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Economic incentives for pheasant production in Iowa

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ECONOMIC INCENTIVES FOR PHEASANT PRODUCTION IN IOWA

by

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INTRODUCTION

This study examines the role of private Iowa firms in supplying ring-necked pheasants as an input for recreational hunting. Public ownership of this upland game bird has given jurisdiction over its harvest to the State of Iowa, but control of land use and access on the pheasant production and hunting areas rests almost entirely with private farm firms.

Attention is given to the economic advantage to Iowa of maintaining an adequate supply of pheasant hunting opportunities and the means to produce this supply. Emphasis is placed on the feasibility and expected results of an economic incentive for pheasant production on naturally populated hunting areas.

Intensive use of farm land in northwest and north central Iowa for production of grain is becoming very competitive with pheasant production. This is evidence that an economic incentive provided by a market for pheasant hunting areas is necessary to maintain pheasant habitat. Continued decline of the hunting quality in much of the area where pheasants have demonstrated their ability to thrive in the past will mean the loss of a valuable source of outdoor recreation opportunity and the forfeiture of economic development generated by nonresident hunters attracted to Iowa.

Participation in Outdoor Recreation

Participation in outdoor recreation activities by Americans has been steadily increasing since World War II in both absolute and per capita measures. For example, recreational visits to reservoirs managed

by the U.S. Corps of Engineers increased from 5 million in 1946 to 106 million in 1960. Visits to national forests and national parks increased from 25 million to 105 million in the same 15 year period, while the U.S. population increased at a much slower rate, from 140 million to 180 million (57, p. 6).

The rapid increases in use of outdoor recreation facilities in the last 20 years can be attributed largely to increases in four variables; leisure, per capita income, mobility and population. Increased leisure allows extra time for outdoor activities. Equally important are the increased incomes and mobility which allow the growing population a greater selection of activities, timing and locations. Table 1 is a time series of these four variables which have had a major impact on participation in outdoor recreation. Projections for 1976 and the year 2000 are also given.

Leisure is defined here as a residual of the total hours available in a unit of time, such as a week, after the time requirements for survival activities--wage work, sleeping, eating and other necessities-- have been deducted. Leisure and recreation are not synonymous. Leisure is time, recreation is activity. Recreation is those activities which form an outlet of creativity, both in a physical sense and an emotional sense.

Increased labor productivity in the United States has provided an opportunity for workers to increase both their leisure and their incomes. The increases in weekly hours of leisure and per capita income have been most rapid since World War II, but the historical trend can be better shown by comparing those measures for the pre-depression year of

Table 1. Population, real disposable income, travel by automobile and leisure; 1929, 1940, 1950, 1960 and projections for 1976 and 2000[a]

Year	Population (millions)	Per capita real disposable income (thousands of 1960 dollars)	Per capita intercity automobile travel (thousands of passenger miles)	Weekly hours of leisure per employed person
1929	121.8	1.22	1.34	14.5
1940	132.0	1.28	1.88	18.8
1950	151.2	1.68	2.66	21.6
1960	180.0	1.96	3.89	23.1
Projected data				
1976	229.5	3.12	6.09	26.6
2000	349.2	4.18	8.00	30.6

[a]Source: (57, p. 22).

1929 with those of 1960. While per capita real disposable income increased from $1,220 in 1929 to $1,960 in 1960, the estimate for weekly hours of leisure per employed person is 14.5 hours in 1929 and 23.1 hours in 1960 (57, p. 6). The paid vacation is an important part of the total number of leisure hours. It provides the time for people to take the longer trips to reach outdoor recreation facilities without a loss of income. The average paid vacation was 2.0 weeks in 1960 and is expected to reach 2.8 weeks in 1976 and 3.9 weeks in the year 2000 (57, p. 22). Increased mobility and incomes increase the range and number of recreation facilities available on paid vacations. They also make the

weekend trips and after-working-hours trips to reach outdoor recreation facilities possible.

Income and leisure are available to most Americans in quantities in excess of the requirements to meet their basic needs. The surplus will be used for time and dollar expenditures on additional goods and services they want. There is a division in the United States labor force between those who enjoy what they are doing and those who are working to earn enough income to do things they want to do in their leisure. Outdoor recreation is often one of the things people who enjoy their work want to do in their leisure for a change of pace. For the other group outdoor recreation may be one of their primary objectives for working. These wants when combined with the ability to purchase a good or service become demand. Demand for outdoor recreation includes willingness and ability to pay and is expressed as a schedule of volume (visits, occasions, user-days, etc.) in relation to the cost of the recreation experience to the participants. Demand for outdoor recreation is an indication of the value people place on these activities to meet their psychogenic needs. When they choose to spend their time and money on outdoor recreation they value these activities more than any other goods or services which would have required the same or less time and money.

The aggregate effect of more leisure, available to more people, and the possibility that people will allocate a greater proportion of their leisure time to outdoor recreation activities will continue to expand the demand for outdoor recreation opportunities in the future. The Outdoor Recreation Resources Review Commission estimates that the participation in outdoor recreation activities in the year 2000 will be

triple that of 1960 (57, p. 22).

Federal, state and local governments have become increasingly concerned with the problem of meeting present and future demands on public outdoor recreation facilities. Recent surveys and studies of outdoor recreation have provided much of the information needed to better cope with this problem. A major step toward providing the information was made when the U.S. Congress established the Outdoor Recreation Resources Review Commission (O.R.R.R.C.) in 1958. Congress assigned it the task of providing (1) facts on present recreation needs and wants of the American people and estimates for 1976 and 2000; (2) an inventory of the nation's recreation resources; and (3) policy and program recommendations to insure that the needs of the present and future are adequately and efficiently met. The Commission's report, Outdoor Recreation for America, was presented to the President and the Congress in 1962. This report and the 27 study reports to the Commission which were used in preparation of the summary report, were all published in 1962 and are for sale by the U.S. Government Printing Office.

The O.R.R.R.C. was dissolved after presenting its report, but a permanent agency, The Bureau of Outdoor Recreation, was created by Congress in 1962 as a bureau under the U.S. Department of Interior. The Bureau of Outdoor Recreation was established to continue the studies initiated by the O.R.R.R.C. and to coordinate outdoor recreation functions of federal agencies in the Department of Interior and other departments.

Requirements attached to grants-in-aid to the states give the Bureau of Outdoor Recreation some control over state and local recreation development. This control has made it possible to collect better

statistics on outdoor recreation, and to require that each state maintain
an up-to-date comprehensive plan for recreational development.

As a partial solution to meeting the increasing demand for outdoor
recreation, the Iowa legislature in 1955 passed enabling legislation for
counties to establish county conservation boards. By June 30, 1966, 83
counties had established conservation boards (25, 1964-1966, p. 59). The
boards are authorized by state law to levy up to a 1 mill property tax
to finance development of recreation facilities (63, p. 7). The role
envisioned for county conservation boards was to provide modest local
recreation facilities. Some of the county developments, however, are
larger than some of the regional parks developed by the state (54, p. 7).
The county conservation boards are rapidly expanding Iowa's outdoor
recreational facilities, and the enabling legislation is studied as a model
in other states.

The role of the private sector

The provision of an adequate supply of outdoor recreation oppor-
tunity will require a joint effort between public and private sectors of
the economy. The extent to which the private sector is already involved
in outdoor recreation can be demonstrated by the personal consumption
expenditures of Americans on outdoor recreation activities. While federal
and state outdoor recreation sites are open to the public free of charge
or at a very nominal fee, the total visitor expenditures to visit these
areas amounted to $11.1 billion in 1960. Over $\frac{1}{2}$ of these expenditures
were made in the visitors' home community, approximately $\frac{1}{4}$ of the total
was spent en route and the other $\frac{1}{4}$ was spent on or near the recreation

area (9, p. 92). An estimate made by the O.R.R.R.C. for all outdoor recreation expenditures in 1960 is $20 billion or 6% of all personal consumption expenditures that year (56, p. 60). Most of these expenditures were for transportation, equipment, food, lodging and other goods and services provided by the private sector. As a comparison, the total cash sales of all farm commodities was $34 billion in 1960 (71, p. 39).

National surveys have been conducted to estimate participation in hunting and fishing and the expenditures made by hunters and fishermen. In 1965 13.6 million hunters spent 185.8 million recreation days hunting and made a total expenditure of $1,121 million on their sport (70, p. 65). Seventy percent of the hunting days were spent in pursuit of small-game and expenditures for small-game hunting amounted to $615 million. The O.R.R.R.C. estimated that the number of separate days spent hunting will increase 34% between 1960 and 1976, and 91% between 1960 and the year 2000 (57, p. 22).

Supply of inputs for outdoor recreation in Iowa

The Iowa population is experiencing rapid changes in place of residence and consumption patterns, which will warrant increased attention be given to outdoor recreation as a source of income.

Recreation expenditures   Barnard has designed a state social accounting system and applied it to Iowa data (2). The current outlays by consumers among nine categories of goods and services was estimated for 1960 and 1975. These estimates appear in Table 2. Current outlays for recreation ranked eighth in both 1960 and 1975 ($171 million and $238 million respectively), but the expected percentage increase in

Table 2. Consumer current outlays in thousands of 1960 dollars, Iowa, 1960 and 1975[a]

Item	Current consumer outlays		
	1960 (thousands)	1975 (thousands)	Percent change 1960-1975
Food	$1,319,110	$1,451,372	+10%
Household operation	800,297	1,092,936	+37%
Housing	579,092	916,656	+43%
Transportation	574,006	790,322	+38%
Clothing	572,092	699,244	+24%
Personal business	262,166	481,832	+84%
Medical services	264,926	440,700	+66%
Recreation	171,098	237,978	+39%
Private education	121,424	211,536	+74%

[a]Source: 1960 data from Barnard (2, pp. 57-58); 1975 data from Barnard (2, p. 131).

recreation outlays is greater than those for clothing, food, household operation and transportation, but lower than that for personal business, housing, medical services and private education outlays. The same study estimated that the per capita personal income in 1960 dollars will increase from $2,003 in 1960 to $2,652 in 1975.

A survey of Iowa hunters and fishermen was conducted in 1955. Hunters numbering 359,000 were estimated to have made current outlays for hunting totaling $13,909,000 (12). This is an average of $38.74 per hunter.

State and county facilities   Financial support for outdoor

recreation by the Iowa Legislature is primarily through the Iowa State Conservation Commission. The appropriations to the Conservation Commission have gone to the Land and Parks Fund and the average annual appropriation in the 1962-64 biennium was $2.2 million which is only about $.80 per capita (54, p. 6). There have been no legislative appropriations for the Fish and Game Division activities (25). The Fish and Game Division is financed primarily by hunting and fishing license sales with other fees and permits, and federal grants providing the remainder of the funds. The total budget of the Fish and Game Division in the 1964-1966 biennium was $5,884,571 which averages to $2,942,285 per year.

In 1964 there were 83 county conservation boards in operation in the state and their recreational facility budget amounted to $3.25 million. Most of this budget is allocated for water based recreation facilities, but $2.5 million of the cumulative total outlay of $20.2 million for land purchase by county conservation boards up to June 30, 1964 was used to obtain wildlife areas (25, 1962-64, p. 57).

Participation in pheasant hunting   The total number of Iowa resident hunting licenses and combination (hunting and fishing) licenses reached an all time high in 1955, but since then there has been a long run decline in the number issued. The total number of resident hunting and combination licenses was 369,493 in 1955 and was down to 292,745 in 1966. The trend in resident licenses is shown in Figure 1. In a 1955 survey of Iowa hunters, pheasants were named as their favorite game animal by 59% of the hunters interviewed and 81.9% had hunted pheasants in the 1955 season (12). A 1967 survey of licensed resident hunters indicated that 82.5% or 231,800 of them had hunted pheasants in the

Figure 1. Resident hunting and resident combination (hunting and fishing) licenses in thousands, Iowa, 1954-1966

License year is from April-March. Year shown is calendar year in which license year began.

RESIDENT COMBINATION LICENSES

RESIDENT HUNTING LICENSES

LICENSE YEAR

RESIDENT HUNTING LICENSES (THOUSANDS)
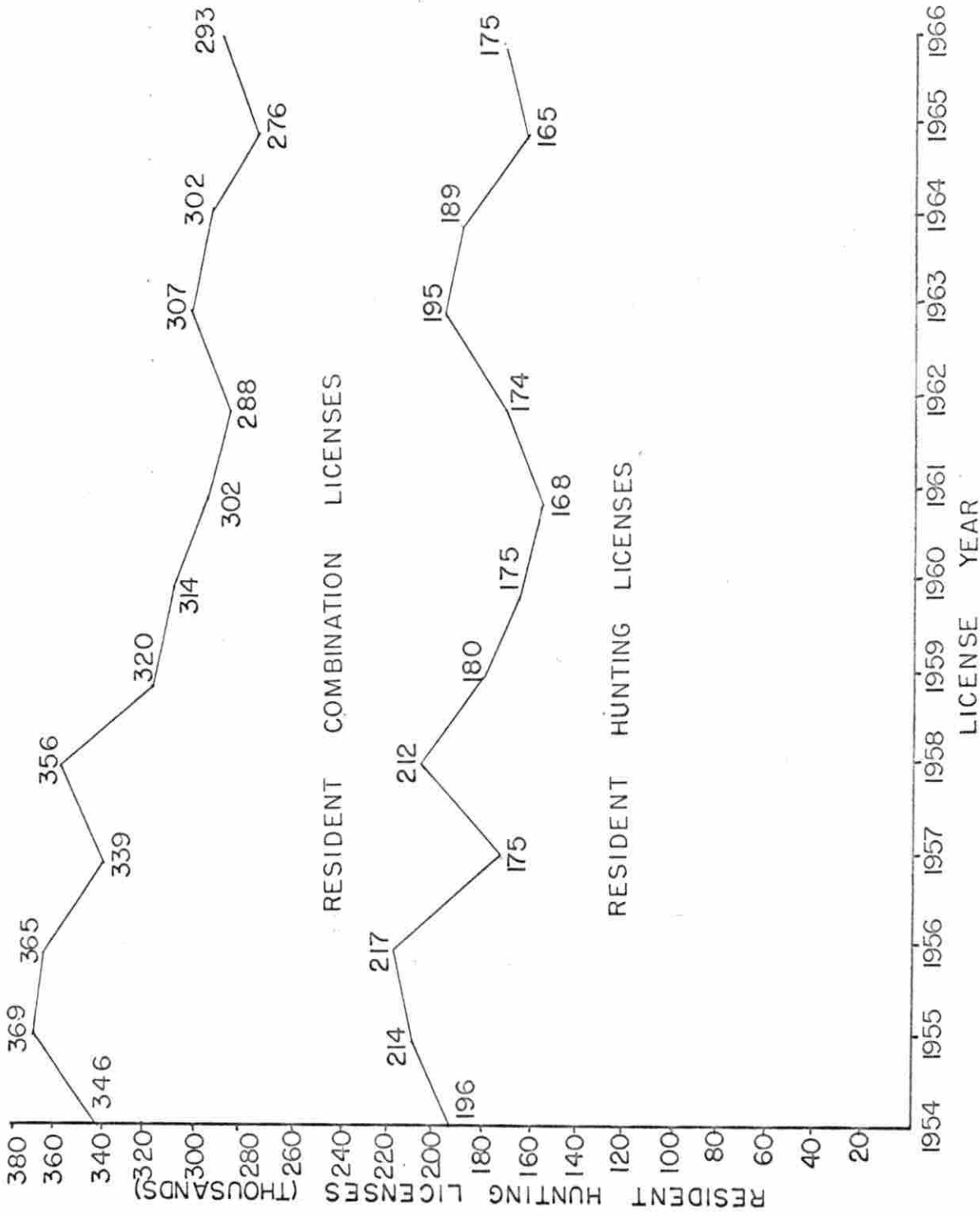
1967-1968 season and they bagged 1,370,000 pheasants.

Nonresident licenses have had an almost continual increase from 3,203 in 1954 to 9,638 in 1966. The trend in nonresident hunting licenses is shown in Figure 2. During the 1966-67 season, 8,600 non-residents, which was 93.4% of the total number licensed, bagged 79,400 pheasants[1].

Supply of pheasants   Since pheasants were originally stocked throughout the state between 1900 and 1918, the distribution of pheasants in Iowa has been concentrated in the northern 1/3 of the state. Figure 3 is a map showing the distribution of spring pheasant populations in 1951. Since then pheasant densities have fallen in the northern part of the state, but an off-setting increase has occurred in eastern Iowa and particularly in southwest Iowa. Figure 4 shows the pheasant distribution in the spring of 1967. The pheasant populations in northwest and north central Iowa have fallen due to the loss of habitat caused by the increasing intensity of agricultural uses of the land. Farming is becoming more intensive in other parts of the state, also, but the percent of the farm land cultivated and the percent in row crops is not as high and is not yet competitive with pheasant production.

A roadside survey is taken of the pheasant population in the fall prior to the pheasant season. The results of this survey for 1954 through 1966 are shown in Figure 5. The survey results are given as pheasants sighted per mile and do not estimate the total population. The results do indicate that despite the redistribution of pheasants,

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[1]Nomsen, Richard, Game Biologist, Iowa State Conservation Commission, Des Moines, Iowa. Private communication. 1967.

Figure 2. Nonresident hunting licenses in thousands, Iowa, 1954-1966 License year is from April-March. Year shown is calendar year in which license year began.

NONRESIDENT HUNTING LICENSES (THOUSANDS)

LICENSE YEAR
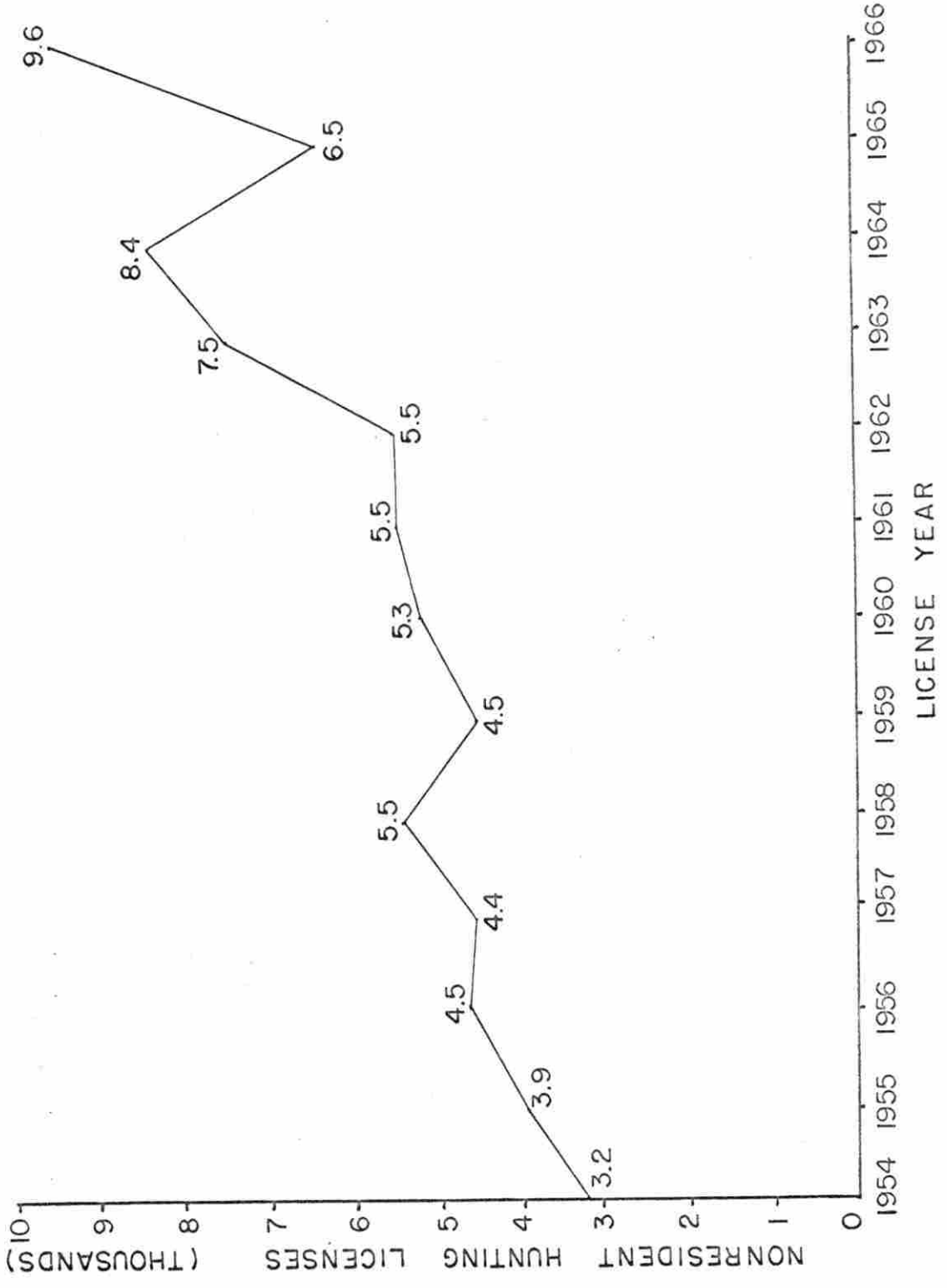
Figure 3. Pheasant distribution, Iowa, spring 1951

BEST   GOOD   FAIR   POOR

Figure 4.   Pheasant distribution, Iowa, spring 1967

BEST   GOOD   FAIR   POOR

Figure 5. Results of the pre-season roadside survey, Iowa, 1954-1967
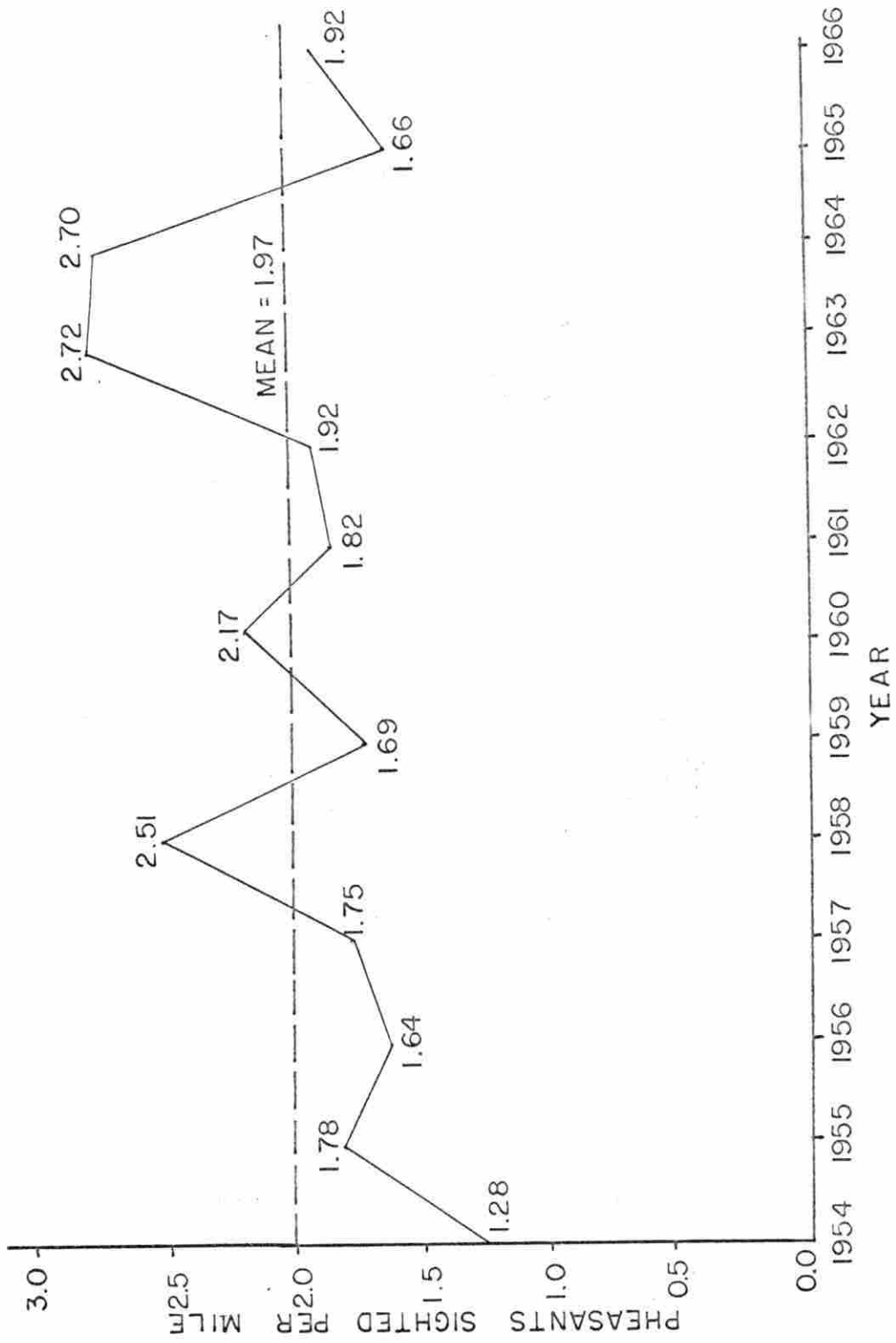
their total number has probably not changed appreciably.

