dorn, Personal Communication) were set in this experiment to get accurate fertility records.

Table 2. Settability, fertility and hatchability for eggs of Ring-necked pheasants housed on litter, 2/3 sloping wire or full sloping wire floors[1]

	Litter	2/3 Wire	Full Wire
Total Settable Eggs	3872[a]	3915[a]	2492[b]
Settability %[2,4]	88.7[a]	91.3[a]	64.6[b]
Settable Eggs/Female	39.51[a]	40.47[a]	25.63[b]
Fertility	82.4	81.9	82.3
Fertile Eggs/Female	32.70[a]	33.14[a]	20.53[b]
Hatchability[3,4]	71.3	73.2	70.1
Chicks/Female	23.22[a]	23.00[a]	14.56[b]

[a,b]Values in same row with different superscripts are significantly different ($P \leqslant 0.05$).

[1]During 110 day hatching period.

[2]Abnormal, dirty and broken eggs not set.

[3]Hatch of fertile eggs.

[4]2-2.5% "blue" shelled eggs included.

Appendix D_3 presents weekly settability for eggs at the DNR Hatchery during the spring 1983 hatching season. Settability figures ranged from 79.0 to 89.1 percent over the 10 weeks presented and averaged 84.4 percent.

The significantly lower settability experienced in Treatment 3 resulted in a significantly lower number of fertile eggs per female and chicks per female when compared to Treatments 1 and 2.

Egg Collection

Despite the fact that corner nest platforms were installed in Treatment 1 to encourage hens to concentrate eggs at these points, it remained necessary to search the entire pen to collect all the eggs. The movement in the litter pen required to completed this search resulted in broken eggs and remained inefficient as was evident by whole and broken eggs found during litter removal.

In excess of 80 percent of all eggs in Treatment 2 were commonly concentrated in the 1/3 litter portion of the pen. Due to the size of this area (2.13 m x 3.35 m) it was observed that less walking around the pen was required to reach all the eggs. The search of this area was more efficient as fewer eggs were found during litter removal as compared to Treatment 1. Observation of the birds during the light period indicated that the feeder and waterers positioned over the wire in Treatment 2 helped keep birds on the wire floor area. Similar observation during the dark indicated the majority of the birds roosted on the wire.

Due to the slope of the wire in Treatment Pen 3, 70 percent of the eggs in this pen could be found under the nest hood at collection time.

It was observed that in excess of 80 percent of all broken eggs could also be found here. The smaller of the pheasant eggs could frequently be found wedged in the 2.5 x 3.8 cm mesh floor making them more susceptible to breakage.

In addition to breakage, data were recorded on body checks observed at collection and at candling during transfer. Body check eggs are defined as eggs with obvious cracks that were repaired in the uterus prior to laying. At least 90 percent of the eggs from Treatment 3 were observed to be body checks while in Treatment 2 only 30 percent body checked eggs were evident. Body checked eggs in Treatment 1 were found in 10 percent of the eggs gathered.

Fertility and Hatchability

Fertility based on candling of all eggs set and macroscopic observation of all unhatched eggs was similar for all treatments, averaging 82 percent for all pens (Table 2). The DNR Hatchery fertility estimates are based on a small sample of candled eggs randomly selected at intervals during incubation. Approximated fertility for the DNR breeders ranged from 76 to 85 percent with an average of 80.3 percent for all hatches (Appendix D_3). Hatchability expressed as hatch of fertile eggs was similar for all treatment pens and averaged above 70 percent for the hatching period in the trial. DNR records indicate an average 79.3 percent hatch of fertile eggs and a 63 percent hatch of all eggs set.

Data in the literature for fertility of pheasant eggs also is subject to variation. Much of this variation must be considered with respect to male to female ratios, stocking densities and the use of natural or artificial insemination.

Woodard (1971) reported that for natural matings an average fertility of 90 percent can be maintained with Ring-neck pheasants. Weisner (1935) also reported fertility of pheasant eggs under a natural mating system to be as high as 90-91 percent.

Spiller and Jordan (1975) housed pheasant breeders on sloping wire floors at a male to female ratio of 1:12. Fertility for birds housed at different densities ranged from 49.9 percent to 68.4 percent.