Shooting preserves which offer pheasant shooting have also been established in Iowa. These are privately owned and operated areas where pen-raised game is released for shooting upon payment of a fee. Iowa law requires that these areas be licensed and allows them to operate from September 1 to March 31. The locations of the six operating shooting preserves in Iowa in 1966-67 are shown in Figure 6.

Objectives and Procedures

The ring-necked pheasant provides a source of outdoor recreation for over 200,000 Iowa hunters and attracts nearly 10,000 nonresident hunters. The purpose of this study is to examine means of providing as large a supply of pheasants as possible and the effect of the supply of pheasants on the number of hunters. This will involve an examination of trends in land use which effect pheasant production, but are occurring independently of the value of pheasants to hunters. A study is made of the use of an income incentive to alter land use decisions and promote adoption of game management practices to favor pheasant production. The effect of the supply of pheasants on the number of hunters will be estimated, but no estimate will be made for the value of this recreation to resident hunters nor of the income generated by expenditures of nonresident hunters.

The primary objectives are:

1) to determine the game management principles which apply to the production and harvest of pheasants.

2) to identify present disassociations between the benefits and

KEY:

P = PHEASANTS
Q = QUAIL
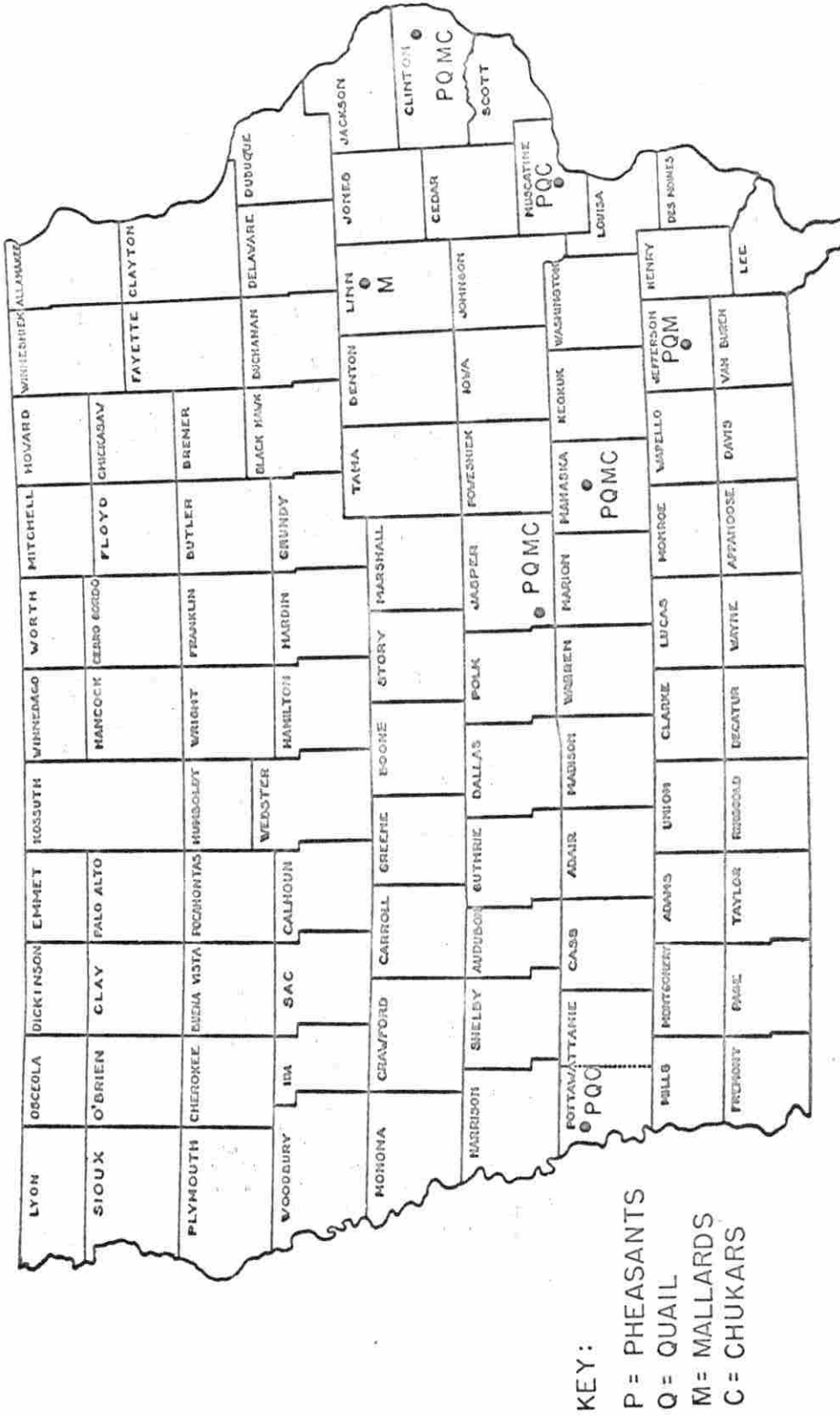M = MALLARDS
C = CHUKARS

Figure 6. Locations of operating shooting preserves, Iowa, 1966-67

costs of pheasant production.

3) to account for the disassociations and explore action which might remove them.

4) to evaluate the effects on pheasant production if the disassociations were removed.

5) to analyze the supply of pheasants in relation to future demand.

The first objective is to determine the game management practices which are applicable to an economic study of pheasant production. This objective is pursued as a resource management problem. The elementary pheasant management principles were provided by Allen (1) and Leopold (36).

The second objective is to identify disassociations between benefits[1] and costs of pheasant production. Hunters receive primary benefits from pheasant hunting for which they do not pay and yet in order to maintain hunting quality for the future they have an interest in the habitat provided by the farmer. At present the farmer receives little monetary evidence of hunters' demand for pheasants. Wunderlich discusses benefit-cost disassociations in another study related to wildlife which provided assistance here (77). Wunderlich's study was concerned with damage done to crops by waterfowl from an adjacent wildlife refuge. Pheasants do not appear to cause any crop damage, but opportunity costs

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[1]The benefit is considered here as composed of two types of benefits (7, p. 23):
　　a)Primary benefits in the form of enjoyment or satisfaction from consumption.
　　b)Secondary or indirect benefits in the form of monetary returns to the resource owner for supplying the resource. Externality benefits are not considered.

and investments must be incurred by farm firms to provide adequate habitat. One way to induce hunters to defray the costs of providing habitat is through the establishment of a market for hunting rights. In order to determine the extent to which a market for pheasant hunting areas has developed in Iowa, I conducted a survey of conservation officers in cooperation with their employer, the Iowa State Conservation Commission. The approximately 60 conservation officers, who are located throughout the state, were asked to provide basic information on leasing and fee arrangements for sale of access rights to hunting areas in their area.

The third objective is to determine the reasons why the disassociation of benefits and costs persist and to explore action which might remove them. Green (16) studied a group of farmers organized in the 1930's to collect fees for hunting rights. His conclusions on the success and failure elements of this organization are considered. This objective is pursued with the hypothesis that a market and a marketable produce are required before an income incentive for pheasant production is possible.

The fourth objective is to estimate the increase in pheasant production which would result if the benefit-cost disassociations were corrected. Research on pheasant study areas in north central Iowa and southwest Iowa by Klonglan et al. (27-32) provide some indication of the limits on the productivity of various habitat improvements. Using these productivity estimates along with cost estimates provides the numbers needed to solve for the price required to meet the economic efficiency criterion that marginal revenue equal marginal cost. The other criteria of economic efficiency are assumed to be met by using market prices for the inputs. The application of this concept to outdoor recreation

follows the framework suggested by Lee (35).

The fifth objective is to make an appraisal of expected changes in demand for pheasant hunting caused by economic and demographic changes for the Iowa and North Central region of the United States. These factors will then be considered simultaneously with indicators of the supply of pheasants to estimate the past and future impact of each on numbers of hunting licenses. The effect of state pheasant population densities on the number of nonresident hunters is of particular interest due to the contribution to state income by nonresident expenditures.

The procedure and approach are similar to those used by Matson who studied the pheasant resource in South Dakota (44). Two independent national surveys furnish data on the characteristics of American hunters. The Outdoor Recreation Resources Review Commission sponsored the National Recreation Survey which obtained information from Americans on their participation in hunting and several other types of outdoor recreation between June 1960 and May 1961. The other national survey of use is the National Survey of Fishing and Hunting sponsored by the Fish and Wildlife Service, U.S. Department of the Interior. This survey was conducted in 1955, 1960 and 1965. Detailed information for Iowa on number of licenses, pheasant populations, kill, license fees, etc. was obtained from publications of the Iowa State Conservation Commission and interviews with its pheasant biologist, Richard Nomsen. Multiple variable linear regression was used to analyze the date. The calculations were performed by the IBM 360-50 computer at Iowa State University. Two models were used. One treated resident hunting licenses as the dependent variable with the following eight independent variables; results of the August

roadside pheasant survey, bag the previous year, number bagged per hour
the previous year, resident license fees, season length, Iowa per capita
personal income, Iowa human population, and percent of the Iowa population
living on farms. The other model treated nonresident licenses as the
dependent variable with the following independent variables; results of
the August roadside pheasant survey, bag the previous year, number bagged
per hour the previous year, season length, North Central region per
capita personal income, and North Central region human population.

Plan of this Report

The initial chapter of this report has introduced the objective of
finding means to increase the production of pheasants in order to improve
the supply of outdoor recreation opportunity and stimulate economic
development of Iowa.

The second chapter consists of a review of biological principles and
research which is then used in an economic framework to determine the
choices of alternative pheasant harvest timing and habitat improvement
which are both feasible and economically efficient for use by firms con-
trolling hunting areas. Benefit-cost disassociations and institutions[1]
affecting land use and the market for hunting areas are discussed in the
context of the obstacles they present in their present form.

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[1]W.G. Sumner as quoted by Ciracy-Wantrup (8, p. 140) has presented
a classic statement of two basic aspects or elements of a social
institution: "An institution consists of a concept (idea, notion, doc-
trine, interest) and a structure. The structure is a framework, or
apparatus, or perhaps only a number of functionaries set to cooperate
in prescribed ways at a certain conjecture. The structure holds the
concept and furnishes the instrumentalities for bringing it into the
world of facts and action in a way to serve the interests of men in
society."

The third chapter examines the past and expected changes in demand for pheasant hunting in relation to the supply of pheasants. From this analysis are made conclusions on the ability of naturally populated hunting areas to provide an adequate supply of pheasants given the biological and economic limitations on production discussed in the second chapter.

The final chapter reviews findings of this study. Alternatives for resolving problems in the production of pheasants as a recreational input are evaluated. Further research is suggested.

CHARACTERISTICS OF PHEASANT PRODUCTION

Game management in the United States has evolved from an entirely different background than has European game management. The simple objective of game management in Europe has been the improvement of hunting for and by the landholder. Ownership of game on a holding and the rights to manage and harvest the game are included in the bundle of property rights accompanying title to the holding (36). In the United States, game has been delegated traditionally as a trust for the people under state ownership. The specific Iowa law declaring state ownership states in part:

> The title and ownership of all...wild game, animals and birds, including their nests and eggs, and all other wildlife, found in the state, whether game or nongame, native or migratory,...are hereby declared to be in the state, except as otherwise in this chapter provided (19).

Public title to the wildlife allows more control over the harvest of wildlife than does the European system. The total game harvest can be regulated by limiting the season length and bag limits. Public title allows the taking of game from public areas, such as roadsides and preserves, and from privately owned areas no matter where the game was produced. This serves to equalize the right to harvest game between landholders and nonlandholders, and the imposition of daily bag limits serves to equalize the harvest among all hunters through the season.

The right to harvest public game such as the pheasant has been modified by allowing farmers to restrict the access of hunters onto their land. The public declares possession of all wild pheasants, but private farm firms have effective posession of most of this resource.

To the hunter, pheasants are a fugitive resource which can come into
his possession only after he has met the public regulations on hunting,
achieved access to a hunting area, and then has competed successfully
with other hunters in locating and bagging pheasants. The right to
restrict the access of hunters was given increased power in 1962 when the
Iowa legislature raised the maximum fine from $10 to $100 for hunting on
land without permission from the owner or occupant. The revised tres-
pass law reads in part:

> Any person who shall hunt with dog, bow and arrow, or
> gun upon the cultivated or enclosed lands of another,...
> without permission from the owner or occupant thereof, or
> his agent, shall for each offense be fined not more than
> one hundred dollars and costs of prosecution, and shall stand
> committed until such fine and cost are paid (21).

Private ownership of hunting areas has limited the effectiveness of
state conservation agencies in providing hunting opportunities. Lack of
control over private game producing areas restricts the amount of game
management that can be applied. Much of the game that is produced is
not efficiently used due to the posting of private land. Berryman states
that public ownership of game, but with little control over the pro-
duction and hunting areas, has caused state agencies to overly restrict
their acceptance of responsibility to provide hunting opportunities:

> Traditionally this has come to mean a direct responsi-
> bility: propogation of farm-game animals, acquisition and
> direct manipulation of habitat; and establishment of
> public shooting grounds. A broader view would assume on
> indirect responsibility: a responsibility for developing
> broad social, economic and legal programs that would result
> in favorable game and its habitat, provide hunting and
> prevent conflict (4, p. 286).

Public ownership of game has allowed the development of bag
limits, hunting seasons, and other hunting regulations to favor

equitable distribution of game harvests among hunters and over time.
Over emphasis on hunting regulations and direct game production, how-
ever, has caused the tendency to ignore the supply side of game
management, particularly on private land. In order to study the supply
of pheasant hunting opportunity, the remainder of this chapter will
review the biological characteristics affecting the supply of pheasants
and incorporate these characteristics into the examination of pheasant
production in an economic framework.

An Annually Renewable Pheasant Resource

The impression left by events such as the near annihalation of the
American buffalo by 1889 and the extinction of the passenger pidgeon in
1899 was that wildlife existed in a finite virgin supply. Hunting
restrictions were imposed to spread the harvest of this finite supply
over time. This is a nonrenewable stock resource concept as is
applicable to resources such as metals or petroleum, and this concept
dominated game management until about 1905 (36, p. 16). The realization
that eventually replaced this original concept is that within annual
limits the harvest of game by hunters is compatable with maintaining
wildlife populations. This characteristic has usually caused wildlife
to be classified as a renewable resource. Wunderlich defines a renew-
able resource as: "Those resources which can be expended and subsequently
returned to a near-original state." He chose this resource category
because: "Wildlife populations can be maintained, increased or depleted
and then returned to the original state through control and management
practices" (77, p. 11). It is not clear, however, whether Wunderlich is

referring to wildlife populations at their peak in the fall or to the much lower breeding stock population in the spring. His definition of a renewable resource best describes the spring breeding population. The breeding stock is a renewable stock resource which can be depleted down to a minimum density and then be allowed to renew to its former numbers.

The prevailing game management policy is to not allow hunting to deplete the breeding stock populations (20). The harvests of game in the fall and winter seasons of the year are to capture the portion of current production which is excess to the numbers of each sex needed to provide an undepleted spring breeding stock. As long as the breeding stock is maintained, all other things remaining constant, reproduction will produce fall populations equal to the fall population level of the previous year. This reproduction is not an attempt to replace past losses from hunting and other causes. Conversely, much of this reproduction is normally an over-production to assure an ample number of each species to perpetuate the species in spite of future losses from the breeding stock and young of the year. Losses are dependent on the number reproduced in excess of the number that can survive to the next breeding season. From estimates of the fall population less the rather closely predictable limit on numbers that will survive until the next breeding season, the surplus in the fall populations can be estimated. The surplus in the number that enter the winter can be either harvested by hunters or be allowed to die from other causes. The surplus which is available for hunting constitutes an annual flow of game resources.

Wunderlich and others have classified the wildlife resource as a renewable stock resource (77). I choose to follow this classification

only for the breeding season population. The surplus in the fall popula-
tion fits better into the broad category of a flow resource. Ciriacy-
Wantrup classifies wildlife as a renewable flow resource significantly
affected by human action. This subclassification of a flow resource is
necessary to differentiate between the renewable flow resources which are
affected by human action and perpetual flow resources over which humans
have no effect on the flow such as tides, wind, and solar radiation.
Ciriacy-Wantrup defines a flow resource as follows:

> Resources are defined as "flow resources" if different
> units become available for use in different intervals. These
> successively available quantities constitute the "flow". The
> flow, without use may increase or decrease continuously or
> discontinuously at either a constant or a varying rate. The
> present flow (which should not be confused with use) does not
> diminish future flow, and it is possible to maintain use
> indefinitely provided the flow continues (8, p. 37).

A definition of a renewable flow resource requires the additional
restriction that the flow is significantly affected by human action
through economic and social institutions.

All resources can be classified either as a stock resource, a
flow resource or a combination of these two. Wildlife is one of the
combination resources, partly a stock resource and partly a flow
resource (renewable subclassifications). The link between the
renewable flow and renewable stock classifications of different portions
of the same wildlife species is that if the flow of surplus game
available for harvest decreases to zero and other losses continue, the
renewable breeding stock will be depleted. If this continues long
enough a critical breeding stock density will be reached where reversi-
bility of the decrease in flow is impossible and the species will become

extinct.

Pheasant reproduction

In order to determine the renewable flow portion of the pheasant resource in Iowa, a discussion of the production capability of pheasants is first necessary. This will provide guidelines for restricting the harvest of pheasants to an amount which will maintain the breeding stock and allow an annual renewal of the fall pheasant population. The renewable characteristic of pheasants gives them the advantage of being responsive to management of both production and harvest. Knowledge of the reproduction characteristics of pheasants is necessary for both types of management.

The reproductive capacity of a pheasant population is theoretically in the range of an increase of 500-600% per year to a 100% decline (72, p. 4). An observed population buildup of +277% per year over a 5 year period was reported on Protection Island, Oregon (1, p. 29). Another dramatic example of the reproductive capacity of pheasants is the experience on Pelee Island, Ontario. In 1927 not more than 3 dozen adult pheasants were turned loose on Pelee, and seven years later, hunters were taking an annual harvest of 10,000 birds, or one pheasant per acre (1, p. 30). The conclusion to be drawn from this eruptive reproductive ability is that when the potential in an area to support a satisfactory population level exists, if there is any breeding stock at all in the area, they are capable of populating the area to the supportable level. The minimum amount of breeding stock required is probably higher in large areas as opposed to an island due to dispersal, but 75-90%

losses in storms, for instance, would in general not call for restocking. Poor pheasant areas are unproductive because of limitations that reduce their capacity to support pheasants. Liberating more birds simply adds to the natural overproduction that already is taking place. Stocking new areas with breeding stock is sometimes successful, but the release of breeding stock to bolster declining pheasant populations is futile.

The release of male pheasants in the summer and fall prior to the hunting season should avoid some of the uncertainties of reproduction encountered in the release of breeding stock. Experience with this type of stocking has been nearly as disappointing as the stocking of breeding stock. The Indiana Department of Conservation estimated that each male pheasant bagged had cost $20 based on a return of 6.4% of the stocked males. The largest rate of recovery was obtained in an Illinois project where 69 of 100 stocked pheasants were recovered when the birds were released at night for the next day's shooting (1, p. 208). This is a shooting preserve technique and possible only at shooting preserve prices which exceed license fees. The release-for-the-gun technique is also an admission by game managers of failure to take advantage of the tremendous reproductive capacity of the pheasant and relying instead on one at a time handling.

An upper limit is placed on pheasant reproduction by the number and sex composition of the adults entering the breeding season. The concept of carrying capacity is used as a measure of the adequacy of habitat in supporting the breeding stock. Carrying capacity is the proven ability of an area to support a certain animal species. This

ability is measured by the number of individual animals that can live until the next breeding season. The carrying capacity establishes a population limit determined by the existing habitat. Most yearly fluctuations in the populations used to measure carrying capacity are caused by the variability of weather conditions which make the habitat relatively more or less adequate and to actual changes in the habitat which are often difficult to detect. A predicted estimate of carrying capacity is a mean population limit projected from past carrying capacities with allowances for expected changes in the environment. Carrying capacity can only be increased by "bringing the essentials of survival into closest possible association. This reduces the area necessary to support an individual or group and thereby increases carrying capacity" (1, p. 48).

Once carrying capacity has been reached, the reproductive ability still exists, but the population cannot increase cumulatively from one year to the next. Pheasants have the theoretical potential to increase their population 500 to 600% per year and had an observed summer increase of 306% in a southwest Iowa study area (27, p. 64). However, a constant carrying capacity will limit the actual increase from one breeding season to the next to 0%. The pheasant population will be reduced by deaths from the original breeding stock and the young of the year to remove the excess. A constant carrying capacity thus requires that the number that die each year from the total pheasant population must equal the number born (72).

High reproduction rates will result in high death rates with correspondingly short life expectancies. From a Wisconsin study on a refuge with no hunting, the expected survival of 100 pheasants from a

winter population over the four succeeding years would be:

1st winter	2nd winter	3rd winter	4th winter	5th winter
100	30	9	1-8	0

Cocks were not known to live over 3 years and there was a mortality of about 84% of the young pheasants before the first winter (1, p. 39).

An additional factor in pheasant populations is their polygamous nature. One male pheasant can mate with 12 or more females. The shooting of cocks to the extent that spring sex ratios are of the order of 1 cock for each 12 females will have no effect on pheasant production the following summer. A higher winter mortality rate for hens means that there is no biological objection to shooting 90% or more of the cocks each year. If the principle of carrying capacity holds true, unless the maximum percent of cocks are harvested, much of the excess will be removed by other means and thus wasted for game purposes. More seriously, increased losses from the population of hens may result. If post-season populations exceed winter carrying capacity, the excess will die off by spring. Much of this loss will be hens which would have contributed far more to the following hunting season than males excess to reproduction requirements (16, p. 118). Due to short life expectancies even without hunting, stock piling of cock pheasants is unfeasible from an efficiency standpoint and unnecessary for reproduction criteria.

Whenever the estimated carrying capacity during the winter is far less than the number of hens entering the winter, a hunting season on hen pheasants may be sound policy in order to capture the surplus. Even if shooting 1 hen for each 2 cock pheasants resulted in a decline in the following year's pheasant production of say 10% due to only partial

compensation in winter survival and hatching success, the total number of pheasants harvested each year would be greater. Assuming 80% harvest of each year's production of cocks and 40% harvest of each year's production of hens, an area producing 100 pheasants annually would yield 40 pheasants under a cocks-only regulation. The same area with hen shooting allowed would produce only 90 pheasants each year following a season on hens, but the total bag would be 36 cocks plus 18 hens for a total yield of 54 as opposed to 45 with a cocks-only regulation. Iowa law would allow a hunting season on hens only if adequate evidence was available to show that the shooting of hens would not reduce the following years production (30, p. 73). The populations are too sparse in many parts of the state for the Iowa State Conservation Commission to make this conclusion. A season on hens would be permissable in the areas which have a dense population of pheasants in order to maximize annual yields. But the possibility that total summer and fall populations would be reduced leaves the Iowa Conservation Commission too vulnerable to public protest and bad public relations for them to try it. Legalizing the shooting of hens in limited areas may also make enforcement more difficult for the ban on shooting of hens in more sparse pheasant areas.