Wing (1976) reported a range of 30 to 53.5 percent fertility in eggs from pheasant hens in studies aimed at selection of high producing pheasant hens. Mating in this study was carried out by placing a single male and female pheasant in a pen for approximately eight hours on a rotation schedule.

Using a 1:10 male to female ratio, Adams _et al_. (1968) reported fertility of 66.8 to 74.6 percent for pheasants housed on wire and in sand floor pens, respectively.

Dorn (1976), studying storage effects on pheasant egg hatchabilty, gave fertility values of 74.16 to 83.45 percent for birds housed on litter floors at a male to female ratio of 1:7.

In experiments by Champion _et al_. (unpublished), using natural mating, fertility of eggs from yearling pheasant averaged 69.58 percent while two year old flocks had an average fertility of 63.48 percent.

Reynnells (1979), in a pheasant nutrition study, used both a natural mating system for floor housed breeders and artificial insemination for individually caged birds. Fertility for floor breeders housed at a male to female ratio of 1:7 ranged from 58.5 to 82.9 percent. Caged breeders, artificially inseminated, produced eggs that were 89.8 to 97.4 percent fertile.

Other authors utilizing artificial insemination programs did not report fertility nearly as high. Carpenter (1980), for selected high producing pheasant breeders, reported averages of 73.48 to 80.64 percent fertility. However, in the whole population studied individual breeder hen fertility ranged from 68.12 and 69.56 percent during the same years.

Hussein (1983), using an artificial insemination program to select for fast feathering pheasants, reported fertility in selected lines ranged from a low of 58.7 percent in one generation of slow feathering birds to 78.9 percent for one generation of rapid feathering lines.

Blake (1984) found significantly higher fertility, 89.3 percent, for pheasant breeders housed under a 26 hour light dark cycle (14L:12D) when compared to that for pheasant breeders on 22 and 24 hour light cycles, which had fertility rates of 80.7 and 78.4 percent, respectively.

The results from this study for fertility of pheasants on sloping wire using a 1 to 7 male to female ratio compare to or exceed results in the literature for most natural and artificial insemination programs with pheasants. Results by Woodard (1971), Weisner (1935) and Reynnells (1979) greatly exceeded the fertility experienced in this experiment. Fertility for the DNR flock was similar to pheasants on sloping wire floors and averaged 80.3 percent for all hatches (Appendix D_3).

It should be noted that the DNR hatchability figures presented in Appendix D for the 1983 hatching season show hatch of fertile eggs from 74 to 84 percent and an average of 79.3 percent for all hatches. These figures were computed after pipped eggs with live embryos were manually broken out or replaced in the hatcher for an additional day for hatching. In this experiment, eggs not hatched by the 24th day of incubation were discarded as these chicks are assumed to be less desirable and not normally saved by hatcheries (Coleman, Personal Communication; Flegal, Personal Communication).

If the treatment pens in this experiment are adjusted to include the eggs listed as pipped with live embryos in Table 3, hatchability figures become 78.4 for Treatment Pen 1, 80.7 for Treatment Pen 2 and 78.0 for Treatment Pen 3. Hatch of total eggs set for the three treatment pens in this trial then becomes 62 percent as compared to 63 percent hatch of all eggs set by the DNR in 1983.

Hulet _et al_. (1978) studied the hatchability of pheasant eggs of the various shell colors. Eggs of olive color showed the highest hatchability, 71.7 percent, while blue eggs showed a hatchability of fertile eggs of 38.2 percent. For all egg shell color categories except blue hatchability was 62.25 percent.

Hatchability for pheasants reported by Champion (unpublished) for eggs from yearling and 2 year old pheasants averaged 74.67 and 70.15 percent, respectively.

Spiller and Jordan (1975) present data which show the hatch of fertile eggs for all pheasants on sloping wire was 75.8 percent. Similar eggs held for seven days hatched at a rate of 70.0 percent. Woodard (1971) reported a range of hatchability from 40-60 percent, while Adams _et al_. (1968) found hatchability averaged 72.2 percent for all pheasant eggs studied.