The other side of the coin on the shooting of hens is the possibility of illegal shooting of hens even under cocks-only regulations. With a decline in numbers there usually would be no need to restrict the shooting of males, but if widespread shooting of hens resulted from the lack of legal game, increased restrictions might be necessary. Wisconsin studies found that approximately 16% of the hen population was shot

illegally and accidentally during the 1953-1959 seasons. This estimate was determined through examinations for body shot incidence in birds killed on highways after the hunting seasons (72, p. 4).

Pelee Island is an outstanding example of the ability of pheasants to continually produce a large annual crop in spite of the shooting of most of the cocks and even some of the hens each year. Data on Pelee Island pheasant population is given in Table 3 to exemplify this potential.

Allen makes the following conclusions about the effects of pheasant hunting based on selective shooting of cocks only and their polygamous nature (1, p. 128):

"A study of published information to date leaves us with some rather startling conclusions on pheasant hunting:

1. There appears to be no biological objection to shooting 90 percent of the cocks, that is male birds can be hunted to a point where spring sex ratios will be of the order of 1 to 10.

2. With any reasonable amount of escape cover present, legal hunting, however, heavy, practically never results in the overshooting of cocks.

3. Season length is of little consequence, since heavy shooting results in greatly reduced kill as the season advances.

4. When pheasants are low, hunting diminishes, and returns are low. There is no reason for restricting the legal hunting of cocks.

5. We haven't mentioned it, but a season limit means nothing at all. A daily bag limit helps distribute the easy early-season harvest among more hunters.

These principles will explain many attitudes of your state pheasant specialists. But they apply only to legal hunting in those parts of the country that realistically can be called pheasant range. Where only a semblance of shooting is being maintained by costly artificial methods, in

Table 3. Calculated fall pheasant populations on Pelee Island[a], Ontario, 1946-1950[b]

	Year				
	1946	1947	1948	1949	1950
Preseason population					
Cocks	5,263	6,418	8,046	14,248	15,200
Hens	5,158	9,114	9,736	21,018	18,392
Postseason population					
Cocks	648	918	1,329	2,403	622
Hens	4,860	8,814	4,436	17,637	5,811
Limits	8 cocks	8 cocks	8 cocks	10 cocks 2 hens	8 cocks 3 hens
Fall sex ratio[c]	0.98	1.42	1.21	1.47	1.21
Winter sex ratio	7.5	9.60	7.10	7.34	9.35
Cocks killed - total	4,615	5,500	6,717	11,895	14,578
Cocks killed - percent	88	86	83	83	96
Hens killed - total	300	300	300	3,381	12,581
Hens killed - percent	6	3	3	16	68

[a]Pelee Island has an area of 10,085 acres ($8\frac{1}{2}$ x $3\frac{1}{2}$ miles) and is located in the western end of Lake Erie.

[b]Source: (62, p. 91).

[c]Females/males.

marginal range -- we can forget such rules.

These ideas often run counter to the teaching of conservatism so long presented to the public. Thus, recommendations for lessening hunting restrictions meet stubborn and sometimes emotional resistance.

Optimum pheasant harvests

Answers to the question of how to best manage the harvest of pheasants as a renewable flow resource are now rather straight forward. The conclusions apply to both the Iowa State Conservation Commission and private farm firms who control the hunting on private hunting areas. By restricting the pheasant hunting to the shooting of cocks, the optimum harvest is the maximum harvest up to at least 90% of the cocks. Very few of the cocks which aren't harvested will live until the next season, so a 100% harvest of the cocks would maximize the use of any one year's production. However, in order for the fall population to renew itself the next year, approximately 10% of the cocks must be left to satisfy reproduction requirements. A harvest of less than 90% may actually reduce the following year's production and would certainly reduce the total two year harvest. Hunters will not apply enough hunting pressure to bag 90% of the cock pheasants and it is nearly impossible to do so, especially in sparse pheasant densities. The most complete harvest in Iowa was an estimated 75% of the cock pheasants in the state in 1964.

The polygamous nature of pheasants, and the possibility of selective harvesting of the males due to their brilliant coloring, make the establishment of very liberal cock pheasant hunting regulations possible and necessary to maximize yearly and long run yields. The Iowa Conservation Commission has in fact been following this policy and has increased the number of legal hunting hours in the pheasant season from 108 hours in 1954 to 390 hours in 1966. There is no biological objection against an even longer season, but conflict with agricultural activities in the summer and fall, and apprehensions about the possibility of increased

illegal shooting from cars in late winter and spring when cover is scarce, limit further extension of the season to about 1 month (240 hunting hours).

The alternative choices for timing of pheasant harvest under various assumed situations can be shown in a series of diagrams. Figure 7 represents the choices available under the following assumptions:

1) A harvest of less than or equal to 90% of the males will not restrict production in the following time period. One time period is defined as the time from the end of one pheasant hunting season through the end of the next.

2) 30% of the unharvested cocks live into the following hunting season.

3) Hunters are physically unable to over shoot the male population; i.e., the practical limit on kill is 90% of the cocks.

4) The original quantity and the potential annual production in each following time period is 100 pheasants of each sex.

The curves in Figure 7 represent upper limits to the harvest, and any point on or enclosed by these curves is a possible choice of intertemporal harvest timing. The theoretical limit on harvest is represented by the solid curve and the practical limit by the dashed lines. Point A is the optimum practical harvest choice for the two year period. Point A corresponds to a 90% harvest each year for a total two year harvest of 180 pheasants. From point A: any point to the left on the practical limit curve would result in an increase of Q_1 less than the decline of Q_2; any point to the right on the practical limit curve would result in an increase of Q_2 less than the decrease of Q_1; any point below the
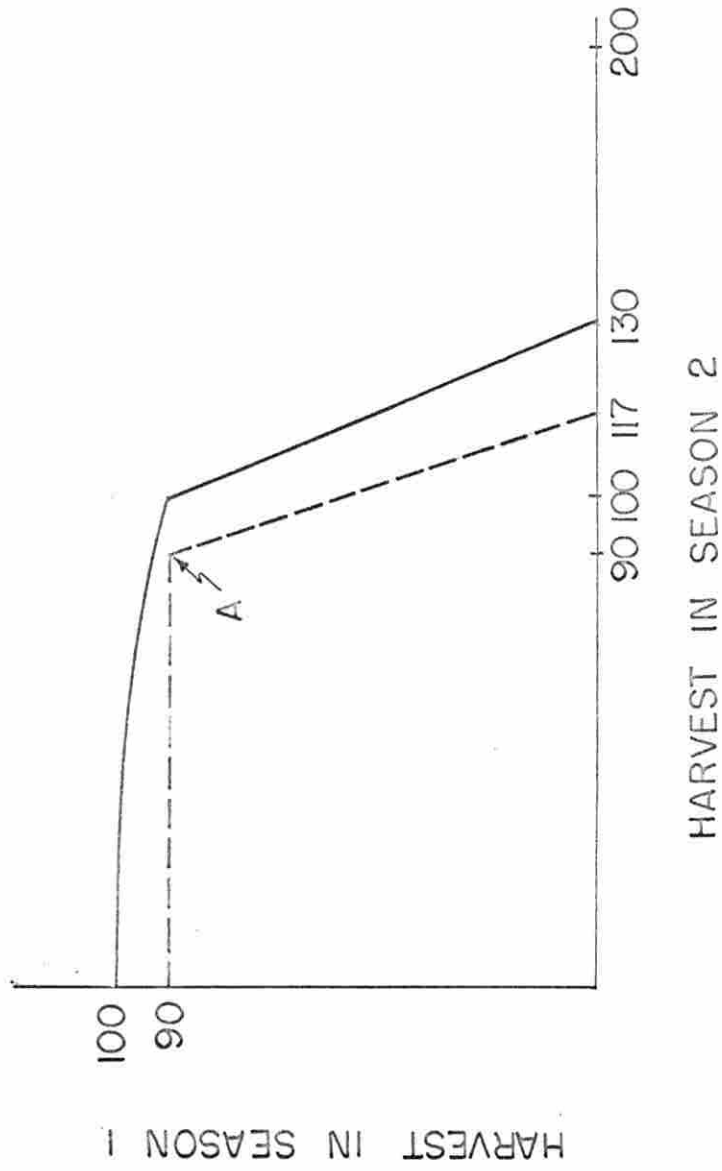
Figure 7. Alternative pheasant harvest timing choices with 30% net carryover

practical limit curve would reduce $Q_1 + Q_2$ to less than at least one alternative point on the curve (all of which are less than $Q_1 + Q_2$ at point A). A harvest of cocks as near as possible to the 90% practical limit each year would yield the largest two year harvest.

The 90% harvest in season 2 will not affect the production in the following period, therefore, the harvest timing choice would again be a 90% harvest in the second and third time period. This solution would apply to all following time periods.

If an under harvest of cocks in season 1 causes increased death losses from the hen population due to competition for winter cover, the production in time period 2 may be reduced. The decline in production of cocks would likely exceed any increase in the quantity available for hunting contributed by survivors from the previous season. The result of an under harvest of the males in season 1 would be a lower harvest in season 1 and fewer pheasants available for harvest in season 2. This case is shown in Figure 8. For any harvest below 90% in season 1, the total two year harvest $(Q_1 + Q_2)$ would be lowered as well as each of the annual harvests. Pheasant would be wasted in period 1 and the potential pheasant production would be wasted in period 2.

The most liberal assumptions possible on the ability to "store" pheasants from one year to the next are; that 100% of the unharvested cocks are able to survive into the next hunting season, and that the extra cocks do not depress production in the second time period. This case is shown in Figure 9.

Even in the extreme and unrealistic case where 100% of the unharvested pheasants are storable, the total two year harvest is not increased
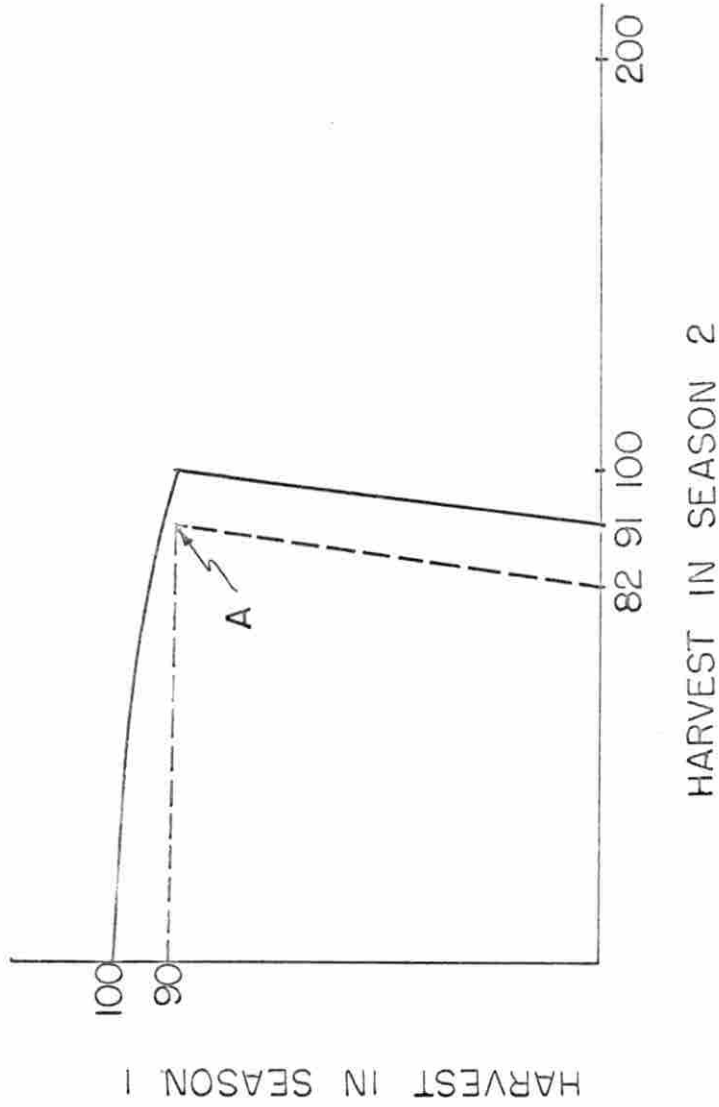
Figure 8. Alternative pheasant harvest timing choices with a negative net carryover
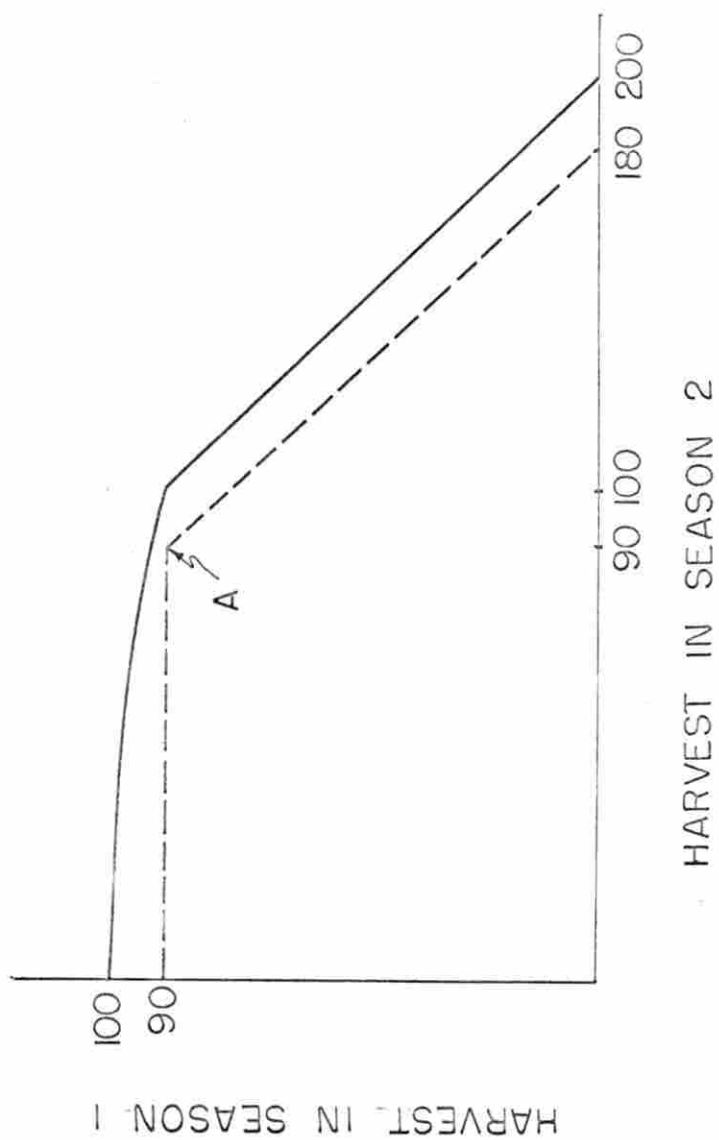
Figure 9. Alternative pheasant harvest timing choices with a 100% net carryover

by restricting the harvest in season 1 to less than 90%.

Sudden changes in the adequacy of pheasant habitat will not affect the optimum harvest. The maximum harvest will still be that nearest 90% of the cocks. If a sudden improvement in habitat increases the annual production potential from one year to the next, the ability to meet this potential would depend on the number of hens. If a 90% harvest of the males gives an optimum sex ratio with no anticipated habitat improvement, a 90% harvest of the males will also yield an optimum sex ratio with an anticipated habitat improvement. The number of each sex is determined prior to the hunting season independently of future events, such as an improvement in winter cover. Production following the habitat improvement is still limited by the number of hens, and extra males in the population will not remove this limitation.

A sudden inadequacy of the habitat would not lower the optimum harvest. The pheasants excess to carrying capacity will die off approximately in proportion to the post-season sex ratio and this ratio will be maintained. There is some evidence that cocks have death rates lower than hens during severe winters and this would cause the sex ratio to go down (29). Advance knowledge of a decline in winter carrying capacity might allow an increased harvest of cocks in order to have an optimum sex ratio by spring.

Land Use

Many of the reasons for success or failure of pheasant populations to become established in an area and survive are unknown, but where a viable population is established, the condition and fertility of the soil

and its plant covering (native or agricultural) determines largely what
an area will yield as game. Wisconsin studies have found the following
relationships between pheasant populations, soil and plant coverings to
hold in general:

> Pheasant densities decline progressively where more or
> less than 55-70 percent of the land is cultivated; where
> within the 55-70 percent cultivation range progressively
> fewer wetlands occur, where the soils are progressively less
> fertile and the growing season shorter (72, p. 3).

These same relationships except for length of growing season also
describe the most productive pheasant range in Iowa. In general, the
most fertile areas with favorable climate produce the most plant
material and proportionately the most game. Pheasants and corn seem to
have a special affinity in this relationship. Historically, the prime
pheasant range in Iowa has been limited to the northern half of the
state exclusive of forested areas. When pheasants were introduced in
this area, the naturally drained areas had been converted into cultivated
land, and the field losses in the corn crop provided an ample source of
food. The area was well interspersed with wetlands which provided
nesting and winter cover. This was ideal pheasant habitat, created
accidentally under the changes dictated by economic factors in agri-
culture. The cost of these changes were in no way charged to pheasants,
and likewise, there was no economic protest mechanism as land develop-
ment continued much too far for the pheasants' welfare. As the
financial rewards from row crops increased relative to other uses of the
land agriculture became more and more intensive. The adoption of engine
powered machinery followed by a continual increase in its size put a
premium on large, uniform fields. Fencerows disappeared and new

technology made drainage of the wetlands technically and economically feasible.

These changes in agriculture have decreased the supportable population of pheasants in northern Iowa, but complementary changes in the habitat of southwestern Iowa have allowed pheasant populations to boom in an area centered on Adair County (27). Increased intensity of agricultural land use is complementary with pheasant production at least to the degree of intensity found in Adair County today and the intensity reached several years ago in northern Iowa. At some intensity beyond this point, increased agricultural intensity becomes competitive with pheasant production. Southern Iowa is now benefitting from the complementary range of this relationship, while northern Iowa appears to be in the competitive range and is experiencing a declining pheasant population. A hypothetical production possibility curve illustrating the complementary and competitive relationships of joint pheasant and agricultural production appears in Figure 10.

The accidental creation of excellent pheasant habitat in the development of Iowa prairies for farming purposes has allowed past pheasant densities to be as high as 1-2 pheasants per acre in some areas of northern Iowa (36, p. 398). Green estimated that an eight section research area in Winnebago had a population density of 1 pheasant to each 4.9 acres just prior to the hunting season in 1937 (16, p. 63). A portion of this same area plus two additional sections was found to have a pre-season population of 1 pheasant for each 15.2 acres in 1954 (33, p. 679). A 1967 study of the area found only 3 successful nests on 1520 acres within the research area, therefore, the 1967 pre-season
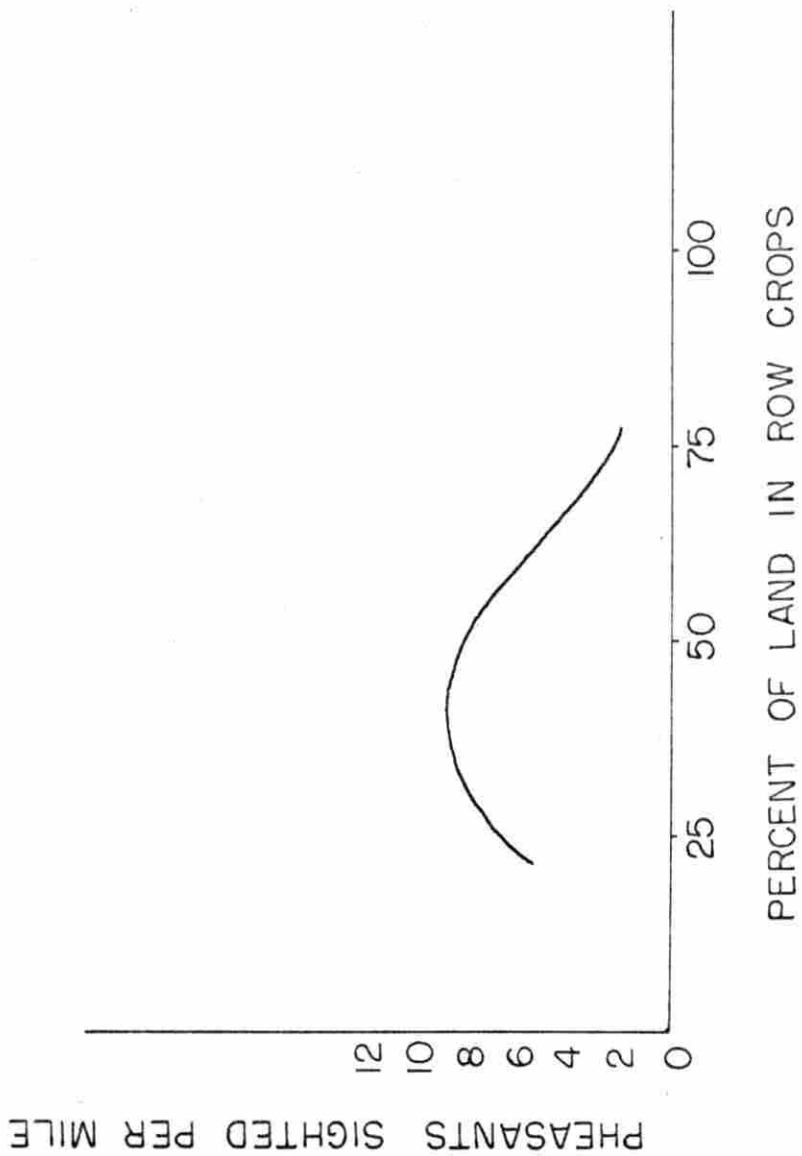
Figure 10. Hypothetical production possibility curve for pheasant production and row crop production, Iowa

population will be only a fraction of earlier populations. The high former populations indicate that the present populations are very much limited by a habitat inadequacy caused by the very intensive development of agriculture in northern Iowa.

Technology and profit motives largely determine changes in land use, but the choice of alternative courses of action to be considered are determined by the land user's tastes and attitudes. These ethical and aesthetic factors offer farmers interested in increasing game production an alternative incentive other than financial reward. If the complementarity between pheasant and crop production could be maintained in this way, pheasant production would not decline and the discontinuance of the free-hunting tradition would need not be considered. Failure of this effort is perhaps due to too much concentration on continuance of the free-hunting tradition rather than on the production of pheasants. The influence of ethic and aesthetic values on the economic system which could have been used to enhance wildlife production has been usurped instead by the completely opposite attitude of clean farming. The prevailing aesthetic value apparently obtained from clean farming takes a different light when viewed as by Leopold:

> The present ideal of agriculture is clean farming; clean farming means a food chain aimed solely at economic profit and purged of all non-conforming links, a sort of Pax Germanica of the agricultural world. Diversity on the other hand, means a food chain aimed to harmonize the wild and the tame in the joint interest of stability, productivity and beauty (38, p. 183).

The socially encouraged principle of clean farming has been fully as destructive of habitat as the profit motive. Social encouragement of this principle has been given considerable economic weight through its effect

on the sale values of farms and by competition between tenants for farm land.

Farm land use and farming practices are of major importance in determining the supply and quality of pheasant habitat. The habitat for upland game is almost entirely under the control of private farm firms. Ninety-five percent of the total Iowa land area of nearly 36 million acres is organized in farms (23, p. 5). The net effect of economic motives, technology and aesthetic values largely determines the use of farm land. Land use data as augmented by direct observation demonstrate the rapid changes these forces have caused in the use of Iowa farm land.

Measures of land use changes

Two appropriate measures of the changes in pheasant habitat are the acreages of pasture, hay, oats, and idle cropland which serve as nesting cover; and secondly the acreage of wetlands, farmsteads, fencerows and roadsides which serve as both nesting and winter cover. An annual estimate of the acreage of each of the many agricultural crops is provided by the Assessors Annual Farm Census published by the Iowa Crop and Livestock Reporting Service. This census, however, does not furnish a satisfactory measure of the acreage in fencerows, farmsteads and other miscellaneous uses. In this census, as well as in the Census of Agriculture conducted every five years, the "other land" category, defined as roads, building sites, lanes, woods and waste, is calculated as a residual. This puts all omissions, changes in definitions and changes in accuracy into the "other land" category. The Census of Agriculture, for example, includes most towns of up to 1000 population in the

"other land" classification. The "other land" acreage estimates in the Assessors Annual Farm Census are even larger than the concurrent "other land" estimates of the Census of Agriculture. Surprisingly, the "other land" acreage, as estimated by the Assessors Annual Farm Census, has increased in all 9 agricultural districts of the state since 1954. This is a doubtful measure of changes in uncultivated areas of pheasant cover.