In work by Reynnells (1979) eggs from naturally mated birds housed on the floor expressed 57.9-72.5 percent hatch of fertile eggs while hatchability in those from caged artifically inseminated birds ranged from 63.6 to 87.0 percent. Other authors report a similar range in hatchability: Wing (1976) 67.9-72.0 percent and Carpenter (1980) 65.43-75.29 percent.

Unhatched Eggs

Eggs not hatched on the 24th day of incubation were broken out to determine stage of development. This is reported as pipped eggs with embryo alive, pipped eggs with embryo dead and unpipped eggs with either embryo alive or dead. Values for all pens for all categories are similar (Table 3). Unpipped eggs made up the largest percentage of unhatched eggs, followed by pipped eggs with live embryos and pipped eggs with dead embryos. These unhatched eggs were discarded in this experiment.

Little data has been presented concerning the stage of development of pheasant eggs which do not hatch. Work by Blake (1984) gives average percent dead embryos from eggs of pheasants on various light/dark cycles. Values for dead embryos range from 13.6 percent of fertile eggs to as high as 25.1 percent. In the present experiment, if categories for pipped eggs with dead embryos and unpipped eggs (Table 3) are summed, values for approximate percent of dead embryos for the three treatments averaged 20.7 percent of fertile eggs.

Champion _et al_. (Unpublished) presented data for unhatched pipped eggs and pipped eggs plus eggs with dead germs as percent of fertile eggs in different shell color categories. For all color categories

Table 3. Observations of unhatched fertile eggs and poor quality chicks at hatching for eggs from Ring-necked pheasants housed on litter, 2/3 sloping wire or full sloping wire floor[1]

	Litter	2/3 Wire	Full Wire
Egg Pipped, Embryo Alive %	7.1	7.5	7.9
Egg Pipped, Embryo Dead %	2.5	2.5	2.4
Egg Not Pipped %	18.1	16.3	18.8
Total Fertile Eggs Not Hatched %	27.7	26.3	29.0
Chicks Weak or Dead at Hatch %[2]	1.0	0.5	0.8

[a,b]Values in the same row with different superscripts are significantly different ($P \leq 0.05$).

[1]During 110-day hatching period.

[2]Birds not included in hatchability or chicks per female figures.

pipped eggs at hatching made up 7.5 percent (range 3.12 to 14.63 percent for colors olive to blue). Pipped eggs plus eggs with dead germs made up an average of 33.3 percent of the fertile eggs incubated.

In the present study an average of 27 percent of fertile eggs were classified as unhatched by 24 days of incubation. Mortality at hatching in the form of dead or weak chicks accounted for less than 1 percent of fertile eggs.

Feed Consumption

Feed consumption for the 96 days birds were housed in the experimental facility and feed conversion for the 84 days eggs were collected for hatching are presented in Table 4.

Feed consumption reported as grams per bird per day averaged 86 gms for all pens. When expressed as feed conversion, birds in Treatment 1, 2 and 3, respectively, consumed 2.4, 2.5 and 2.8 kilograms of feed per dozen eggs. These feed conversion values included feed consumed by both males and females in each pen.

Feed consumption for the DNR flock (Appendix D_2) averaged 83.60 grams per bird per day and feed conversion was 2.72 kilograms per dozen eggs.

Blake (1984) measured feed intake of male and female pheasants housed separately in cages. In his trial, males consumed an average of 84 grams per bird per day while females consumed an average of 98 grams per bird per day. Data presented by Reynnells (1979) on adult pheasant feed consumption indicated lower values. Females consumed only 69.9 to 74.5 grams per bird per day while males ate 64 to 65 grams per bird per day.

Table 4. Feed consumption and conversion for pheasants housed on litter, 2/3 sloping wire or full sloping wire floors[1]

	Litter	2/3 Wire	Full Wire
Feed consumption[2] gms/b/d	86.0	85.7	86.3
Feed Conversion[3] kg feed/doz. eggs	2.4	2.5	2.8

[1]Breeder diet only.

[2]For 96 days birds were housed.

[3]For 84 days eggs were collected for setting.

Fuentes (1981) indicated laying pheasant females feed consumption as being between 60 and 70 grams per bird per day for various protein and methionine levels in the diet.

Mortality

Mortality for the 84 days of production is presented in Table 5. Female livability for Treatments 1 and 3 remained above 95 percent while hens in Treatment 2 had a livability of 97 percent. Livabilities of 95 percent and 97 percent correspond to 4 and 2 hens lost, respectively.

The greatest male mortality occurred in Treatment 3 due to mechanical cervical dislocation from being hung on pen netting used to support the nest hood. During the course of the experiment, one male in Treatment 2 was found dead while no male mortality occurred in Treatment 1. The principle cause of mortality in males was cannibalism while in females prolapse in conjunction with cannibalism was observed.

Female livability for pheasants housed on sloping wire with approximately .48 square meters per bird as reported by Spiller and Jordan (1975) compared favorably with the results from this study. An average of 95 percent livability was reported for females, and an overall average livability of 92 percent for birds housed at .18, .46, and .93 square meters per bird.

Mortality at the DNR Hatchery averaged 7.2 percent for all pens and ranged from 4.5 to 10.1 percent for individual pens during the 1983 breeding season.

The lower mortality experienced in this study as compared to the DNR pens may be due in part to the use of low intensity red lights in

Table 5. Mortality of Ring-necked pheasants on litter, 2/3 sloping wire or full sloping wire floors

	Birds/Pen	Final Inventory		
	Initial	Litter	2/3 Wire	Full Wire
Males	14	14	13	12[a]
Females	96	92	94	92
Female Livability		95.85	97.91	95.83
Total Mortality		4	3	6

[a]Males in full sloping wire pen both hung due to pen design problem.

the treatment pens, which provides an economical way to control picking and cannibalism (Shellenbarger, 1976).

The male mortality which occurred in Treatment Pen 3 was due to the use of flexible plastic netting to suspend the nest hood. This netting would entangle the pheasant's specs and cause them to hang until death occurred.

Body Weights

Statistical analysis of the bird weights after assignment to each treatment supports random distribution of the breeders (Table 6). At the conclusion of the 84 day laying period all birds were killed by cervical dislocation and weighed. This weight corresponds to 54 weeks of age. When comparing the final body weights of the male breeders in the three Treatments, there were no significant differences due to treatment. Final body weights of hens in Treatments 1 and 2 also show no significant weight difference. However, hens in Treatment 3 were significantly lighter in body weight as compared to hens in Treatments 1 and 2.

Fuentes (1981) recorded initial and final body weights of laying Ring-necked pheasant hens fed various protein and methionine levels. For birds fed diets similar to those in this study (18 percent protein and .29 percent methionine), initial weights at approximately 32 weeks of age averaged 1009 grams and final 48 week weights averaged 1189 grams.

Blake (1984) presented body weight data for both male and female pheasants at approximately 40 and 60 weeks of age. For males on a 24 hour light dark cycle initial and final body weights were 1527 grams and

Table 6. Mean ± S.E. of body weights for Ring-necked pheasants housed on litter, 2/3 sloping wire or full sloping wire floor

	Litter	2/3 Wire	Full Wire
Females			
36 Wks.	1178.65 ± 12.16	1186.96 ± 11.51	1168.70 ± 5.34
54 Wks.	1130.98 ± 12.62[a]	1149.73 ± 15.59[a]	1081.38 ± 14.36[b]
Males			
40 Wks.	1701.79 ± 34.01	1675.00 ± 33.76	1725.00 ± 35.94
54 Wks.	1500.00 ± 32.42	1463.46 ± 59.28	1445.83 ± 28.51

[a,b]Values in the same row with different superscripts are significantly different ($P \leqslant 0.05$).

1418 grams, respectively. For females the 40 week body weights averaged 1285 grams and at 60 weeks hens weighed an average of 1225 grams.

The significantly lighter body weights for hens in Treatment 3 in conjunction with the high incidence of body checked eggs from hens in this treatment may indicate some adverse effects of full wire floor on the hens in this experiment.