Complete tabulation of land use acreages with a much more detailed breakdown of the other land category is provided by specific pheasant research area studies. The best series of land use data is for a 1520 acre tract in Winnebago County located in north central Iowa. This series will have to serve as an index of changes in acreages of wetlands, farmsteads, roadsides, fencerows, etc., due to the deficiencies of the "other land" estimates in census data. The research area data will also serve to indicate the total and per acre contribution of the several land uses to pheasant production.

The acreages reported in the Assessors Annual Farm Census for the state and for each agricultural region will be presented first to show the trends in selected agricultural crops. This will be followed by the detailed breakdown of land use over several years on the Winnebago research area. The number of pheasants sighted per mile for each year and region is included in the land use tables to indicate the effect of land use changes on pheasant populations. Converting the number of pheasants per mile to an estimate of pheasants per section is possible, but the conversion rate differs widely over the state. Klonglan in September 1954 counted 100 pheasants per section in the Winnebago study area which had a pheasants per mile count of 3.6 (33, p. 635). Using

this relationship makes each pheasant sighted per mile equivalent to a pre-season density of 28 pheasants per section. On the Adair-Union pheasant study area in southwest Iowa, Klonglan made roadside counts and flushing counts in the late summer of 1957-1959, which indicated about 60 pheasants per section for each pheasant sighted per mile (27, p. 63).

Trends in crop acreages

The acreages of the major Iowa agricultural land uses in 1954 through 1966 appear in Table 4.

Immediately evident from the table of crop acreages is the upward trend in the combined acreage of the major row crops - corn and soybeans. The federal feed grain program shifted the row crop acreage to a lower level in 1961, but the upward trend has continued and the total acreage of corn and soybeans reached new highs in 1965 and again in 1966. Hay and pasture acreages have declined somewhat since 1954, but the largest decline was in the acreage of oats.

The acreage for "crop land not harvested or pastured" is largely the acreage under the federal programs to remove land from feed production. While the state oat acreage has been falling, an increased acreage of crop land not harvested has served to at least partially compensate for the loss of nesting cover in oats. Most of this increased acreage is crop land diverted in the feed grain program which probably contributed less to pheasant production than the oat acreage it replaced. Local Agricultural Stabilization and Conservation (A.S.C.S.) committees too often insisted that the diverted acres be mowed by specified dates, which fell before the end of the pheasant hatching season, and that new

Table 4. Acreage summary of farm crops in thousands of acres[a], Iowa, 1954-1966

Year	Pheasants sighted[b] per mile	Corn and soybeans	Oats	Hay	All pasture	Crop land not harvested or pastured[c]	Land in lots, roads, buildings, woods and waste
1954	1.28	12,500	5,971	3,697	9,428	365	2,351
1955	1.78	12,888	5,734	3,872	9,200	249	2,424
1956	1.64	12,496	4,915	3,309	9,238	1,574	2,450
1957	1.75	12,966	5,122	3,500	8,775	924	2,456
1958	2.51	13,068	4,740	3,790	8,570	1,243	2,463
1959	1.69	14,688	4,284	3,524	8,390	830	2,489
1960	2.17	15,049	4,045	3,451	8,160	1,071	2,491
1961	1.82	13,618	3,204	3,241	8,105	3,560	2,516
1962	1.92	13,433	2,923	3,441	8,143	3,787	2,519
1963	2.72	14,527	2,737	3,244	8,047	3,117	2,545
1964	2.70	14,435	2,305	3,230	7,868	3,845	2,550
1965	1.66	15,134	1,971	3,006	7,753	3,680	2,556
1966	1.92	15,527	1,951	2,958	7,590	3,459	2,510

[a]Source: Assessors Annual Farm Census (22).

[b]Results of late summer roadside survey (30, p. 78).

[c]Includes acreage under federal land retirement programs.

areas be established each year.

The land use trends shown for the entire state between 1954 and 1966 also apply to each of the 9 agricultural districts. Land uses as a percentage of total land in farms and the number of pheasants sighted per mile are given in Table 5 for 1954, 1960 and 1966. All districts have had an increase in the acreages of corn, soybeans and crop land not harvested, and a decline in acreages of hay, pasture and oats. The absolute increases and percentage increases in the row crop acreage have been the greatest in the Northwest, North Central and Central districts. The increase in row crop acreage in each of the 9 districts has been approximately proportional to their percentage of farm land in row crops in 1954. The districts which were relatively intensively farmed in 1954 are now even more so. As shown by the changes in the number of pheasants sighted per mile, the land use trends in northern Iowa are competitive with pheasant production while the increased pheasant densities in southern Iowa may be the result of a complementary relationship with increased farming intensity. The 9 agricultural districts of Iowa are delineated in Figure 11.

Land use on the Winnebago research area

The decline of nesting and winter cover in northern Iowa is much more severe than for the state as a whole. A series of land use tabulations from nesting studies on the Winnebago pheasant research area will be used to exemplify the habitat trends in northern Iowa. This land use and pheasant production data is presented in Table 6.

From 1940 to the present, row crops have increased from less than

Table 5. Percent of farm land in selected agricultural uses[a], and pheasants sighted per mile for Iowa agricultural districts, 1954, 1960, 1966

Agricultural district[b]	Pheasants sighted per mile[c]			Percent of farm land in corn and soybeans			Percent of farm land in oats			Percent of farm land in hay		
	1954	1960	1966	1954	1960	1966	1954	1960	1966	1954	1960	1966
Northwest	1.91	2.90	1.46	45	55	59	23.6	15.8	6.1	8.2	7.7	6.4
North Central	2.80	4.48	2.49	46	58	58	20.8	13.8	5.7	9.4	8.6	6.7
Northeast	2.43	2.43	2.04	28	34	34	16.7	11.6	9.2	14.0	13.5	12.9
West Central	1.23	2.41	1.92	40	47	48	19.3	10.7	5.1	10.0	9.0	7.0
Central	0.53	1.34	1.61	41	51	55	18.4	13.4	5.3	11.1	9.4	7.1
East Central	1.09	0.73	2.02	32	39	41	15.7	12.1	8.1	13.3	11.7	9.9
Southwest	0.78	1.25	4.50	34	40	40	15.0	9.4	2.9	11.3	10.4	8.7
South Central	0.35	0.36	1.50	24	25	27	9.9	6.0	3.7	11.8	11.8	11.9
Southeast	0.09	0.19	.62	31	38	40	11.8	7.2	4.4	10.5	9.5	8.3
State	1.28	2.17	1.92	36	43	45	17.2	11.7	5.6	11.0	10.1	8.7

aSource of acreages: Assessors Annual Farm Census, 1954, 1960 and preliminary 1966 (22).

bAgricultural acreages are delineated in Figure.

cSource: Nomsen, Richard, Game Biologist, Iowa State Conservation Commission, Des Moines, Iowa. Results of the late summer roadside survey. Private communication. 1967.

Table 5. (Continued)

Agricultural district[b]	Percent of farm land in pasture			Percent of farm land in crop land not harvested or pastured			Percent of farm land in woods, roads, buildings or waste		
	1954	1960	1966	1954	1960	1966	1954	1960	1966
Northwest	15.8	12.0	11.1	.6	1.8	10.6	6.1	6.1	6.2
North Central	16.1	11.3	10.4	1.1	1.4	12.2	6.6	6.7	6.9
Northeast	36.6	28.4	26.4	.8	3.3	8.5	7.8	8.2	8.5
West Central	21.4	18.5	18.4	1.7	4.1	12.7	6.8	7.0	7.3
Central	19.2	17.4	15.7	1.0	1.9	10.3	6.5	6.8	6.7
East Central	31.0	29.2	25.9	.8	2.3	8.1	6.4	6.8	7.2
Southwest	29.4	26.1	25.6	1.3	4.3	10.0	7.3	8.2	8.4
South Central	46.3	43.5	42.2	1.2	5.2	7.6	6.6	7.6	7.4
Southeast	37.5	34.5	31.4	1.0	4.2	7.5	7.1	7.8	8.1
State	27.1	23.6	22.2	1.2	3.1	10.1	6.8	7.2	7.4

Figure 11. Iowa agricultural districts

Table 6. Land use and pheasant production on the 1520 acre Winnebago pheasant research area, 1940[a], 1954[a], 1959[b], 1967[c]

Land use	Number of acres				Number of parcels			Number of nests			Nests per acre		
	1940	1954	1959	1967	1940	1954	1967	1940	1954	1967	1940	1954	1967
Hay crops	210.7	162.7	98.6	66.1	30	10	7	52	62	9	.25	.38	.14
Small grain	478.4	402.8	194.5	65.1	28	18	5	32	48	1	.07	.12	.02
Pasture	208.1	125.9	6.8	13.5	17	10	3	10	5	0	.05	.04	.00
Corn and sorghum	426.1	587.0	834.7	700.2	22	20	20	0	0	0	.00	.00	.00
Soybeans	65.0	124.6	284.7	396.7	10	9	16	1	0	0	.02	.00	.00
Other													
Fencerows	7.9	6.0	5.2	4.6	-	-	-	23	17	0	2.91	2.83	.00
Sloughs	14.4	9.6	0.0	0.0	12	2	0	2	0	0	.14	.00	.00
Roads and lanes	20.7	16.6	17.8	15.8	-	-	-	0	0	0	.00	.00	.00
Idle	11.3	0.0	0.0	160.8	2	0	12	0	0	3	.00	.00	.02
Farmsteads	52.6	58.3	48.3	57.7	8	8	8	4	3	0	.08	.05	.00
Road ditches	20.4	26.5	29.4	37.2	-	-	-	12	27	5	.59	1.02	.13
Miscellaneous	4.4	0.0	0.0	0.4	3	0	1	1	0	0	.23	.00	.00
Subtotals	131.7	117.0	100.7	326.5	25	10	20	30	20	8	.23	.17	.02
Totals	1520	1520	1520	1520	132	77	65	140	162	18	.092	.125	.012

[a]Source of 1940 and 1954 data: (33, pp. 670-671).

[b]Source of 1959 data: Klonglan (27, pp. 287-288) Nesting data was not reported in 1959.

[c]Source: Fischer, Wayne, Wildlife Research Unit, Iowa State University, Ames, Iowa. Winnebago County nesting study, 1967. Private communication. 1967.

Table 6. (Continued)

Land use	Successful nests			Successful nests/acre			% of all successful nests			Approx. no. hatched		
	1940	1954	1967	1940	1954	1967	1940	1954	1967	1940	1954	1967
Hay crops	12	5	1	.06	.03	.02	34	18	33	96	45	9
Small grain	13	9	0	.03	.02	.00	37	32	0	104	72	0
Pasture	4	2	0	.02	.02	.00	12	7	0	32	16	0
Corn and sorghum	0	0	0	.00	.00	.00	0	0	0	0	0	0
Soybeans	0	0	0	.00	.00	.00	0	0	0	0	0	0
Other.												
Fencerows	3	3	0	.38	.50	.00	9	11	0	24	24	0
Sloughs	1	0	0	.01	.00	.00	3	0	0	8	0	0
Roads and lanes	0	0	0	.00	.00	.00	0	0	0	0	0	0
Idle	0	0	0	.00	.00	.00	0	0	0	0	0	0
Farmsteads	0	1	0	.00	.02	.00	0	4	0	0	8	0
Road ditches	1	8	2	.05	.33	.05	3	29	66	8	64	18
Miscellaneous	1	0	0	.00	.00	.00	3	0	0	0	0	0
Subtotals	6	12	2	.04	.10	.01	17	43	66	40	96	18
Totals	35	28	3	.022	.018	.002	100	100	100	280	244	27

1/3 of the total acreage to over 2/3 of the 1520 acre research area.
This increase has been largely at the expense of hay, oat and pasture
acreages. Land put into cultivation as a result of drainage, field
enlargement and farmstead abandonment has also caused a substantial and
permanent loss of nesting and winter cover. Land diverted from row crops
through the federal feed grain program ("Idle" category) has at least
temporarily shifted the increasing row crop trend to a lower level.

The one bright spot in the land use changes is the increased
acreage of road ditches. These ditches have been widened to allow improve-
ment of the secondary road system. The roadsides were farmed as hayfields
during the 1940 study, and most of the roadside nests were destroyed by
mowing. The mowing of road ditches has been practiced less and less
since 1940 due to the use of 2,4-D for weed control and the prohibitive
costs of the road ditch haying operation. Roadsides produced 29% of the
successfully hatched nests in 1954, and the number of successful nests per
acre was nearly 10 times that of the hay fields. In 1967 2/3 of the
total production was on roadsides. Fencerows were the most productive
per acre in 1940 and 1954, but by 1967 the remaining fencerows were too
narrow to provide any nesting cover.

Roadside cover management

The demonstrated contribution of road ditches to pheasant production
on the Winnebago research area and similar studies in north central Iowa
were used as the basis for the following conclusion by Klonglan in 1961
(28, pp. 1,2):

> Road ditches have the most extensive and well spaced state-
> wide distribution of permanent nesting cover, with considerable

total acreage averaging about 4 to 5 acres per mile of road. Management practices aimed at improving roadside nesting, which involves public land, seem to hold more promise than attempting to encourage establishment of nesting areas on private land.

One of the major causes of destruction of roadside nests is mowing, and it has more prospect of successful management than predation, the other major cause of nest loss in roadsides. If mowing can be delayed until after the hatching peak has passed, a major boost in pheasant production from roadsides would result.

There are 100,264 miles of rural primary and secondary roads in Iowa: secondary roads total 91,352 miles; interstate highways and other rural primary roads total to 8,912 miles (26, p. 5). The average acreage of road ditch is about 5 acres per mile of road. The total nesting cover provided by road ditches is approximately 500,000 acres, or an average of over 5,000 acres per county.

The Iowa Highway Commission has been delaying the mowing of ditches along the primary roads until after July 1st, since 1961. Appeals to individual farmers to do the same on the much greater acreage of secondary road ditches have had a slower but increasing acceptance.

While the average width of the secondary road ditches has been increasing, approximately 75 miles of Iowa secondary roads are vacated (abandoned) each year[1]. The vacated roadway reverts to the adjoining landowners, since the counties hold only an easement for use of the land as a road. The county must report its intention to vacate a road to the Iowa Highway Commission and then hold a public hearing on the proposal. The counties usually receive much objection to county road vacations and as many as ½ are not carried out or are postponed. In 1967 there were

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[1]Larson, Mel, Secondary Road Engineer, Iowa Highway Commission, Ames, Iowa. Secondary road mileages. Private communication. 1966.

764 miles of legal secondary roads not open to or suitable for traffic (26, p. 5). This mileage includes the terminated roads (stubs) created by the interstate highway system. Farmers often prefer to leave these poorly maintained roads intact to serve as farm lanes.

The recent establishment of county conservation boards in most counties of the state presents an opportunity to switch the emphasis from transportation to wildlife production on the secondary roads not suitable or necessary for through traffic. The transfer of maintenance responsibility to the county conservation boards would be an intra-county government transfer. The conservation boards can levy up to a 1 mill property tax which by 1970 could total as much as $6 million (54, p. 6). This financial support may put the conservation board in a better position than the hard pressed secondary road funds. The conservation boards could shift the maintenance emphasis to roadside development rather than surface maintenance. The action suggested here could take advantage of the resistance to vacating secondary roads and prevent transfer of the right of way into more crop land.

Several miles of railroad right of way also are being abandoned each year. There are over 8,000 miles of railroad in Iowa, and in 1965, 92 miles of this was abandoned as a railway (24, p. 338). The width of railroad right of way is, in general, at least 100 feet wide which amounts to 12 acres per mile. The estimated total acreage abandoned in 1965 is then 1,104 acres, most of which has, or will, become crop land. Preventing this loss of pheasant cover appears to be much more difficult than with secondary roads. For one thing, there is no consistent pattern of fee simple title and railroad use easements. The two degrees of title

are often interspersed even within sections, and sometimes occur on opposite sides of the same portion of railway. Secondly, in order to discontinue use of a railroad and salvage the track, the railroad must go through legal procedures to have the railway declared legally abandoned. This procedure would not be necessary with intra-county agency transfers of responsibility for secondary roads. When the railway is legally abandoned, the railroad easement rights are relinquished, and control goes to the adjoining landowner. In order for a state or county agency to acquire the right of way, they would have to negotiate with all the adjoining landowners who hold reversionary rights and with the railroad company for the land it owns in fee simple. The Chicago, Milwaukee, St. Paul and Peoria Railroad was able to sell its rural right of way on an abandoned railroad in Boone County for $50 to $300 per acre in 1965 and 1966. The higher prices were obtained where different landowners were on each side of the right of way. It would cost as much or more for a government agency to purchase the land.

The Iowa Conservation Commission does own 14 acres of abandoned railroad right of way which is located in Crawford County. Based on experience on this area and other small hunting areas, the Conservation Commission would be reluctant to purchase similar areas and then cope with the fencing and weed control problems.

Windbreaks

The use of land as windbreaks contributes to pheasant production by furnishing both nesting and winter cover. Windbreaks on the Winnebago research area are included in the "farmstead" category in the land use

and pheasant production data. There were some successful nests in farmstead areas, but the production per acre is very low. The major contribution is as winter cover. In most years the bottleneck in pheasant production is the lack of nesting cover, but in severe winters as occurred in 1965, pheasants in dense farm groves were able to withstand the March storms while those in poor cover were almost completely killed out in some areas of northern Iowa. The birds died of exposure or suffocation during the blizzards, and no deaths were attributed to starvation. On the Winnebago research area, where windbreaks gave inadequate protection, 388 pheasants were counted on February 14-15, 1965 and only 194 on March 24th, a 50% loss (29, p. 2). Losses such as this are often partially compensated for by increased reproduction success by the remaining birds, so a measure of the contribution of good windbreaks to the success of the following hunting season was not attempted in the storm loss evaluation. Estimation of an average annual contribution is even more difficult. An estimate of the annual benefit from an individual high quality farmstead windbreak would require an intensive study of specific research areas where land use could be controlled. The State Conservation Commission does not feel such an expensive experiment is warranted. This is particularly true since the federal government is now providing financial assistance for windbreak improvement without any estimates of the resulting increases in pheasant populations. The very low number of nests established on the increased acreage of roadsides and idle land of the Winnebago research area in 1967 suggests that the spring breeding population was too small relative to the nesting cover available. If this is true, winter cover was the

limiting factor even in the mild winter of 1966-67. Further evidence
of this nature may cause added emphasis be given to windbreak establish-
ment and improvement.

Economic Incentives

The fact that economic and clean farming motives have been so
effective in destroying habitat presents a strong case for considering
economic incentives and aesthetic appeal for maintaining or restoring
habitat. Free-hunting advocates consider these two means to be mutually
exclusive, but exclusion of either means will impose limitations on the
results obtained. Taber and Bolle, by considering a farm operation as
consisting of both a household unit and a business unit, effectively out-
line the limitations on attempts to increase farm-game production with
appeals to aesthetic values without economic incentives (64). One of
their major points is the increasingly urban-orientated living standards
of farm families. Attempts to duplicate urban consumption necessarily
require more importance be placed on the profitability of the business
unit and a lower value be placed on some amenities of rural living. If a
conflict between the business unit and the household unit exists, the
family is unwilling to sacrifice income for characteristically rural
amenities such as the presence of wildlife. The business function
usually proves the stronger influence.

With heavy hunting pressure, economic losses to the business unit
and a nuisance factor for the household unit may result. Due to the
avoidance of making a charge for hunting, rising nuisance and economic
losses leads to posting. Taber and Bolle see correctives other than

economic as severely limited:

> Because of this valiant efforts are being made to improve
> landowner-hunter relations, and so maintain free hunting on
> private land. However, since this can do no more than raise
> wildlife from a negative to a neutral value in the eyes of the
> landowner it will never give wildlife a significant place in
> his management decisions. If every hunter asked permission,
> closed gates, cleaned up trash, avoided frightening livestock
> and gave the landowner a nice Christmas present, wildlife
> would continue to dwindle as the landowner improved his economic
> position (with government help) by making his fields larger,
> filling brushy draws, cleaning up his fencerows, silting or
> draining his potholes and straightening his stream channels.
> The failure of these well-meant efforts to improve the land-
> owner-sportsman relations and so perpetuate free hunting, stems
> from the fact that they are directed toward the landowner in
> his household function, whereas his continuing destruction of
> habitat is carried on in his business function (64, p. 260).

Thus to Taber and Bolle, monetary compensation for providing hunting

opportunities appears to be mandatory in order to maintain farm-game

habitat. Their unpublished survey of the existing hunting rights market

led them to make the following preliminary observations:

> 1. The better the hunting in terms of game kill per
> acre per year, the higher the price paid for lease or sale
> of the land. Game concentration spots yield the highest pro-
> duct. Aquatic areas are game (waterfowl) concentration spots.
> 2. In areas where there is not much public land, even
> areas of low productivity (forest and range land) yield an
> income from game.
> 3. The clear pattern which emerges for aquatic (high) and
> forests and range (low productivity) wildlife lands, is not
> followed by agricultural (medium productivity) lands; income
> from wildlife production on farmland lies, on the average, well
> below that for either of the other two land categories (64,
> p. 261).

Taber and Bolle found the majority of private waterfowl concentra-

tion areas had a lease value of $10-$100 per acre, per year and a

verified offer for a lease on a goose-hunting area in Missouri was over

$1,000 per acre per year. This same survey found that leases for the

hunting rights to upland farm game were rare.

In cooperation with the Iowa State Conservation Commission I made a survey to determine the extent of a market for hunting rights in Iowa. Five copies of a questionnaire on this subject were sent to each of the State Conservation Commission's 60 conservation officers throughout the state in June, 1967. The questionnaires were mailed to each conservation officer with a transmittal letter signed by their supervisors to explain the survey. A copy of the questionnaire and the transmittal letter are in Appendix A of this report. The transmittal letter asked each conservation officer to fill out one questionnaire for each case in his county or counties where hunting rights were marketed. They were asked to provide names and addresses of the parties involved, type of game provided, characteristics of the financial arrangement, and the degree of habitat improvement in response to the income incentive.

Questionnaires were returned for 57 of the 99 Iowa counties. After questionnaires from about 40 counties had been returned, a reminder was sent to the officers who were located in 10 counties which seemed to have the greatest potential for a pheasant hunting market, but hadn't returned any questionnaires. This reminder brought a 100% response.

Not a single case of the sale of pheasant hunting rights was reported. The conservation officers were asked not to report licensed shooting preserves which offer hunting for pen raised birds. Information on shooting preserve location and operation is reported by shooting preserve operators to the State Conservation Commission in accordance with licensing requirements. There were seven shooting preserves operating in the 1966-1967 season, six of which offered pheasant hunting. The conservation officers reported numerous cases of leased hunting

rights, daily fees and membership arrangements permitting access to
waterfowl concentration areas.

Based on the results of the survey of conservation officers, I
conclude that the market for pheasant hunting, where the pheasants are
produced in the wild, is very limited or nonexistant. These areas will
be called hunting areas to differentiate them from shooting preserves.
However, as shown by the operation of shooting preserves, hunters will
pay for an opportunity to hunt pheasants. During the 1965-1966 season,
930 hunters paid up to $5 for each of 3,369 pheasants bagged on shooting
preserves[1]. This compares with a total statewide bag by 225,735 hunters
of 1,117,500 pheasants from hunting areas. While opportunities for
pheasant hunting are marketable on shooting preserves, pheasant hunting
opportunity seems to be an unmarketable product on hunting areas.