CONCLUSIONS

The results of this study with pheasant breeders kept on sloping wire floors indicate that good production and hatching results can be obtained from breeders housed on full sloping wire and 2/3 sloping wire, 1/3 litter floor pens as compared to full litter pens. No significant difference with respect to egg production, feed conversion, fertility, hatchability, and mortality was noted between birds kept in sloping wire pens and the full litter breeder pens.

Production results from this study compared favorably with the DNR 1983 flock results and reports in the literature.

A serious drawback to the use of full sloping wire floor pens for pheasant breeders is the excessive breakage which occurred in Treatment 3 as compared to birds which had access to litter. A more effective method of protecting or removing pheasant eggs laid on the wire floor needs to be designed to reduce the floor egg breakage.

The advantage of the 2/3 sloping wire 1/3 raised litter floor pen is the reduced litter use, concentration of manure under the wire, concentration of eggs in smaller litter area and decreased traffic on litter by breeders due to feeding, watering and roosting over the wire floor.

APPENDICES

APPENDIX A

Pen Specifications

APPENDIX B_1

Feed Formulations

APPENDIX B_2

Vitamin Premix

APPENIDX C

Jamesway Pheasant Hatching Guide

APPENDIX D_1

DNR Egg Production Results

APPENDIX D_2

DNR Feed Consumption

APPENDIX D_3

DNR Hatchery Results

Appendix A

Pheasant Pen Specifications

Treatment 1

3.05 m x 6.71 m wire enclosed cement floor
20.45m^2 total area
5 cm x 10 cm lumber frame
2 metal hanging tube type feeders
2 plastic self filling water cups
2 plywood corner nest cover platforms 30 cm high
5-10 cm deep wood shavings floor cover

Treatment 2

3.35 m x 6.10 m 1/3 litter 2/3 sloping wire floor pen
20.45m^2 total area
- 1/3 raised litter covered floor:
  - 2.13 m x 3.35 m plywood platform, not sloped
  - 5-10 cm deep wood shavings cover
- 2/3 sloping wire floor:
  - 4.27 m x 3.35 m, wire covered area
  - 5 cm x 10 cm lumber frame sloped 1/12
  - 2.54 cm x 3.81 cm 14 ga. welded wire mesh
  - cinder block support columns

2 metal hanging tube type feeders
2 plastic self filling water cups
1 plywood corner nest cover platform 30 cm high
5-10 cm wood shavings floor cover

Treatment 3

3.35 m x 6.10 m full sloping wire floor pen
20.45 m^2 total area
5 cm x 10 cm lumber frame sloped 1/12
2.54 cm x 3.81 cm 14 ga. welded wire mesh
cinder block support columns
2 metal hanging tube type feeders
2 plastic self filling water cups
3.35 m x 1.22 black plastic nest cover hood

Room Dimensions

10.67 m x 11.58 m clear span
2.44 m ceiling

Ventilation

1, 61 cm single speed thermostatically controlled fan
light control hood

Lighting

(15L:9D)
6 40 watt red bulbs
3 reostatically controlled 40 watt white bulbs

Appendix B_1

Pheasant Ration Specifications* (DNR-1983)

	*Maintenance Pellets	Breeder**
Crude protein, % min.	13	17.0
Calcium, % min.	1.00	2.30
Calcium, % max.	1.10	2.40
Phosphorus, % Available	.40	.45
Metabolizable energy, Cal/lb.	1050-1150	1050-1200
Methionine (per 1,000 M.E.)	.20%	.26%
Methionine & Cys. (per 1,000 M.E.)	.47%	.42%

*The vitamin-trace mineral premix must be as the attached premix.
**At least 5.0% of these rations must be made from:

Fish meal
Meat & bone meal
Whey, dried

Not more than 2.5% of the 5.0% may come from meat and bone meal.

Appendix B_2

Pheasant Vitamin-Trace Minerals (DNR-1983)

Amount Per 10 Pounds of Premix

Vitamin A, I.U.	12,000,000
Vitamin D_3, I.C.U.	2,000,000
Vitamin E, I.U.	20,000
Riboflavin, gm.	8
Calcium pantothenate, gm.	14
Niacin, gm.	40
Choline chloride, gm.	800
Vitamin B_{12}, mg.	20
Folic Acid, mg.	1,000
Menadione sodium bisulfate, gm.	3
Biotin, mg.	100
BHT, gm.	225
Manganese, gm.	66
Zinc. gm.	48
Iron, gm.	30
Copper, gm.	4
Iodine, gm.	1.5
Cobalt, gm.	.2
Selenium	(at .2 mg/kg of feed)

Usage Per Ton of Complete Feed

Starter	12 1/2 pounds
Grower	10 pounds
Flight and Main.	10 pounds
Breeder	12 1/2 pounds

Appendix C

Guide for incubation of pheasant eggs*

	Dry Bulb Temperature	Wet Bulb Temperature	Exhaust Setting
1st day to 3rd day	100°	88°	Closed to 1/8" opening
3rd day to 12th day	100°	82°-83°	1/8" opening
13th day to transfer	99 3/4°	82°-83°	1/8" to 1/4" opening
After transfer (22nd day)	99°	86° After transfer bring humidity up to 86° and allow it to go up to 90° when hatching starts.	Ventilate only enough to hold humidity.
Hatching	98 3/4°	88°-90°	During hatching when humidity reaches 89° open exhaust to hold the wet bulb at 89° Ideal would be 88° to 90° wet bulb with wide open exhaust

*Taken from Temperature, Humidity and Ventilation Guide for Model Jamesway 252 Single-Stage Incubator-Hatcher.

Appendix D_1

1983 breeder production performance for pheasants housed at the DNR hatchery.

Pen No.	Number Eggs Gathered	Number Eggs Discarded	Number Eggs Set	Percent Eggs Set	No. Days In Production At First Eggs	Number of Eggs/Bird At Lighting	Percent Hen Housed Production	Mortality Hens In	Mortality Hens Out	Percent Mortality
1	34854	5334	29520	84.70	83	44.91	54.11	776	700	8.9
2	39918	6533	33385	83.60	83	47.46	57.19	841	790	6.0
3	39963	6377	33626	84.10	83	48.32	58.22	827	772	6.5
4	31520	4608	26912	85.40	83	51.84	62.46	608	547	10.1
5	36818	4642	32176	87.40	74	43.70	59.20	841	802	4.5
TOTAL OR AVERAGE	183073	27494	155619	85.04		47.23	58.24	3893	3611	7.3

Appendix D_2

1983 Feed consumption summary for pheasants housed at the DNR hatchery*

Pen No.	Breeder Kg	Gms/Bird/Day	Kg Feed/Doz. Eggs
1	7337	73.17	2.53
2	9789	90.31	2.94
3	9498	88.84	2.85
4	6622	84.64	2.52
5	8464	81.04	2.76
TOTAL OR AVERAGE	41710	83.60	2.72

*Estimates based on breeder feed only.

Appendix D_3

1983 Pheasant hatching performance summary for breeders housed at the DNR hatchery.

Hatch No.	Hatch Set Date	# Eggs Gathered	No. Discarded	# Set	Percent Settable Eggs	Date Hatched	# of Chix Hatched	% Hatched of all Eggs Set	Approximate Percent Fertility	Percent Hatch of Fertile Eggs
1	3/18	13571	1472	12099	89.1	4/12	8060	67.0	82.0	83.0
2	3/25	17333	2165	15168	87.5	4/19	9261	61.0	81.0	80.0
3	4/1	17104	2214	14890	87.1	4/26	9854	68.0	83.0	82.0
4	4/8	17689	2741	14948	85.0	5/3	9497	64.0	85.0	77.0
5	4/15	13808	2015	11793	85.0	5/10	7128	60.4	82.0	74.0
6	4/22	17182	2418	14764	85.0	5/17	9930	68.0	81.0	84.0
7	4/29	14865	2861	12004	82.0	5/24	7616	64.0	78.0	82.0
8	5/6	14777	2804	11973	82.0	5/31	6981	59.0	76.0	77.0
9	5/13	14056	2131	11925	84.0	6/7	7257	61.0	77.0	80.0
10	5/20	14360	2467	11893	83.0	6/13	6350	58.0	78.0	74.0
11	5/27	11307	2371	8936	79.0					
Total or Average		166052	25659	140393	84.4		82739	63.0	80.3	79.3

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