There have been occasional attempts to market hunting areas in Iowa
in the past, but the recorded attempts were all short lived. Aldo
Leopold reported in his Game Survey of the North Central States, 1931
that he had found a "perceptable tendency to charge for pheasant shoot-
ing" in Iowa. He mentioned one case of a $2.50 per day charge near Ft.
Dodge, but concluded:

> These instances of charging are conspicuously rare,
> especially when one considers the heavy pressure of hunters
> desiring to shoot pheasant in states like Ohio, Michigan,
> Minnesota and Iowa. Evidently the theory that the farmer
> should not charge the public for the privilege of harvesting
> his pheasant crop, because the seed was originally provided
> at public expense, enjoys considerable credence among farmers

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[1]Cummings, Don, Game Manager, Iowa State Conservation Commission,
Des Moines, Iowa. Shooting preserve operations, 1965-66. Private
communication. 1967.

as well as sportsmen. If this were not the case, charges would be expected to be more frequent (37, p. 133).

Twelve farmers in Winnebago County organized the Amund Hunting Club in 1928 which furnished hunting areas and guides for $1 per day per hunter. This club's operation was studied by Greene who found all parties were satisfied with the arrangement (16, p. 24). However, by 1943 the club had ceased to function. Greene concluded that failure of the State Conservation Commission to maintain contact and provide technical assistance contributed to the club's failure. A permanent government agency to sponsor a farmer organization such as this was considered necessary to overcome the membership discontinuity.

Other attempts to collect fees for access to pheasant hunting areas have been made more recently, but apparently none were successful. I noticed some leased hunting areas in Cerro Gordo County in 1961, but these areas have not been leased recently. My survey did bring in a report of an organization controlling a 4000 acre area in Fayette County to which hunting access was controlled, but no fee was charged.

No instances of the sale of hunting rights for rabbit, squirrel or quail hunting areas was reported in my survey. This lack of an income incentive for production of upland farm-game has severly limited the adoption of game management practices by farm firms. There is a greater and greater disparity between knowledge about game management and its application. As stated by Berryman: "We find ourselves in the paradoxial position of knowing how to produce a highly prized commodity without being able to "market it" (3, p. 320).

In order for pheasant hunting areas to produce any hunting rights

income, a market and a marketable product must exist. "Sellers must be
in a position to withhold the product or service, so that buyers are
forced to pay a price to make use of the facilities" (10, p. 265). The
product of pheasant hunting areas is the opportunity for recreational
pheasant hunting, and pheasants are a required input for this product.
In order to market hunting rights on farm land, some minimum number of
pheasants must be located on the hunting area, and the area will have
to be patrolled to withhold the product of pheasant hunting for paying
hunters only. Pheasants do not concentrate very much in small areas as
do waterfowl. After the season starts, they are both dispersed and
reduced in number. A single farm firm would not normally control enough
land to affect the local availability of hunting areas if withheld for
a price and would have to offer exceptional hunting quality to attract
a hunting rights buyer. A larger hunting area withheld by a multi-farm
organization would have a much greater effect on the supply of hunting
areas. A complicating factor is that all public roadsides within the
withheld hunting area are legal public hunting areas. Complete control
of access to private land would only partially restrict hunting in the
area to paying hunters. The total farm land area in the state with a
legal pheasant season may also be so great as to make local withholding
of access ineffective in extracting a price. There are more than 30
million acres of land in farms within the Iowa legal pheasant hunting
zone. This 30 million acres, less the posted farms, supplied hunting
areas for 250,000 hunters in 1966. This is an average of about 120
acres per hunter. The quality of hunting in many of these areas may
not be as good as hunters would like, but the supply of all pheasant

hunting areas is high enough to offer competition for hunting areas controlled by those who try to charge for access. The competition from free hunting areas would be greatest for low quality hunting areas and least for the high quality hunting areas. Until all hunting areas of equal or better quality are reserved with leases, withholding hunting privileges in a relatively small area will not limit hunters' choices of free hunting areas enough to pressure them into paying an access fee.

Adair County has the highest average pheasant density in Iowa, and thus its farmers are in a better position to withhold access to hunting areas except for a fee than in any other area of the state. Alternative area choices for pheasant hunting are almost all of poorer quality than Adair County hunting areas. However, the conservation officer assigned to Adair County reported that he knew of no leased or daily fee hunting areas. This result was unexpected considering that Adair County receives more hours of hunting than any other county and most of the hunters are not residents of the county. With rigid enforcement of the state trespass law and widespread withholding of hunting areas, it seems that farm firms in Adair County would have a marketable product. A county-wide organization to provide a centralized market place would then be necessary to provide a means to market the hunting areas. If these organizational obstacles could be overcome in order to establish a market, the question remains of whether the market would be a financial success. In addition, the sale of hunting rights would probably not increase the area available for hunting and the fee requirement would reduce the number of hunters using the area. Unless the income derived is effective in maintaining the present high quality habitat, a hunting rights market will have a

negative long run effect on the supply of hunting opportunities.

Polk County (Des Moines area) and other hunters from outside the county spent approximately 37,000 hunting days in Adair County during the 1966-67 season[1]. If an average daily fee of $2 were collected, and $\frac{1}{2}$ of the hunters avoided the fee or hunted elsewhere, this would yield $37,000 per year. The largest shooting preserve in the state charges $3 to hunt on the preserve plus $4 a pheasant. An average fee of $3 per day from $\frac{1}{2}$ of 37,000 hunter-days would yield $56,000. Divided over the 1512 farms in Adair County (22, 1966 prelim.), the average revenue per farm would be only $37. I would expect marketing costs, including the value of time spent by each farm firm in patrolling to keep out trespassers, to at least equal the revenue. Concentrations of pheasants in hunting areas are just too low to yield revenues which will allow any overhead marketing costs. The Union-Adair County pheasant study area yielded an average of 128 cocks per section in 1957-1959 (27, p. 313). Roadside counts indicate that populations are higher in Adair County now, and this years' harvest may be nearer 150 cocks per section. The farm firms will not be able to market the pheasants that are bagged on the roadsides and railroad right of way, and they will not be able to prevent losses to trespassers for the full 52 day season. Hunting rights to about $\frac{1}{2}$ of the 150 pheasants is at most what could be sold. This only amounts to about 25 cock pheasants per farm. In all other counties of the state this estimate would be lower.

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[1]Estimated by the author directly from the returns of a .71% postcard survey of resident licensed hunters made by the Iowa State Conservation Commission.

While the leasing and management of pheasant hunting areas for an entire season seems to hold little promise as an additional farm enterprise, a centralized organization representing the farm firms could possibly sell reservations for hunting areas for only the first weekend of the season. This would provide a service for hunters in locating hunting areas in order to avoid the opening day scramble, and would allow farm firms to capitalize on the opening day demand for hunting areas while minimizing days of patrolling required.

A reservation system for the opening weekend of pheasant season has the advantage of being able to stress the service aspect. While hunters may be willing to pay a fee to locate a hunting area quickly and easily, the payment of fees for access rights to hunt publicly owned game has been strongly resisted by hunters. Payment of fees for access would be resisted not only because of the expenditure required for a formerly free good, but free-hunting advocates consider the payment of fees itself destructive of hunting quality. Access fees would be just one more admission to the high degree of exclusive rights that landowners have been given in the United States. Part of the reason hunters resist paying fees is that there is no immediate benefit received other than allowing them access. For any one year the same amount of game would be available whether an access fee was collected or not. If there were any beneficial improvement in habitat resulting from the payment of fees, the increased game production would not occur until at least a year later. The payment of access fees is disassociated from the benefits by a time period long enough to cause hunters to fail to recognize and accept the actual association of costs and benefits.

The inter-temporal disassociation between the primary benefits received from hunting and the costs of producing game actually consists of two benefit-cost disassociations. One of these is an inter-party disassociation caused by the distribution of benefits from hunting to parties other than those who must develop and maintain habitat improvements to increase game production. The inter-party disassociation can theoretically be corrected by a fee for access to hunting areas paid to the farm firms. The second disassociation of benefits and costs is within parties, but among time periods. Collection of an access fee will often occur in different seasons of the year and in different years than the costs incurred by farm firms in maintaining or developing habitat. This disassociation of benefits and costs over time when compounded by uncertainty will make hunters reluctant to pay access fees and may cause farm firms to make less investment in game habitat than justified by their past and potential income from access fees.

The effect on hunting opportunities of any effort to establish a market for pheasant hunting will ultimately depend on how much additional pheasant production results from the income incentive provided by access fees to pheasant hunting areas. When direct attempts to increase pheasant populations through habitat improvement are made, the costs of production rise rapidly. MacMullen has offered the following estimate of these costs:

> Occasionally we find instances where habitat improvement can produce pheasants in the bag for less than a dollar a bird. But these are rare. More likely costs are $4.00-$40.00 a bird, or perhaps explained in terms such as $20.00 per acre of nesting cover provided (41, p. 270).

MacMullen was referring to costs borne by state conservation departments.

State and federal game habitat improvement programs increase the extent
to which farm firms could develop pheasant habitat for a pheasant hunting
area market. These programs will be inventoried next in order to esti-
mate the amount of habitat improvement farm firms would be able to make
in response to an income incentive with this government assistance.

Government assistance on habitat development

Table 7 summarizes the Iowa Agricultural Conservation Program
(A.C.P.)[1] projects which are thought to have a beneficial effect on
wildlife. All the technical assistance for these projects is provided
by state and federal agencies. The county offices of the U.S. Agri-
cultural Stabilization and Conservation Service (A.S.C.S.) are authorized
to provide cost-share assistance on practices which would not be carried
out to the "needed extent" without financial and technical assistance.
The cost-share practices must in general meet one or more of the follow-
ing criteria (67):

    1) Soil and/or water conservation

    2) Exclusively for wildlife benefit

    3) Farm beautification

The Iowa State Conservation Commission has put full support behind
the A.C.P. This provides a very impressive pool of willing assistance
to farmers interested in improving wildlife habitat. The specialists
in all the agencies involved cooperate very closely to determine the

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[1]Administered by the Agricultural Stabilization and Conservation
Service of the U.S.D.A. with technical assistance provided by local
Soil Conservation Service offices and the Iowa State Conservation
Commission.

Table 7. Agricultural Conservation Program cost-share for selected practices, Iowa, 1966-1967[a]

Practice	Clearing Max. % of cost per acre	Clearing Per acre	Non-ornamental % of cost acre	Non-ornamental Per acre	Ornamental Per shrub	Ornamental Per windbreak[b]	Seed, seeding and fertilizer %	Seed, seeding and fertilizer Per acre	State nursery stock available	Maximum cost-share
A-2 (Long term seedings)							70%	$23	-	$23/A.
A-8 (Trees and shrubs to stop wind and water erosion)	80%	$15	80%	$45					yes	Fencing[c] + $75/A.
D-4 (Vegatative cover on crop land out of production)								$4	-	$4/A.
G-1 (Wildlife habitat plots)	80%	$10	80%	$45					yes	Fencing + $55/A.
G-1(A) Wildlife cover around existing farmstead windbreaks)			80%				80%		no	$200 per windbreak[d]
G-2 (Marsh development)	60%								yes	60% of total cost

[a]Source: (67).

[b]Assumes an average of ½ acre in size for total cost-share calculations.

[c]Fencing cost-share is 60% or $2.50 per rod for woven wire and $1.00 per rod for a four strand barbwire fence.

[d]80% of the fencing costs are eligible for cost share on this practice.

Table 7. (Continued)

Practice	Clearing Max. % of per cost acre	Land preparation % of Per cost acre	Trees, shrubs and planting Non-ornamental % Per acre	Ornamental Per shrub	Per windbreak[b]	Seed, seeding and fertilizer[b] % Per acre	State nursery stock available share	Maximum cost-share
H-1 (Tree plot improvement)	80% $25		(10¢/tree) $.75	$75			no	Fencing + $88/plot
H-2 (Grass plots at intersection, ½ acre minimum)						$10	–	$10 each
H-3 (Establishment of farmstead windbreaks)		80%	80% $70	$.75	$75		no	Fencing + $10/ windbreak

most effective and efficient means of improving habitat, whether for aesthetic or economic motives of the farmer.

The cost-share assumed by the A.S.C.S. is generally 60-80% of the total cost of the A.C.P. practice. The major exception is the H-3 practice (establish a windbreak). The trees and shrubs must be purchased for this practice from a private nursery. The maximum cost-share is approximately $110 for all trees, shrubs, landscaping and planting, plus 60% of the cost of fencing or up to $2.50 per rod of woven wire fence. The actual cost experience of Story County landowners for establishing windbreaks was an average total cost of $533.74. The A.C.P. cost-share, if paid, will average $178.65 leaving an out of pocket cost of $355.10. The actual cost-share was only 34%. These averages were calculated from the applications of the four Story County landowners who have applied for cost-share on windbreak establishment in 1967[1]. The average windbreak size was ½ acre.

The G-1(A) practice is the improvement of wildlife cover in existing farmstead windbreaks. This practice is allowed a maximum assistance of 80% cost-share up to $200 per windbreak and had an average total cost for the two Story County participants of $186.18. The actual A.C.P. cost-share averaged $129.82 which covered 70% of the costs leaving a net cost of $56. This practice will no doubt have greater state-wide acceptance than the H practices due to its lower total cost and the higher cost-share percentage.

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[1]Huhn, Henrietta, Office Manager, Story County A.S.C.S., Nevada, Iowa. Cost-share experience on H-3 and G-1(A) A.C.P. practices. Private communication. 1967.

The G practices of the A.C.P. have the primary purpose of improving wildlife habitat. The other practices, which were listed in Table 6, are of benefit to wildlife, but have farm beautification or erosion prevention as their major purpose. Decisions to carry out these other practices will be made largely according to the expectations of economic returns and esthetic values from other than wildlife sources. The A.C.P. practices which are not designed primarily for wildlife habitat improvement may, however, have a higher rate of acceptance by farm firms when the benefits from higher wildlife populations are considered.

The Iowa State Conservation Commission is actively promoting the A.C.P. projects to improve farmstead windbreaks. In addition, the Iowa State Conservation Commission still offers free labor and material for establishment of small wildlife areas on uncultivated plots, but the program is receiving much less emphasis than in the past. Planting programs in Iowa and other states have been found to have very high costs, while demonstrating little benefit for game (41, p. 407). Cover and food plantings can be beneficial, but they must be in the right locations in relation to the ecological features of the area and its game, as well as to the prevailing and future farming practices. Plantings in odd-corners of farms have all too often disappeared before any benefit is derived because of changing fencing and cropping patterns. Plantings in farmstead windbreaks which also serve to protect and beautify farmsteads are expected to have greater permanency, and they qualify for federal financial assistance. Much of the cost of windbreak improvement is thus shifted to federal agencies.

Economic efficiency of habitat development

With sufficient information on the resulting increases in pheasant production from carrying out one or several of the possible habitat improvements at various scales, a farm firm's marginal cost curve, allowing for government assistance, could be estimated. If a market for hunting areas existed, the supply curve would correspond to the portion of the marginal cost curve which lies above the average cost. A supply curve would represent the relationship between price per pheasant and the quantity supplied. The present pheasant population exists with a zero supply price, and the average cost of each pheasant to farm firms is zero. A hypothetical supply curve extended beyond the single known point at $0 is shown in Figure 12.

Empirical evidence on the contribution of specific farm-game management practices to pheasant populations is practically nonexistent. The procedure to estimate marginal costs will be carried as far as possible without this data. Poorly supported estimates of added productivity will have to be used in some cases, and for others the analysis will only serve to show what data is needed.

While the costs attributable specifically to pheasant production from A.C.P. and other game management practices are difficult to measure, the added production from these practices is even more difficult to determine. Rather than try to determine specific cost and benefit estimates for each game management practice, it will be better to use economic efficiency criteria to first eliminate the practices which are not economically efficient even under liberal assumptions on added pheasant productivity and pheasant prices.
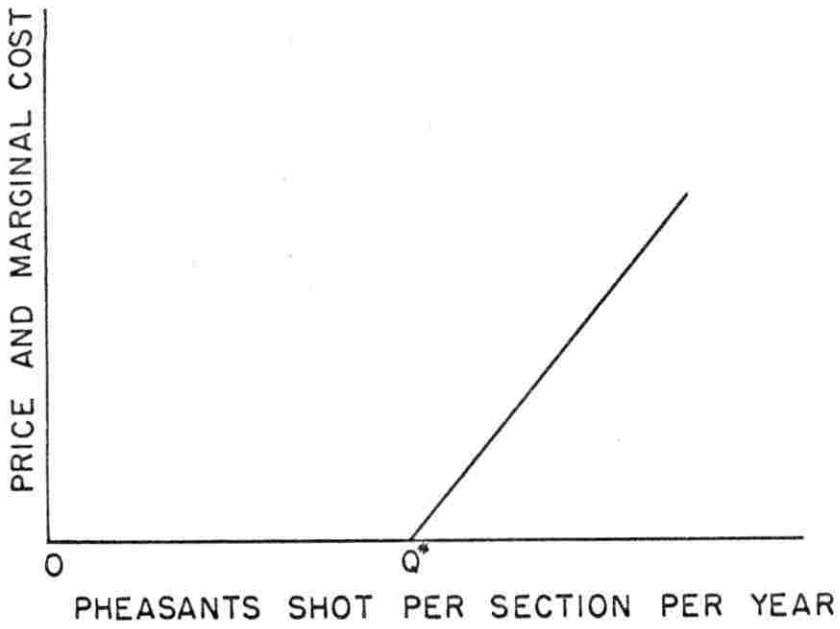
Figure 12. Hypothetical pheasant supply curve

Economic efficiency criteria provide a means to make comparisons between investment in pheasant production and alternative investment opportunities. The comparisons are made at the margin by considering only the added increment of product value against the added increment of input cost. The framework to apply this technique to outdoor recreation development was suggested by Lee (35).

Each game management practice selected for analysis will be assumed to require the entire capital expenditure at time $t = 0$ and will have an expected life of T years. Capital expenditures and annual operating inputs will be assumed to increase with the number of pheasants produced. The annual net return is the annual revenue from sale of hunting rights (Price x Quantity of pheasants harvested) less the annual costs for the n operating inputs (Market prices for inputs x Quantities of inputs). Annual net return for year t will be written as:

$$P_t Q_t - \sum_{j=1}^{n} (C_{jt} X_{jt})$$

This net return is expected to occur annually over the entire life of the capital improvement and must be discounted to determine its value at time $t = 0$. The discounted net return is given by:

$$\sum_{t=0}^{T} \frac{P_t Q_t - \sum_{j=1}^{n} (C_{jt} X_{jt})}{(1 + i)^t}$$

where i is the discount rate. By assuming the prices and quantities of the product and of the annual inputs are constant over the life of the development, and by defining w as equal to $\sum_{t=0}^{T} 1/(1+i)^t$, the formula can be simplified to:

$$w \left[PQ - \sum_{j=1}^{n} (C_j - X_j) \right]$$

The value for w at various discount rates can be found in compound interest tables as the present value of a $1 annuity, $\left[1-(1+i)^t \right] /i$.

In order for a habitat improvement project to be economically feasible, the present value of future net returns from the project must equal or exceed the initial capital expenditure. Letting k represent the capital expenditure this requirement is written as:

$$w \left[PQ - \sum_{j=1}^{n} (C_j X_j) \right] \geq k$$

The scale of pheasant production may be increased by either extending the application of a single practice or group of practices to more area, or by applying more intensive techniques to a specific tract. The equation developed so far will only determine whether a given scale is a profit making or a losing proposition. There is a positive profit if:

$$\pi = w \left[PQ - \sum_{j=1}^{n} (C_j X_j) \right] - k \geq 0$$

The scale which maximizes profit is the quantity of pheasants where $\frac{d\pi}{dQ} = 0$ and $\frac{d^2\pi}{dQ^2} < 0$. If the input prices are an accurate measure of the value of the inputs in other uses, this scale is an economically efficient scale. At this scale the net value of the marginal increment of production is equal to the cost of the marginal increment of production which in turn is the value of the marginal input requirements if put to other uses.

Divisibility of increases in pheasant production and increases in the associated costs into increments in scale of one pheasant at a time

is impossible. An approximation is possible by using larger increments
of Q, X_j and k denoted by ΔQ, ΔX_j and Δk. Economic efficiency is
approximated where

$$\frac{\Delta \pi}{\Delta Q} = w \left[\frac{P \Delta Q}{\Delta Q} - \sum_{j=1}^{n} \frac{(C_j \Delta X_j)}{\Delta Q} \right] - \frac{\Delta k}{\Delta Q} = 0$$

Adding the cost components to both sides of the equation gives the
usual form of price equal to marginal cost:

$$wP = w \frac{\Sigma(C_j \Delta X)}{\Delta Q} + \frac{\Delta k}{\Delta Q}$$

An alternative equation is formed by dividing both sides of the
equation by w which transforms the components to current annual measures
of price, input cost and capital:

$$P = \frac{\Sigma(C_j \Delta X_j)}{\Delta Q} + \frac{\Delta k}{w \Delta Q}$$

The economically efficient scale is where

$$P = \frac{\sum_{j=1}^{n} (C_j \Delta X_j)}{\Delta Q} + \frac{\Delta k}{w \Delta Q}$$

which is the equality of current annual price and current annual marginal
cost. The hypothetical solution to this equation for a farm firm is
shown in graphical form in Figure 13. Referring to Figure 1, Q^* repre-
sents the economically efficient quantity at price P^*. Q' is the
economically efficient quantity under the existing pheasant hunting market
where the market price is P' (zero) and pheasant production is a passive
by-product of crop production. The economic efficiency criterion can be
used to estimate what price per pheasant must be obtained, or what cost
per pheasant must be absorbed for nonmonetary motives in decisions
to apply game management practices.

$$\sum \frac{(C_j \triangle X_j)}{\triangle Q} + \frac{\triangle K}{\triangle Q}$$
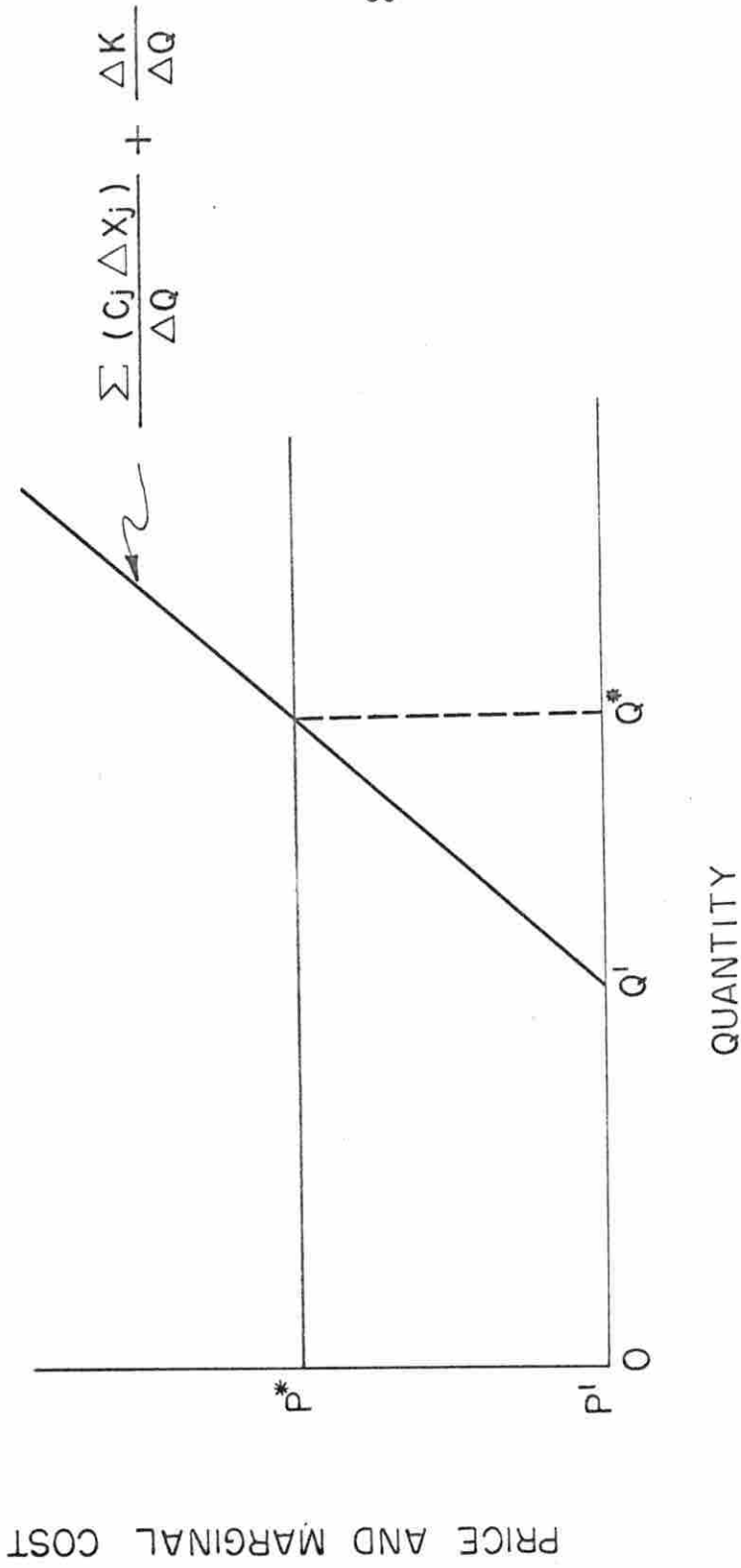
QUANTITY

PRICE AND MARGINAL COST

Figure 13. Hypothetical graphical solution of current annual marginal revenue and current annual marginal cost

In evaluating pheasant management practices the importance of using the incremental economic efficiency criterion rather than just the more simple test for economic feasibility can be shown in an example for the practice of using flushing bars ahead of hay mowers. A flushing bar is a bar with hanging strips which is attached to a farm tractor 12-16 feet ahead of the cutting bar of a trailing hay mower. This device was tested in Iowa hayfields in 1953-55 to test its effectiveness. Only 37% of the nesting hens were killed in the fields mowed using flushing bars as opposed to 60% of the hens killed when the bar was not used. However, the nest was still destroyed whether the hen escaped or not and no increase in fall populations attributable to the use of flushing bars was detected (32, p. 549).

Klonglan reported an average pheasant harvest of 128 cocks per section on the Union-Adair research area in the years 1957-59. Adair had an average of about 3 farms per section at that time. To apply this practice would have required 3 flushing bars per section at an approximate cost of $20 each.

Given the test for economic feasibility:

$$w \left[PQ - \sum_{j=1}^{n} (C_j X_j) \right] \geq k = \text{capital expenditure}$$

The value for k is $60 and w for 5% is 4.3 based on a 5 year life of the flushing bars. Solving for price:

$$P(128) - 0 \geq \$60/4.3$$

$$P \geq \$1.39$$

If the use of flushing bars were the only active attempt by farmers to increase pheasant production, this practice would have been economically

feasible if the value per pheasant was only $1.39, even though the practice would not have benefited pheasant populations at all.

Using the marginal economic efficiency concept gives a correct evaluation of flushing bars by comparing only added productivity and costs rather than totals. Given the economic efficiency equation:

$$P = \frac{\sum_{i=1}^{n} (C_j \Delta X_j)}{(\Delta Q \to 0)} + \frac{\Delta k}{(\Delta Q \to 0)}$$

$$P = \frac{0}{(\Delta Q \to 0)} + \frac{60}{(4.3)(\Delta Q \to 0)}$$

$$P \to \infty$$

Each pheasant would have required an extremely high value to justify the practice of using flushing bars.

Productivity estimates

To determine the maximum possible effect of pheasant management practices, estimates of past pheasant harvest rates from the pheasant research areas will be used as guidelines. These estimates appear in Table 8.

Economic efficiency applications

Farmstead windbreak improvements   To estimate the value on pheasants needed to justify the A.C.P. G-1(A) practice for improving the wildlife cover in existing windbreaks, the difference in pheasant harvest between 1964 and 1965 (before and after the severe March storms of 1965) on the Winnebago study area will be used as the increment to production. In Table 8 this difference is estimated to be 12 cocks per section. The average farm size in the North Central agricultural district in 1966

Table 8. Estimated pheasant harvest per section from pheasant research
areas

Year and research area	Estimated number of cocks harvested per section
1940 Winnebago County	70[a]
1954 Winnebago County	33[a]
1964 Winnebago County	24[b]
1965 Winnebago County	12[c]
1957-1959 Union-Adair Counties	128[d]
1950 Pelee Island, Ontario	925[e]

[a]1/3 of fall population density reported by Kozicky (33).

[b]1/2 of the density reported in February 1965 (29, p. 2).

[c]1/2 of the 1964 harvest; based on ratio of pheasants sighted per mile in the region for the two years.

[d](26, p. 226).

[e](59).

was 232 acres or 2.75 farms per section (22, 1966 prelim.). If there is a 1:1 correspondence between farms and farmsteads, 2.75 windbreak improvements would develop the typical section at a net cost of $56 per windbreak as estimated earlier in this chapter. I will use a 5% discount rate over an expected life of 10 years in the economic efficiency equation below (w=7.7):

$$P = \frac{\sum_{j=1}^{n} (C_j \Delta X_j)}{\Delta Q} + \frac{\Delta k}{w \Delta Q}$$

$$P = 0 + \frac{(\$1.54/\text{sec.})}{(7.7)(12 \text{ pheasants/sec.})}$$

$P = \$1.67$ per pheasant

Taking advantage of A.C.P. cost-share assistance would allow farmers to produce additional pheasants by improving their windbreaks at a cost of \$1.67 under the assumptions used. It must be remembered, however, that the estimate for productivity of windbreak improvement has very little empirical support and the actual productivity may vary widely from the estimate of 12 pheasants per section. As a comparison with costs of pheasant production on shooting preserves, Maryland shooting preserves were able to produce pen-raised birds at an average cost of \$2.52 per pheasant (61, p. 19). Additional shooting preserve costs are encountered in the labor requirements to transport pheasants from the pens to the shooting areas.

Allowing a windbreak to develop into good wildlife habitat through natural succession is an laternative to planned development which will have less immediate effect, but the long run results may be improved. This practice requires only good fences around the existing windbreak. Fences are usually in place, but are often in need of repair and will require annual maintenance and occasional replacement. An approximation of the typical section and windbreak fencing costs is 2.75 farms, each requiring 50 rods of fencing with an annual maintenance cost of \$.40 per rod. Assuming an increase of 12 pheasants bagged per section the economically efficient price would be:

$$P = \frac{\Sigma(C_j \Delta X_j)}{\Delta Q} + \frac{\Delta k}{w \Delta Q}$$

Let the cost of the investment be included in annual maintenance costs.

$$P = \frac{(\$.40/rod)(133.5 \text{ rods/sec.})}{(12 \text{ pheasants/sec.})}$$

Price = $4.45

Improvement of farmstead windbreaks by natural succession rather than by artificial planting is a less costly method, but does not have the advantage of up to 70% federal cost-share assistance. A slight modification in the definition of what constitutes improvement of windbreaks for wildlife purposes would allow cost-share on fencing to allow natural succession of windbreak plant life.

Roadsides   Pheasant production in road ditches can be increased by not mowing roadsides at all or at least not until after July first. The Iowa State Highway Commission does not mow the primary road system ditches until after July first, but many farmers mow or burn the secondary road ditches on their farms. The primary motives for burning and mowing seem to be for appearance and weed control. Use of chemicals for weed control is more efficient than mowing so the practice of leaving roadsides undisturbed would be economically efficient even at a zero value on pheasants. However, any extra-market value farmers obtain from having neat ditches will have to be exceeded by the market and extra-market values of additional pheasants before all ditches will be left undisturbed. Nomsen found that the north central Iowa roadsides he studied in 1960 produced 33 chicks per section (48, p. 39). About $\frac{1}{4}$ of these would have been harvested due to summer death losses, the cocks-only season, and only a 70% harvest. The contribution of roadsides to pheasant harvest in the area studied by Nomsen was probably as much as 1 cock per acre of roadside.

Wildlife habitat plots   Land set aside as wildlife areas requires

only a land contribution by landowners. The labor and materials to develop the plots are furnished by the Iowa State Conservation Commission. If these plots are placed on productive land areas, their pheasant productivity should be approximately the same as found on roadsides, which was estimated at 1 cock harvested per acre per year. Assuming an annual upkeep cost of $1 per acre plus property taxes of $2 an acre and $400 land capitalized at 5% (w = 20) over a perpetual life, the cost for each additional pheasant bagged is very high. The price required to make this practice economically efficient even at the scale of 1 acre per section is unobtainable:

$$P = \frac{\sum_{j=1}^{n} (C_j \Delta X_j)}{\Delta Q} + \frac{\Delta k}{w \Delta Q}$$

$$P = \frac{\$3/sec}{1 \text{ pheasant/sec}} + \frac{(\$400/acre)(1 \text{ acre/sec})}{(20)(1 \text{ pheasant/sec})}$$

Price = $23 per pheasant

The annual cost to return cock pheasant harvests on the Winnebago area to the 33 cocks per year rate as in 1954 by setting aside wildlife plots would be at least $483 per section per year.

Nonagricultural areas   Land that is still in wetlands, waste and other nonagricultural areas would not have as high a market value as land developed for agriculture. An income from pheasants on these nonagricultural areas would increase the land value of these areas and reduce the value differential between the nonagricultural areas and agricultural land. The reduced value differential would provide less incentive for the farmer to develop these good wildlife habitat areas into agricultural land. An estimate of the increment in value of nonagricultural areas can

be made using the economic efficiency criterion. I will assume the

additional cock pheasant harvested per acre is sold at a shooting pre-

serve price of $5.00 and is subject to the applicable shooting preserve

marketing costs from Table 9 which amount to $.87 per pheasant. The

income stream from the pheasant source or an alternative source will be

assumed to be perpetual and capitalized at 5% (w = 20). Given the

efficiency equation:

$$P = \frac{\sum\limits_{j=1}^{n} (C_j \Delta X_j)}{\Delta Q} + \frac{\Delta k}{w \Delta Q}$$

solving for the increment in land value, Δk, for an increase of 1 cock

harvested per year;

$$\Delta k = P \, w \, \Delta Q - w \sum_{j=1}^{n} (C_j \Delta X_j)$$

$$\Delta k = (\$5/\text{pheasant})(20)(1 \text{ pheasant}) - (20)(\$.84)$$

$$\Delta k = \$100 - \$16.80 = \$83.20$$

Pheasant productivity equal to that of roadsides for which an esti-

mate of 1 cock bagged per acre was derived is assumed here to hold for

other nonagricultural areas, also. The $83.20 value for Δk is the per

acre increment in land values of farm land in nonagricultural uses which

is possible when shooting preserve prices and marketing costs are applied

to hunting areas.

Economically efficient habitat development alternatives

Farm firms are very limited in the amount of habitat development

they can do even with income incentives. The practices to increase

pheasant production are not able to compete for land with the prevailing

Table 9. Average variable and fixed costs per pheasant for Maryland
shooting preserves reporting these costs, 1964[a]

Item	Average cost per bird
Annual Variable Costs	
Chick cost	$ 1.78
Feed cost	.74
Cover maintenance	.10
Hired labor[b]	.49
Other maintenance	.15
Dog feed	.17
Insurance	.06
License and posting	.04
Utilities	.08
Advertising	.09
Miscellaneous	.02
Total variable cost	$ 3.72
Annual Fixed Costs	
Land improvements	c
Holding pens	$ .08
Kennel	.03
Lodge/office	.09
Dogs	.03
Miscellaneous	.01
Total annual fixed cost	$ .24
Total Annual Costs Per Pheasant	$ 3.96

[a]Source: (61, p. 19).

[b]An additional $\frac{1}{2}$ hour of operator and family labor was required per
bird. The largest labor requirement was guiding.

[c]Less than one percent.

agricultural uses. Pheasants are actually a low yielding crop relative

to agricultural crops and even assumptions of shooting preserve prices

for hunting areas gives a low per acre annual value for pheasants.

Except for the costless practices and possibly improvement

of windbreaks, the number of economically efficient practices to
preserve or restore pheasant habitat appears quite limited. This
would be true even if a method to provide an economic incentive
for pheasant production were developed. However, an income incentive
would increase application of the costless practices by raising the value
of pheasants from a neutral value to a positive value for farmers. This
positive value may cause farmers to refrain from needlessly destroying
pheasant habitat for clean farming motives. An income incentive for
pheasant production would also retard the movement of wetlands and waste
areas into agricultural uses by increasing the land value of these areas
in their present use. With shooting preserve prices and marketing prices
this increase in land value per acre of nonagricultural land use was
estimated to be $83.

Shooting preserve costs

Active measures to increase the production of pheasants is subject
to much uncertainty and high costs. However, pheasants are widely
distributed over all but the southeast corner of the state and at present
provide hunting opportunities without any large scale expenditures for
habitat improvement. The southeast quarter of Iowa has historically been
the least successful area of the state for pheasant populations. In the
1966-67 season, 5 of the 6 operating pheasant shooting preserves were
located in this area. The sixth shooting preserve offering pheasants was
near the southwest border. Shooting preserves have located in Iowa where
competition from naturally populated hunting areas is at a minimum due to
some unknown limitations on pheasant populations in southeast Iowa.

If pheasant populations continue to decline in northwest and north central Iowa, firms will have the opportunity to market superior pheasant hunting either on well developed hunting areas or on shooting preserves. The very high costs for habitat development relative to the number of pheasants produced on hunting areas indicates that the firms will choose to establish shooting preserves. Whenever the pressure for game bird hunting greatly exceeds the supply of naturally produced game, shooting preserves are usually established in deference to intensified game management practices. The number of shooting preserves in the U.S. increased from 756 in 1954 to 2,121 in 1963 (61, p. 2). The choice by so many firms to develop shooting preserves rather than intensify game management to increase natural production is an indication that marginal costs for hunting area pheasants increase so rapidly with active habitat improvement measures that they exceed the marginal costs of shooting preserve pheasants.

Variable costs and annual fixed costs for pheasants released on Maryland shooting preserves are presented in Table 9. The costs are given as average costs, but the shooting preserves showed decreasing average variable costs with increases in scale, and the marginal costs would be below the average variable costs (61, p. 33).

Pheasants were the most profitable bird for the Maryland shooting preserves, but profits ranged from $1.57 per bird to a loss of $1.34 per bird. The average number of birds released was 3,873 pheasants and 10,168 birds of all species. The typical shooting charge was $5 per pheasant (61, p. 25).

DEMAND ANALYSIS

The expressed demand for outdoor recreation activities in the United States has been growing at the rate of 10% per year since 1956, where expressed demand is measured by the total number of participation occasions. The expressed demand for hunting, however, is not sharing in this growth. Estimates for the number of U.S. hunters in 1955 and 1965 show only a 15% increase for the entire decade (70, p. 65).

This chapter will look at the national trends in the number and activity of hunters and examine the participation in the sport of hunting. Multiple linear regression will then be used to consider changes in several socio-economic factors which affect the demand for pheasant hunting in Iowa. This method will simultaneously consider biological and economic factors affecting the supply of pheasants to determine which of these supply and demand factors have been important in the past in determining the number of Iowa and nonresident hunters in the state. Identification of the important causes of changes in participation and estimation of the impact of each causual factor will furnish a means to project future hunter numbers.

Trends in the Number of Hunters and their Expenditures

Two separate national surveys furnish data on the characteristics of American hunters. The Outdoor Recreation Resources Review Commission sponsored the National Recreation Survey which obtained information from Americans on their recreation habits in each season of the year, June 1960 through May 1961. The other national survey of use is the National

Survey of Fishing and Hunting sponsored by the Fish and Wildlife Service, Dept. of the Interior. This survey was first conducted in 1955 and has been conducted each 5 years since then. The Survey of Hunting and Fishing collected data only from active hunters and fishermen but it furnishes specific information on their expenditures and participation in the different types of hunting and fishing. The National Recreation Survey had a much broader coverage and the relevant results of this survey will be presented first to show the expected changes in hunting activity relative to other outdoor recreation activities.

The National Recreation Survey

The National Recreation Survey provided data from which projections of participation in hunting and other recreational activities were made for the years 1976 and 2000. The prospected growth rate for the number of hunting occasions is the lowest of all seventeen outdoor recreation classifications. The percent change in the number of hunting participants is expected to be lower than the percent change in population. The percent change in number of hunting occasions is expected to be even lower than the percent change in participants (57, p. 27). The projected growth in population will cause an increase in the total number of hunting days, but the per capita participation rates and per capita hunting trips are expected to fall from the 1960 rates. The above summary is based on the O.R.R.R.C. projections presented below in Table 10 for the years 1976 and 2000 at which time the U.S. population is expected to have increased 27% and 94% respectively from 1960.

Table 10. Actual and estimated number of occasions[a] (millions) by persons 12 years and over in selected recreation activities, 1960, 1976 and 2000[b]

Activity and period[c]	Number of occasions (millions)			Percent change	
	1960	1976	2000	1960-1976	1960-2000
All activities	11,205	17,318	30,449	54	172
Driving for pleasure	2,705	4,084	6,674	51	147
Swimming (June-Aug.)	672	1,182	2,307	76	243
Walking for pleasure	2,340	3,454	6,009	48	157
Playing outdoor games or sports	1,659	2,883	5,698	74	244
Sightseeing	771	1,265	2,320	64	201
Picnicking (June-Aug.)	279	418	700	50	150
Fishing	547	736	1,099	35	101
Bicycling	672	964	1,600	44	138
Attending outdoor sports events (June-Aug.)	489	757	1,300	55	166
Boating except sailing or canoeing	159	285	557	79	250
Nature walks	352	528	874	50	148
Hunting (Sept.-Feb.)	295	375	527	27	79
Camping (June-Aug.)	60	113	235	89	293
Horseback riding (June-Aug.)	55	82	143	49	162
Water skiing (June-Aug.)	39	84	189	114	384
Hiking (June-Aug.)	34	63	125	89	269
Attending outdoor concerts, drama, etc. (June-Aug.)	27	46	92	69	232

[a]Number of separate days on which persons 12 years and over engaged in activity.

[b]Source: Data for annual estimates and Nov.-Feb. hunting estimates from (53, p. 27); Data for June-Aug. estimates and Sept.-Nov. hunting estimates from (57, p. 22).

[c]Annual estimates unless otherwise indicated.

Multiple linear regression analysis was used to estimate the effect of six socio-economic factors on participation rates determined from the National Recreation Survey. Urban dwellers were found to have

a much lower participation rate for hunting than people from rural residences. The hunting participation rate during September to November 1960 was only .14 day per person 12 years and older living in an urban Standard Metropolitan Area (SMA) of over 1 million people. The rate increased to .73 for smaller urban areas, and the rural participation rate was 1.33 days per person over 12 years old (57, p. 19).

Participation in hunting, unlike most of the other activities, is largely independent of income. Next to place of residence, the age-sex characteristic was of major importance. Participation fell off with age of the male respondents and is very low for females at all ages (57, p. 19).

In making projections to 1976 and 2000, estimates of the expected changes in the size and distribution of the six socio-economic factors were made by the O.R.R.C. staff and used in the regression equations developed from the Recreation Survey data. The estimated effect of each socio-economic factor and the composite effect on per capita participation in hunting are presented below in Table 11 as percent changes from 1960 to 1976 and from 1960 to 2000. The effects on participation in camping and water-oriented recreation is also presented to serve as a comparison.

The National Survey of Fishing and Hunting

The National Survey of Fishing and Hunting furnishes more detail on hunters' expenditures, and a supplemental survey of Iowa was done in 1955. The 1960 and 1965 surveys were expanded only at the regional level except for states that requested and financed supplemental state

Table 11. Estimated net and composite effects (percent changes) 1960 to 1976 and 1960 to 2000 upon selected seasonal days-per-person activity rates, expected from changes in 6 socio-economic factors[a]

Season and activity	1960 – 1976							1960 – 2000						
	Income	Education	Occupation	Residence	Age-Sex	Leisure	Composite	Income	Education	Occupation	Residence	Age-Sex	Leisure	Composite
Fall: Sept.-Nov.														
Hunting	2.5	.8	-1.4	-5.3	2.9	0	-.7	3.4	1.6	-2.7	-13.3	4.5	0	-7.3
Winter: Nov.-Feb.														
Hunting	-.9	-1.5	-1.6	-5.2	3.0	0	-6.2	2.6	-2.9	-3.1	-12.7	4.7	0	-11.8
Summer: June-Aug.														
Swimming	14.0	6.2	.7	.8	.8	7.9	33.7	22.7	12.3	1.4	2.2	3.5	18.6	75.3
Fishing	-.1	1.2	-.2	-3.4	1.5	3.4	2.4	-1.5	2.4	-.4	-8.2	2.7	7.9	2.3
Boating other than sailing or canoes	18.2	5.1	.5	0	.1	8.8	35.9	31.1	10.1	1.1	.4	2.3	19.4	78.9
Camping	18.3	5.3	0.7	-1.6	.9	15.7	44.2	25.6	10.5	1.4	-3.8	2.4	44.7	100.6
Water skiing	29.4	8.0	.3	-.2	4.7	11.0	62.6	54.7	16.1	.5	-.1	7.9	27.2	147.4

[a]Source: (57, p. 28).

surveys as Iowa did in 1955. The 1960 and 1965 interviews were restricted to persons who had hunted on at least 3 occasions during the 1960 or 1965 calendar year or had spent at least $5 to go hunting. A 1965 survey of national recreation conducted by the Bureau of Outdoor Recreation estimated about 18 million persons 12 years old and over went fishing at least once. The 1965 National Survey of Fishing and Hunting estimated there were 13.6 million hunters in 1965, using the more restrictive definition. The number of hunters by four selected characteristics as estimated from the 1965 survey are given in Table 12.

The national surveys of fishing and hunting continually stress the expenditures of sportsmen. The original purpose of the surveys was to provide expenditure data for use in inter-agency benefit-cost analysis of land-use and water-use projects to impute economic values to fish and game. As discussed by Lerner (39), expenditure totals, no matter how large, do not provide any decision criteria for changing fish and game numbers. Expenditure totals do not measure the net impact on the economy, since alternative uses for the sportsmen's dollar are available, and the multiplier effects of sportsmen's expenditures are ignored. The expenditure data was never accepted for federal inter-agency benefit-cost analysis, but the data is valuable for many less ambitious uses.

The expenditure item of particular interest is that for annual lease and privilege fees. The U.S. averages for this item in 1965 was $1.47 per big game hunter, only $.39 for small game hunters and $.82 for waterfowl hunters (70, pp. 47-49). This item was not estimated in the supplemental 1955 Iowa survey, apparently due to the lack of observations. The complete breakdown of expenditures for Iowa hunters

Table 12. Number of hunters by selected characteristics in 1965, and U.S. totals for 1955, 1960 and 1965[a]

Characteristic	Total number of persons 12 and over (thousands)	Total persons who hunted Number (thousands)	Percent
U.S. Total 1955	118,366	11,784	10.0
U.S. Total 1960	131,226	14,637	11.2
U.S. Total 1965	141,928	13,583	9.6
Census geographic divisions:			
New England	9,256	583	6.3
Middle Atlantic	27,346	1,631	6.0
East North Central	28,124	2,563	9.1
West North Central	11,681	1,620	13.9
South Atlantic	20,593	1,900	9.2
East South Central	9,652	1,294	13.4
West South Central	12,724	1,571	12.3
Mountain	5,029	988	19.6
Pacific	17,523	1,433	8.2
Population density:			
Big cities (500,000 and over)	22,539	793	3.4
Small cities and suburbs (2,500-500,000)	56,296	3,814	6.8
Towns and rural areas	63,093	8,976	14.2
Sex:			
Male	67,508	12,804	19.0
Female	74,420	779	1.0
Age group:			
12-15 years	14,635	1,302	8.9
16-17 years	6,920	929	13.4
18-24 years	18,916	2,338	12.3
25-34 years	21,444	2,963	13.9
35-44 years	23,740	2,588	10.9
45-64 years	38,693	2,904	7.5
65 years and over	17,580	559	3.1

[a]Source: (70, pp. 49, 65).

in 1955 is presented in Table 13. A major expense item is for transportation on hunting trips which had a median of $3\frac{1}{2}$ hours per trip, and 92.8% of these trips were within the state (12, pp. F10, F24).

The Iowa hunter's average total expenditure was $38.74 in 1955, which amounts to $47.20 in 1965 dollars (12, p. F8). The national average expenditure in constant dollars by small game hunters has not changed significantly since 1955, so the $47.20 estimate for hunter expenditures in 1965 should be reasonably accurate. To calculate the total amount spent by Iowa hunters in 1965, an estimate of the number of hunters must be made from the number of hunting licenses issued. The 1955 survey found that only 83% of the hunters were licensed, but many of those licensed did not hunt at all or enough to meet the definition as a "hunter" (12, p. F22). The ratio of the Fishing and Hunting Survey's estimate of number of hunters to resident hunting licenses sold in 1955 is 359,000 : 369,500. But the hunting license year ran from April 1st of 1955 through March of 1956 (license year and calendar year will coincide effective in 1968). The number of licenses for March 1954 through February 1955 was 346,450 and the number for March 1955 through February 1956 was 369,500, thus the number of resident hunting licenses sold in the calendar year 1955 was probably quite close to the survey's estimate of hunters. Based on this bit of reasoning, I will assume that the number of resident licenses sold in a license year will serve as a close approximation at the number of active hunters in the license year. The total expenditure on hunting equipment, transportation, dogs, etc. by the 275,500 Iowa resident hunters in 1965, at $47.20 each, was approximately $13,003,600 in 1965 dollars. The estimate of

Table 13. Expenditures of Iowa hunters, 1955[a]

| Item | Total spent | | Average spent | Hunters with expenditures | |
	Thousands of dollars	Percent of total		Number	Percent
Equipment					
Hunting equipment	$ 5,675	40.8%	$ 15.81	299	83.3%
Other	1,208	8.7	3.36	56	15.6
Sub total	6,883	49.5	19.17		
Trip expenditures[b]					
Food[c]	662	4.8	1.84	83	23.1
Lodging	117	.8	.33	15	4.2
Transportation[d]	2,104	15.1	5.86	304	84.7
Other	913	6.6	2.54	109	30.4
Sub total	3,796	49.5	10.57		
Licenses and fees					
Licenses	631	4.5	1.76	297	82.7
Leases and privileges	--	--	--	--	--
Duck stamps	134	1.0	.37	67	18.7
Sub total	765	5.5	2.13		
Dogs	2,154	15.5	6.00	50	13.9
Other expenditures	311	2.2	.87	107	29.8
Totals	$ 13,909	100%	$ 38.74		

[a]Source: (12, p. F8).

[b]Trips specifically for hunting.

[c]Less estimated cost at home.

[d]3.5¢ per mile.

total expenditures for hunting in 1966 is higher at $13,817,564 due to an increase to 292,745 in the number of resident hunters as indicated by the number of resident hunting licenses.

In conclusion, both national surveys indicate that the total number

of hunters in the U.S. will increase in the years ahead, but at a slower rate than the total population. The total number of hunters in the U.S. increased 15% between 1955 and 1965 and the O.R.R.R.C. expects average annual increases of about 2% above the 1960 total number of hunters through 1976 and even to the year 2000. The number of hunters who might come to Iowa as nonresident hunters is, therefore, increasing. An additional source of nonresident hunters is the group of hunters who travel to states such as Nebraska and South Dakota to hunt pheasants. Iowa is in a better location than South Dakota relative to the population centers in the East, but South Dakota attracted 57,000 nonresident hunters in 1963 and Iowa attracted only 7,500. If Iowa could improve its pheasant hunting opportunities relative to other states, a greater number of nonresident hunters would come to Iowa to hunt pheasants.

Place of residence was found to be a major determinant of participation rates for hunting, with the participation rate much higher in rural areas. Iowa is experiencing a rapid net migration from rural to urban areas, while its total population is remaining about constant. The net effect on the future number of Iowa hunters is likely to be negative.

Multiple Regression Analysis of Several Factors Affecting the Number of Hunting Licenses Issued in Iowa

This section will evaluate the importance of several factors possibly affecting the number of resident and nonresident hunting licenses issued. Over 80% of the licensed resident hunters and over 90% of the licensed nonresident hunters had hunted pheasant in each of the years that this relationship was checked. This suggests that there is

a strong correlation between the number of hunting licenses and the number of pheasant hunters. Due to the lack of a series of estimates on the number of pheasant hunters, the number of hunting licenses will be used as a surrogate.

The number of hunting licenses will be determined by the interaction between demand for hunting activity and the supply of hunting opportunities. The importance of several socio-economic factors in shifting the demand to different levels and the importance of changes in the supply of pheasant hunting opportunity will be analyzed using the multiple regression method to estimate their relative effect on the number of hunting licenses. This procedure will be carried out separately for resident and nonresident hunters.

The best index of pre-season pheasant populations is the annual late summer roadside survey. The results of this survey were first released in 1954 and are available for each year from 1954 through 1966. Values for the other variables were collected for the same time period to allow the regression analysis of the number of hunting licenses issued annually during this 13 year period.

Multiple linear regression analysis was used to analyze the data. The IBM 360-50 computer at Iowa State University performed the calculations using the least-squares method of fitting the data to linear regression equations. The prediction equations for number of hunting licenses were developed by considering only the logically relevant independent variables. The relevant variables were then tested in a regression equation for statistical significance. Those variables showing the most significance were then used to build prediction models

which included the minimum number of variables, while still explaining as much of the variation as possible. The "F" test was used to test the significance of the variation explained by each regression equation relative to the total variation. An R^2 was calculated for each equation to measure the percentage of variation explained by the regression equation. The student's "t" test was used to test the significance of each partial regression coefficient to determine whether to accept or reject the hypothesis that the coefficient is equal to zero.

Mathematical models of hunting license numbers

Twelve variables are considered in the analysis of hunting license numbers, and the data is from the thirteen year period, 1954 through 1966. Variables entered as the dependent variable have the notation Y_{ik}, i = (1,2), k = (1954, 1955,...1966). Those entered as independent variables are expressed as X_{jk}, j = (1,2,...,10), k = (1954, 1955,....,1966). The derived multiple regression equations are of the form, $\hat{Y}_i = b_0 + \sum_{j=1}^{10} b_{ij} X_j$ where several or all of the b_{ij} may be zero. These derived equations will be termed prediction equations. The prediction equations are an estimate of the assumed mathematical model, $Y_{ik} = \beta_{io} + \Sigma\beta_{ij} X_{jk} + \epsilon_{ik}$ where the ϵ_{ik} are unobserved random variables independent of the other variables.

The dependent variables analyzed are; resident hunting license sales (Y_1) and nonresident hunting license sales (Y_2). For clarity in the presentation, Y_1 will be represented by Y_r, and Y_2 will be represented by Y_{nr}.

Considering only the logically relevant variables for each

dependent variable yields the following estimation equations for the number of licenses issued each year:

I. $\quad Y_1 = Y_r = b_{r0} + \Sigma\, b_{rj}\, X_j + \mu_r$, $\quad j = (1,2,3,4,5,6,8,10)$

II. $\quad Y_2 = Y_{nr} = b_{nr0} + \Sigma\, b_{nrj}\, X_j + \mu_{nr}$, $\quad j = (1,2,3,5,7,9)$

where variable:

Y_r = Number of resident hunting licenses.

Y_{nr} = Number of nonresident hunting licenses.

X_1 = Pheasants sighted/mile in the late summer roadside survey.

X_2 = Number of pheasants bagged the previous season in thousands.

X_3 = Pheasants bagged per hour the previous season.

X_4 = Resident hunting license fee adjusted to 1958 dollars.

X_5 = Season length in hours of legal hunting time.

X_6 = Iowa per capita personal income adjusted to 1958 dollars.

X_7 = North Central region of the U.S., per capita personal income adjusted to 1958 dollars.

X_8 = Iowa population in thousands.

X_9 = Population of the North Central region of the U.S. in thousands

X_{10} = Percentage of the Iowa population living on farms.

The b_{i0} are the equation intercept values and the b_{ij} are the regression coefficients. The μ_i are the unexplained residual variations.

Factors affecting the number of hunting licenses

The number of resident licenses issued (Y_r) serves to indicate the rate of participation by Iowans in hunting activities. There has been a secular decline in resident licenses issued as well as year to year fluctuations. Multiple regression analysis of the factors selected as independent variables may indicate the degree to which each of these factors has been important in causing secular and annual changes in the number of resident hunting licenses.

The number of nonresident hunting licenses (Y_{nr}) represents a contribution to economic development of the state in the form of hunting license revenue and income generated by expenditures of the nonresident hunters. The effect of pheasant population density in attracting non-resident hunters is of particular interest to evaluate the potential contribution of pheasants to state income.

The number of pheasants sighted per mile (X_1) is the state-wide total number of pheasants sighted in the late summer roadside survey divided by the total number of miles in the survey routes. The results are released prior to the pheasant hunting season and thus should affect license sales. The results are announced as the number of pheasants per mile and the percentage change from the previous year for the entire state and by region.

The success of hunters during the previous season may have some effect on license sales, particularly for the nonresident hunter who has less exposure to current information on the pheasant population. The lagged variables are: number of pheasants bagged the previous season (X_2) and pheasants per hour the previous season (X_3). The

previous year's kill is an overall indication of success, and the pheasants per hour variable is more an indication of the individual hunter's success. The number of birds per hour should increase in good hunting years and fall in poorer years.

The resident hunting license fee (X_4) has risen from \$1.50 in 1954 to \$2.50 in 1966. GNP deflators were used to convert to 1958 dollars, which gives a real license fee of \$1.67 for 1954 and \$2.63 for 1966. This fee increase is assumed to have had a nonpositive effect on the number of resident licenses when included as a variable in the regression analysis.

The nonresident license fee is set at a minimum of \$5.00 and a reciprical fee for residents of states which charge Iowans more than \$5.00. Effective January 1, 1968, the fee for all nonresident hunters will be \$20.00. The average fee for nonresident hunters in 1966 was \$17.86 which is deflated to \$15.63 in 1963 dollars. The average fee in 1958 dollars has not fluctuated more than \$1 above or below the 1966 fee, so this variable was not included in the analysis of nonresident license sales.

The length of the pheasant hunting season (X_5) has increased from 108 to 390 hours since 1954, which may have attracted additional hunters. Both the number of days and legal hunting hours in each day have been increased in the hunting season.

A variable for real per capita personal income was included in the analysis of both resident and nonresident licenses. Iowa per capita personal income (X_6) has increased rather steadily since 1954. Each year's income has been adjusted to 1958 dollars for better comparability.

No a priori conclusion can be made on whether increased per capita
income has a positive or negative effect on the number of licenses. The
North Central region of the U.S. per capita personal income in 1958
dollars (X_7) was considered in the analysis of nonresident licenses. A
positive correlation seems more likely between North Central per capita
income and nonresident licenses than between Iowa per capita income and
resident licenses, due to the greater expenditures required of nonresident
hunters.

The Iowa population (X_8) and the North Central region population
(X_9) were included in the analysis of resident and nonresident licenses
respectfully. Population increases with all other variables held
constant, should increase the number of licenses issued.

The Iowa Hunting and Fishing Survey indicates that hunting partici-
pation differs significantly between rural and urban dwellers (12, p. 7).
The percentage of Iowa's population living on farms (X_{10}) has declined
sharply over the period analyzed and is entered as an independent
variable in regressions on resident hunting licenses.

The trend in the number of resident licenses over the past 13 years
has definitely been downward (see Table 14). Wide fluctuations have
occured in the State pheasant population, but there has not been any
secular decline which could be identified as the principle causual
factor for falling hunting license sales. The decline in hunting parti-
cipation rates must be largely caused by a change in attitudes toward
hunting relative to other types of outdoor recreation. A decline in
the number of resident hunting licenses has occurred in the same time
period as has a rapid migration from rural to urban areas of the state.

Table 14. Data used in the analysis of number of hunting licenses issued by the Iowa State Conservation Commission, 1954-1966

Year	Number of licenses issued Resident Y_r [a]	Y_{nr} [a]	Pheasants sighted per mile in preseason resident survey X_1 [b]	Previous year Pheasants bagged (thousands) X_2 [c]	Pheasants bagged per hour X_3 [c]	Governed variables Resident license fee 1958 (dollars) X_4 [d]	Hunting season length in hours X_5 [c]	Per capita personal income in 1958 dollars North-central Iowa U.S. X_6 [e]	North-central U.S. X_7 [e]	Human population in 1958 (thousands) North-central Iowa U.S. X_8 [e]	North-central U.S. X_9 [e]	Percent of the Iowa population living on farms X_{10} [f]
1954	346450	3203	1.28	1121	.30	1.67	108	1923	2042	2626.2	47505.7	27.4
1955	369500	3936	1.78	1452	.29	1.65	108	1769	2077	2678.5	48514.4	26.8
1956	365000	4544	1.64	1744	.34	1.60	108	1802	2100	2703.7	49317.5	26.2
1957	339400	4422	1.75	1091	.28	1.54	180	1917	2107	2716.4	49945.5	25.1
1958	355650	5521	2.51	1088	.27	2.00	180	1921	2087	2708.0	50576.5	25.1
1959	320250	4535	1.69	1598	.32	1.97	180	1918	2122	2729.1	51118.6	24.5
1960	313850	5352	2.17	1114	.23	1.94	457	1923	2154	2756.8	51713.6	23.9
1961	301800	5448	1.82	1303	.25	2.39	263	1990	2163	2758.4	52128.8	23.3
1962	288100	5470	1.92	1598	.26	2.36	263	2053	2250	2758.4	52505.8	22.8
1963	307400	7500	2.72	1239	.26	2.33	405	2148	2301	2758.1	52988.4	22.2
1964	301650	8350	2.70	1935	.33	2.30	435	2197	2370	2762.5	53577.6	21.6
1965	275500	6500	1.66	1737	.33	2.25	383	2413	2529	2758.2	54084.6	21.0
1966	292745	9638	1.92	1118	.26	2.63	390	2567	2635	2746.8	54353.9	20.4

[a] Taken from the Biennial Reports of the Iowa Conservation Commission (25).

[b] From Klonglan (30, p. 78).

[c] Nomsen, Richard. Game biologist, Iowa Conservation Commission, Des Moins, Iowa. Pheasant production and hunting data. Private Communication. August 1967.

[d] See Table 15 for original data. GNP defators (14, p. 24) adjusted fees to 1958 dollars.

[e] Income and populations are estimates used in (15, p. 13).

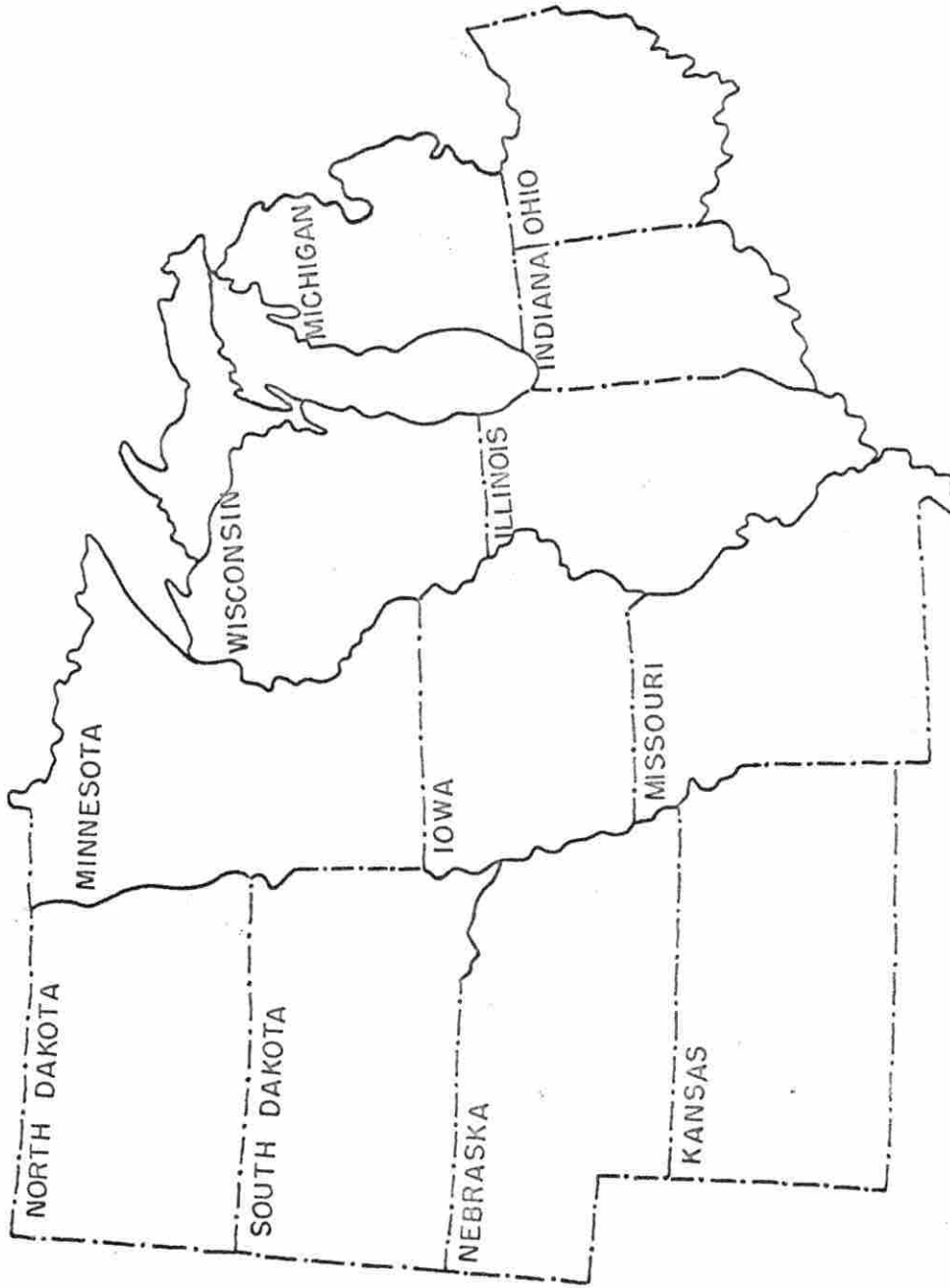[f] Linear interpolation from projections by Maki (42, p. 14).

Figure 14. States within the North Central region of the United States

Table 15. Original source data and supplemental data for the variables in the regression analysis of hunting license sales, 1954-1966

Year	Pheasants sighted per mile in the pre-season roadside survey		Pheasants bagged		Post-season sex ratio	Estimated pre-season pheasant population	Resident hunting license fee	Hours hunted per bird bagged	Pheasants per hour hunted
	Number	% change	(thousands)	% of cocks					
	-a	-b	-c	-c	-c	-c	-d	-c	-c
1954	1.28	-	1,452	68	3.5	4,642	1.50	3.4	.29
1955	1.80	+41	1,744	65	3.3	5,835	1.50	2.9	.34
1956	1.64	-09	1,091	65	3.3	3,648	1.50	3.6	.28
1957	1.75	+05	1,088	51	2.3	4,640	1.50	3.7	.27
1958	2.51	+43	1,598	62	3.1	5,611	2.00	3.1	.32
1959	1.72	-31	1,114	61	3.0	4,107	2.00	4.4	.23
1960	2.09	+67	1,303	60	2.8	4,723	2.00	4.0	.25
1961	1.82	-13	1,598	62	3.1	4,345	2.50	3.8	.26
1962	1.92	+12	1,239	61	3.0	4,200	2.50	3.9	.26
1963	2.72	+42	1,935	70	3.6	5,300	2.50	3.0	.33
1964	2.70	-01	1,737	75	4.3	4,800	2.50	3.0	.33
1965	1.60	-39	1,118	64	3.2	3,600	2.50	3.8	.26
1966	1.92	+16	1,449	64	3.2	4,100	3.00	3.5	.28

a From Klonglan (30, p. 78).

b Calculated as per cent change in birds sighted per mile from the previous year.

c Source: Richard Nomsen, State pheasant Biologist, Iowa Conservation Commission. Des Moines, Iowa. Pheasant production and hunting data. Private communication. 1967.

d Taken from the Biennial Reports of the Iowa Conservation Commission (25).

While the Iowa population is remaining constant, the farm population is declining at the rate of 2.4% per year (41, p. 3). Adoption of urban consumption patterns by the new urbanites and even by the people still living in rural areas has occurred concurrently. The percentage of the Iowa population living on farms (X_{10}) will be included in all the accepted prediction equations to account for the secular decline in the number of resident licenses.

The data used in the analysis of hunting license sales is presented in Table 14. Original and supplemental data on the Iowa pheasant population over the same time period is presented in Table 15. The states included in the North Central region are shown in Figure 14.

Multiple regression analysis of resident hunting licenses

Multiple regression analysis provides a means to select linear equations which best describe the variation in the number of resident hunting licenses issued. Only the equations with combinations of independent variables which yield statistically and logically consistant results will be presented. The goals are reliable prediction equations for the number of resident licenses, and an appraisal of the impact of each independent variable on the number of licenses. The variables selected for analysis are those factors which are thought to have an effect on participation in pheasant hunting. This will allow an evaluation of anticipated or proposed changes in the factors affecting the supply and demand for pheasant hunting opportunities.

An R^2 is calculated for each prediction equation to determine the percent of the total variation in licenses accounted for by the prediction

equation. Significance of the R^2 is determined by comparing a calculated F ratio to a tabled F value. The F ratio is:

$$F = \frac{(\text{Sum of squares due to regression}/p)}{(\text{Residual sum of squares}/n-p-1)}$$

where p is the number of independent variables in the equation and n is the number of years observations are made on the number of licenses. The tabled F for the α percent significance level is the F ratio which would result in only α out of 100 trials with random samples from a normal distribution (6, p. 214).

Significance of the regression coefficients is determined by using the Student's t test, which is based on a concept similar to the F test described above. However, only the contribution of each independent variable in explaining the total variation is checked rather than the contribution of the entire equation. With only one independent variable in the estimated equation, the t test and the F test are equivalent. The t value for comparison with the tabulated t is calculated by dividing the regression coefficient by its standard error. This tests the null hypothesis that the regression coefficient is actually zero. If the null hypothesis is rejected at the α significance level the calculated t value is so large that the same t value would be possible with random samples from a normal distribution in only α out of 100 trials (6, p. 126).

Significance of the regression coefficients and the R^2 is not determined by their size, but by their reliability as estimates. In order to be termed significant, the estimates in this report must be significant at α = 5%. Significant estimates will be marked with a single asterisk. Highly significant estimates are significant at

α = 1% and are marked with a double asterisk.

Resident licenses regressed on pheasants per mile and percent of
Iowa population on farms   Resident hunting licenses (Y_r) regressed on
pheasants sighted per mile (X_1) yielded an R^2 of only .04. This points
up the need for socio-economic variables to account for the secular
decline in the number of licenses issued. The percent of the Iowa
population living on farms (X_{10}) seems a logical choice to represent the
change in demand for hunting. The prediction equation for resident
licenses regressed on percent living on farms is:

$$\hat{Y}_r = 28,687 + 12,237^{**}X_{10}$$
$$(1,809)$$

The R^2 for this equation is .81, significant to the 1% level. The per-
cent of the Iowa population living on farms thus explains 81% of the
variation in the number of resident hunting licenses issued in 1954
through 1966.

The regression of resident licenses (Y_r) on both pheasants sighted
per mile (X_1) and percent of Iowa population on farms (X_{10}) gives a
better fit than equations with either variable alone and accounts for
86% of the variation in number of licenses issued. The prediction equa-
tion is:

$$\hat{Y}_r = -46,071 + 18,414^{*}X_1 + 13,849^{**}X_{10}$$
$$(9,331) \qquad (1,805)$$

The regression coefficients are 18,414 additional licenses for each
unit increase in pheasants sighted per mile and 13,849 fewer licenses
for each unit decrease in the percent of Iowa's population living on
farms.

State-wide averages for the number of pheasants sighted per mile

has not shown any long run trend, but the farm population is falling
at the rate of 2.4% per year (42, p. 3). If this trend continues and
the total Iowa population remains constant, the decline in the percent
living on farms will average .5 units annually for the next 10 years.
Using the prediction equation presented in the preceeding paragraph
indicates that the number of resident hunting licenses will fall by about
7,000 per year.

Changes in the number of resident licenses are caused at least in
part by fluctuations in the supply of pheasants and changes in the demand
for hunting. The number of pheasants sighted per mile (X_1) is an index
of annual fluctuations in the pheasant population and the percent of
the Iowa population living on farms (X_{10}) explains some of the secular
shifts in the demand for hunting. Other socio-economic variables will
next be added to the estimation equation to better explain the changes
in the demand for hunting.

Resident hunting licenses regressed on per capita income and Iowa
population   Including per capita personal income (X_6) in an estimation
equation with pheasants per mile (X_1) and percent of Iowa population on
farms (X_{10}) increased the R^2 to .89**, only slightly higher than the R^2
obtained by regressing the number of licenses on only X_1 and X_{10}. The
prediction equation is:

$$\hat{Y}_r = -299,188 + 25,616^*X_1 + 53\ X_6 + 19,331^{**}X_{10}$$
$$(10,217) \qquad (37) \qquad (4,210)$$

The t value of the regression coefficient for per capita income is not
large enough to reject the hypothesis that the true value of this
coefficient is zero.

Adding Iowa population (X_8) to the estimation equation does not change the R^2 and only the same regression coefficients are significant. The prediction equation is:

$$\hat{Y}_r = -1,118,241 + 27,350^*X_1 + 94\ X_6 + 206\ X_8 + 26,404^*X_{10}$$
$$\qquad\qquad\quad (11,245)\qquad (92)\qquad (420)\qquad\ (15,052)$$

Although the R^2 was unchanged, the reliability of the prediction equation and all the regression coefficients was lowered by adding the variable for Iowa population. Other estimation equations containing Iowa population (X_8) give a negative regression coefficient for this variable. The resulting prediction equations thus had to be rejected on a logical basis.

The prediction equations resulting from the regression of resident hunting licenses on pheasants sighted per mile and the various socio-economic variables are summarized in Table 15.

The prediction equations for resident hunting licenses were calculated to best explain (predict) the number of licenses issued each year in the historical period by using concurrent values for the independent variables. If the same relationships found in the regression analysis are expected to hold true in the future, the prediction equations can be used for projecting the future number of resident hunting licenses.

Estimates which are available for the variables in the following equation allow a projection of the number of resident hunting licenses for 1974:

$$\hat{Y}_r = -1,118,291 + 27,349.2^*X_1 + 93.9329\ X_6 + 206.223\ X_8 +$$
$$\qquad\qquad\quad (11,245)\qquad\quad (92.2061)\qquad\ (419.728)$$

$$\qquad 26,403.9^*X_{10}$$
$$\qquad (15,052.1)$$

$$\hat{Y}_r = 195,615 \text{ resident hunting licenses}$$

Table 15. Prediction equations, R^2, and standard errors for number of resident hunting licenses (Y_r) related to pheasants sighted per mile (X_1) per capita income (X_6), Iowa population in thousands (X_8) and percent of population on farms (X_{10}), Iowa, 1954-1966.

$$\hat{Y}_r = 348,807 \underset{(20,816.9)}{-13,974.9}\, X_1 \qquad\qquad\qquad\qquad\qquad ;\ R^2 = .04$$

$$\hat{Y}_r = 28,688.6 \qquad\qquad\qquad\qquad\qquad + \underset{(1,809.47)}{12,236.5^{**}}\, X_{10} \ ;\ R^2 = .81^{**}$$

$$\hat{Y}_r = -46,070.8 + \underset{(9,331.58)}{18,414.0^*}\, X_1 \qquad\qquad\qquad + \underset{(1,805.45)}{13,848.7^{**}}\, X_{10} \ ;\ R^2 = .86^{**}$$

$$\hat{Y}_r = -812,527 \qquad\qquad + \underset{(39.7897)}{6.95879}\, X_6 + \underset{(4,117.86)}{12,875.9^{**}}\, X_{10} \ ;\ R^2 = .81^{**}$$

$$\hat{Y}_r = -299,188 + \underset{(10,217.1)}{25,615.5^*}\, X_1 + \underset{(37.0164)}{52.8093}\, X_6 + \underset{(4,209.89)}{19,331.4^{**}}\, X_{10} \ ;\ R^2 = .89^{**}$$

$$\hat{Y}_r = -1,118,241 + \underset{(11,245.0)}{27,349.2^*}\, X_1 + \underset{(92.2061)}{93.9329}\, X_6 + \underset{(419.728)}{206.223}\, X_8 + \underset{(15,052.1)}{26,403.9^*}\, X_{10} \ ;\ R^2 = .89^{**}$$

*Significant at $\alpha = .05$.

**Significant at $\alpha = .01$.

where the variable values are:

X_1 = 1.97 = 1954 through 1966 average number of pheasants sighted per mile.

X_6 = 2,646 = 1974 per capita Iowa personal income in 1958 dollars.[1]

X_8 = 2,920 = 1974 Iowa population in thousands.[2]

X_{10} = 15.5 = Percent of the Iowa population living on farms in 1974.[3]

The projected number of resident hunting licenses for 1974 is a 33% decline from the number in 1966.

An alternative equation for projecting the number of resident hunting licenses does not include a variable for Iowa population. The realistic assumption that the Iowa population will remain constant allows the use of this equation. Leaving population out of the projection equation also improves the reliability of the regression coefficients. The equation restated is:

$$\hat{Y}_r = -299,188 + \underset{(10,217.1)}{25,615.5^*} X_1 + \underset{(37.0164)}{52.8093} X_6 + \underset{(4,209.89)}{19,331.4^{**}} X_{10}$$

Using the same value for X_1, X_6 and X_{10} as used in the previous paragraph, the projection for 1974 is:

$$\hat{Y}_r = 190,613 \text{ resident hunting licenses.}$$

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[1] Total personal income is expected to increase 2.2% annually (42, p. 35).

[2] Projected by Maki (42, p. 3).

[3] Calculated from the farm population of 452,000 projected by Maki (42, p. 3).

This projection for the number of resident hunting licenses is 35% below the number in 1966.

Resident licenses regressed on adjusted hunting license fee and pheasant hunting season   The Fish and Game Division of the Iowa Conservation Commission is financed almost entirely by license and permit fees plus Federal Aid. The various fees, including the hunting license fee, are set by the Iowa Legislature. The Legislature's power to set fees is the means by which it controls the extent of the Fish and Game Division programs. Hunting license fees are established at certain levels to serve a regulatory function rather than to maximize revenue. In regulating the activities of the Fish and Game Division, the Legislature is assumed to be aiming for a maximum benefit above costs. Total benefit must be measured in extra-market values and is assumed to increase with the number of residents who are able to enjoy the opportunity to hunt. This approach to setting hunting license fees may maximize revenue, but only by coincidence.

Calculation of a regression coefficient for resident hunting license fees will serve as an estimate of the effect on the number of hunting licenses per dollar increase in the resident hunting license fee. This coefficient can be used to indicate whether an increase in license fees will increase total revenue or cause the number of licenses sold to fall enough to actually reduce total license revenue. If the number of resident hunting licenses continues to fall, this information may become very important to the Iowa Conservation Commission as it seeks funds to finance the programs of the Fish and Game Division. The Legislature's assumed goal of maximizing an extra-market measure of total

benefit above license costs, also relies on an estimate of the effect of license fees on the number of licenses.

To estimate the regression coefficient for resident hunting license fee (X_4), the variables pheasants sighted per mile (X_1) and percent of the Iowa population on farms (X_{10}) were included in the estimation equation. The multiple regression method holds the latter two variables constant to estimate the coefficient for license fees. An R^2 of .86** was obtained using the prediction equation:

$$\hat{Y}_r = 26,090 + \underset{(9,702)}{18,713^*} X_1 - \underset{(25,335)}{13,440} X_4 + \underset{(4,027)}{11,958^*} X_{10}$$

Each dollar increase in the price of resident licenses will cause an estimated decline of 13,440 resident licenses. The standard error is nearly twice the size of the coefficient for license fees. The calculated t value is .53 which allows only 70% confidence that the true coefficient value is not zero.

Price elasticity, using: the license fee regression coefficient, -13,440; the 13 year mean adjusted fee, $2.05; and the mean number of resident licenses, 321,330, is calculated as:

$$- \ \frac{\% \text{ change in number of licenses}}{\% \text{ change in the license fee}} \ = \ .09$$

A fee increase will raise total revenue when the price elasticity is less than one. This price elasticity does not apply to prices for resident hunting licenses which fall outside the range of fees in the 1954-1966 period. The very low elasticity of .09 does indicate that the license fee where unit elasticity and maximum revenue are reached is at a higher level than the present $3.00 fee.

The prediction equations which contain the resident license variable are summarized in Table 16.

Whenever the variable for season length (X_6) was included in an estimation equation, its regression coefficient was negative. This variable should have a positive effect, but the season length has more than tripled since 1954, while the number of resident licenses has fallen. The other variables do not account for the downward trend in number of licenses completely enough to allow a measure of the positive effect from increased season length.

The length of the pheasant hunting season is set each year by the Iowa Conservation Commission. Season length has been positively correlated with pheasant population estimates. The correlation coefficient between season length and the late summer roadside survey is +.60. There is no biological justification for restricting the season length during down-turns in the pheasant population to maximize total long run harvest, but pressure from groups who think the season length must fluctuate with pheasant populations has often caused the season to be shortened.

Resident licenses regressed on indicators of success the previous season   The two variables selected as indicators of success the previous season are: thousands of pheasants bagged the previous season (X_2), and pheasants bagged per hour the previous season (X_3). These variables will be evaluated with estimation equations containing the variables pheasants sighted per mile (X_1) and percent of Iowa population on farms (X_{10}). The prediction equation to evaluate kill the previous season (X_2) is:

Table 16. Prediction equations, R^2 and standard errors for number of resident hunting licenses related to pheasants sighted per mile (X_1), resident license fee (X_4), per capita income (X_{10}), Iowa population in thousands (X_8) and percent on farms (X_6), 1954-1966.

$$\hat{Y}_r = 26,089.9 + 18,712.5^* X_1 - 13,439.7 X_4 + 11,957.8^* X_{10} \; ; \; R^2 = .86^{**}$$
$$\phantom{\hat{Y}_r = 26,089.9 + }(9,702.41) \quad (25,335.2) \quad (4,026.82)$$

$$\hat{Y}_r = -792,549 + 26,814.9^* X_1 - 6,957.39 X_4 + 78.9835 X_6 + 134.375 X_8 + 22,896.5 \; X_{10} \; ; \; R^2 = .89^{**}$$
$$\phantom{\hat{Y}_r = -792,549 + }(12,236.7) \quad (32,340.0) \quad (120.339) \quad (558.167) \quad (22,869.9)$$

*Significant at $\alpha = .05$.

**Significant at $\alpha = .01$.

$$\hat{Y}_r = -51,231 + 18,565^* X_1 + 2 X_2 + 13,929^{**} X_{10}$$
$$(9,869) \quad\quad (13) \quad\quad (1,967)$$

The R^2 for this equation is .86**, the same as for the equation estimated without kill the previous season (X_2). The regression coefficient for X_2 is very small in absolute measures and relative to its standard error. Kill the previous season appears to be a very poor indicator of the number of resident licenses. One reason for this may be that when pheasant populations are down, each hunter increases the number of hours he hunts in order to meet his own success standard. His standard may be only one pheasant or on up to the legal bag limit. If this is true, the total number of pheasants harvested would not fully reflect the lower hunting quality.

An indication of the pheasant hunting quality for each hunter is given by pheasants per hour the previous year (X_3). The effect of the previous season's bag per hour (X_3) was analyzed in an estimation equation which held pheasants per mile (X_1) and percent of Iowa population on farms (X_{15}) constant. The prediction equation is:

$$\hat{Y}_r = -80,599 + 20,652^* X_1 + 108,344 X_3 + 13,812^{**} X_{10}$$
$$(9,580) \quad\quad (107,091) \quad\quad (1,804)$$

The R^2 is .87**, and although the regression coefficient for previous year's kill per hour is not significant, its inclusion in the equation will probably improve the ability to project the number of hunting licenses. The regression coefficient is 108,344 additional licenses for each pheasant bagged per hour the previous year. This variable has ranged from a minimum of .23 to a maximum of only .33 in the 13 year period studied, so the net impact on the number of licenses has been small.

The estimated prediction equations containing the lagged indicators of pheasant hunting success are summarized in Table 17. Neither variable has significant regression coefficients.

Standardized regression coefficients   The regression coefficients for the resident hunting license prediction equations estimate the change in number of licenses per unit change in each independent variable. None of the variables are measured in the same units, so the regression coefficients for different variables cannot be directly compared for size. By converting the coefficients to standardized units, the regression coefficients can be compared directly to determine which has had the most influence on the number of resident licenses.

The regression coefficients (b_j) are standardized by multiplying each b_j by $\frac{\sqrt{CSSQ_{jj}}}{\sqrt{CSSQ_{rr}}}$, where the $CSSQ_{rr}$ and $CSSQ_{jj}$ are from the diagonal of the corrected sum of squares matrix (6, p. 213). The above conversion is necessary when the X_j are standardized to units of their standard deviation. In order to allow the use of the original values of Y_r and b_{r0} in the prediction equations, both sides of each equation were multiplied by $\sqrt{CSSQ_{rr}}$ and W_j is defined as $(\sqrt{CSSQ_{rr}})(X_j/\sqrt{CSSQ_{rr}})$.

Table 18 restates some of the prediction equations with standardized coefficients to allow direct comparison of the coefficients for different variables. Comparison of the standardized regression coefficients shows that the coefficients for percent of the Iowa population on farms (X_{10}) are by far the largest in all the equations. The next largest are the coefficients for real per capita income (X_6), but these were never found to be significant. Next in size are the coefficients for pheasants

Table 17. Prediction equations, R^2 and standard errors for Resident hunting license related to pheasants per mile (X_1), pheasants bagged the previous season (X_2), pheasants per hour the previous season (X_3), license fee (X_4) and percent on farms (X_{10}), Iowa, 1954–1966

$$\hat{Y}_r = -51{,}231.2 \; +18{,}565.3^* \, X_1 \; +2{,}109.03 \, X_2 \; +13{,}929.0^{**} \, X_{10} \; ; \; R^2 = .86^{**}$$
$$(9{,}868.97) \quad (13.3142) \quad\quad (1{,}966.91)$$

$$\hat{Y}_r = -80{,}599.4 \; +20{,}652.1^* \, X_1 \; +108{,}344 \, X_3 \; +13{,}812.1^{**} \, X_{10} \; ; \; R^2 = .87^{**}$$
$$(9{,}579.56) \quad (107{,}091) \quad\quad (1{,}803.69)$$

$$\hat{Y}_r = -62{,}402.8 \; +20{,}596.6^* \, X_1 \; +102{,}391 \, X_3 \; -3{,}035.77 \, X_4 \; +13{,}387.0^* \, X_{10} \; ; \; R^2 = .87^{**}$$
$$(10{,}167.4) \quad (126{,}845) \quad (28{,}876.2) \quad\quad (4{,}472.40)$$

*Significant at α = .05.

**Significant at α = .01.

Table 18. Prediction equations for number of resident hunting licenses issued converted to standardized regression coefficients, 1954-1966

$$\hat{Y}_r = -46070.8 +.261406^* W_1^a +1.01612^{**} W_{10} \qquad ; R^2=.86^{**}$$

$$\hat{Y}_r = -299188. +.363638^* W_1 +.401003 W_6 +1.41840^{**} W_{10} \qquad ; R^2=.89^{**}$$

$$\hat{Y}_r = -1118241. +.388252^* W_1 +.713273 W_6 +.272949 W_8 +1.93733^* W_{10} \qquad ; R^2=.89^{**}$$

$$\hat{Y}_r = 26089.9 +.265644^* W_1 -.155003 W_4 +.877393^* W_{10} \qquad ; R^2=.86^{**}$$

$$\hat{Y}_r = -792549. +.380665^* W_1 -.082413 W_4 +.599755 W_6 +.177855 W_8 +1.67999^* W_{10} \qquad ; R^2=.89^{**}$$

$$\hat{Y}_r = -80599.4 +.293179^* W_1 +.123871 W_3 +1.01343^{**} W_{10} \qquad ; R^2=.87^{**}$$

$$\hat{Y}_r = -62402.8 +.292390^* W_1 +.117066 W_3 -.035012 W_4 +.982247^* W_{10} \qquad ; R^2=.87^{**}$$

[a]The W_j are defined as $\sqrt{CSSQ_{rr}}$ times the X_j in units of their standard deviation $\left(\frac{X_j}{\sqrt{CSSQ_{jj}}}\right)$.

Y_r = Number of resident hunting licenses issued.
X_1 = Pheasants sighted per mile in the late summer roadside survey.
X_3 = Pheasants bagged per hour the previous year.
X_4 = Adjusted resident hunting license fee.
X_6 = Iowa real per capita personal income.
X_8 = Iowa population in thousands.
X_{10} = Percent of the Iowa population living on farms.

*Significant at α = .05.

**Significant at α = .01.

sighted per mile (X_1) which are all significant. The size of the standardized coefficients for license fees and the lagged variables indicates that changes in these variables have had a negligible effect on the number of resident hunting licenses in the past 13 years.

Multiple Regression Analysis of Nonresident Hunting Licenses

The analysis of the number of nonresident hunting licenses follows the same methods and procedures as was used for resident hunting licenses. The same or similar variables will be used with two exceptions; no variable for license fees is used, and no variable for percent of the population living on farms is used.

Over 90% of the nonresident hunting licensees use their license to allow them to hunt pheasants in Iowa. The variables selected for analysis are those factors which are thought to have an effect on participation in Iowa pheasant hunting as measured by the number of nonresident hunting licenses issued. Regression analysis of these factors will estimate their effect on the number of nonresident licenses in the past and will allow an evaluation of anticipated or proposed changes in these factors which affect the demand and supply for pheasant hunting opportunities.

Unlike the resident demand for hunting, the nonresident demand is increasing. The supply of pheasant hunting opportunities in Iowa relative to the supply offered by other states may also have increased because the number of nonresident licenses has tripled since 1954. The economic reward for attracting a nonresident pheasant hunter is $20 for the license (effective Jan. 1, 1968) plus the income generated by

his expenditures within the state. Multiple regression analysis of the supply of pheasants with factors affecting the nonresident demand for pheasant hunting will aid in evaluating the importance of maintaining or increasing pheasant hunting opportunity in the state.

Nonresident hunting licenses regressed on pheasants per mile
The prediction equation for nonresident hunting licenses (Y_{nr}) regressed on the number of pheasants sighted per mile (X_1) is:

$$\hat{Y}_{nr} = 788 + \underset{(1011)}{2511^*} X_1$$

The R^2 is only .36, but significant at the 5% level. Although this variable alone explains only 36% of the variation in nonresident licenses, it explained only 4% of the variation in resident licenses.

Nonresident hunting licenses regressed on variables indicating success the previous season   The two lagged variables are pheasants bagged the previous season (X_2) and pheasants bagged per hour the previous season (X_3). Neither of these variables alone or together gave an R^2 of over .37 and no significant R^2 or regression coefficients were obtained. When the lagged variables were added to estimation equations containing the nonlagged variables, the lagged variables did not add to the percentage of variation explained.

The indicators of pheasant hunting success which are lagged only one year do not show any significant effect on the number of nonresident licenses. However, past hunting success is no doubt important. It is very unlikely that the same hunters return each year to hunt in Iowa. The decision to return to hunt in Iowa may be based on the hunting success more than one year in the past. The decision to hunt pheasant

in Iowa may also be based on poor success the previous season in other states.

Nonresident hunting licenses regressed on population and real per capita income   The regression of nonresident licenses (Y_{nr}) on real per capita income of the North Central region (X_7) and on population of the North Central region in thousands (X_9) gave prediction equations with highly significant R^2 of .77 and .76 and highly significant regression coefficients.   The prediction equation with only real per capita income (X_7) is:

$$\hat{Y}_{nr} = -13,597 + \underset{(1.4)}{8.7^{**}} X_7$$

The prediction equation with only North Central region population (X_9) is:

$$\hat{Y}_{nr} = -32,464 + \underset{(.12)}{.74^{**}} X_9$$

The regression of nonresident licenses on both per capita income (X_7) and population (X_9) gave a slightly better R^2 of .82, but neither regression coefficient was significant.   This prediction equation is:

$$\hat{Y}_{nr} = -24,886 + \underset{(2.6)}{4.8} X_7 + \underset{(.23)}{.39} X_9$$

Adding the supply factor of pheasants sighted per mile (X_1) to the regression of Y_{nr} on per capita income (X_7) gives a prediction equation which explains 94% of the variation in nonresident licenses. This is the highest R^2 obtained in the analysis of nonresident licenses and both regression coefficients are significant.   The prediction equation is:

$$\hat{Y}_{nr} = -14,996 + \underset{(335)}{1,777^{**}} X_1 + \underset{(.79)}{7.7^{**}} X_7$$

This prediction equation provides the estimate that 1,777 additional hunters have been attracted by each unit increase in the average number of pheasants sighted per mile. The coefficient for income is 7.7 nonresident hunters for each dollar increase in the North Central per capita personal income.

Assuming the number of pheasants per mile stays constant at the 1954-1966 average of 1.97 and the North Central real per capita personal income reaches $3,380 in 1976 as projected by the National Planning Association (49, p. 68), the projected number of nonresident licenses in 1976 is:

$$\hat{Y}_{nr} = -14{,}996 + (1{,}777)(1.97) + (7.739)(3{,}380) = 14{,}660$$

This projection for 1976 is an increase of 52% over the 1966 number of 9,638 licenses.

The prediction equation estimated by the regression of nonresident licenses on pheasants per mile (X_1), North Central per capita income (X_7) and North Central population (X_9) has an R^2 of .94, but unfortunately, the regression coefficient for population is negative. This equation, therefore, has to be rejected on logical grounds. In order to consider population in a projection of the number of nonresident licenses, the equation containing only the demand factors of income (X_7) and population (X_9) will have to suffice. This equation restated is:

$$\hat{Y}_{nr} = -24{,}886 + \underset{(2.6)}{4.8} X_7 + \underset{(.22)}{.39} X_9$$

Using National Planning Association projections for 1976 (49, pp. 67-68), the projected number of nonresident hunting licenses in 1976 is:

$$\hat{Y}_{nr} = -24{,}886 + (4.8)(3{,}380) + .39(66{,}000) = 17{,}078$$

This is a 77% increase from the 1966 number of 9,638 licenses. At $20 each, 17,078 licenses amounts to $341,560.

The prediction equations for nonresident hunting licenses are summarized in Table 19. The equation that best explains the variation in the number of nonresident licenses over the period 1954 through 1966 is a regression on pheasants sighted per mile and real per capita personal income of the North Central States.

Table 20 restates the prediction equations in standardized regression coefficients to allow direct comparison among the regression coefficients for relative size. The size of the standardized regression coefficients is an indication of their effect on the number of nonresident hunting licenses. Although the impact of the 3 independent variables appears to have been nearly equal, the rank of the coefficients from largest to smallest tends to fall in the following order; per capita income (X_7), North Central population (X_9) and then pheasants per mile (X_1).

Summary of Multiple Regression Analysis of Resident and Nonresident Hunting Licenses

The variables describing socio-economic characteristics of the human population were found to be the most important factors in determining the number of both resident and nonresident hunting licenses. Changes in these variables since 1954 have apparently caused a change in the demand for pheasant hunting which has been reflected in part by changes in the number of hunting licenses.

The migration of Iowans from farm to nonfarm residences was found

Table 19. Prediction equations for number of nonresident hunting licenses issued (Y_{nr}) related to pheasants sighted per mile (X_1), per capita personal income of the north-central U.S. (X_7) and population of the north-central U.S. (X_9), 1954-1966

$$\hat{Y}_{nr} = 787.740 + \underset{(1011.30)}{2510.89^* \, X_1} \quad ; \quad R^2 = .36^*$$

$$\hat{Y}_{nr} = -13597.0 + \underset{(1.43717)}{8.68023^{**} \, X_7} \quad ; \quad R^2 = .77^{**}$$

$$\hat{Y}_{nr} = -32463.8 + \underset{(.124983)}{.742868^{**} \, X_9} \quad ; \quad R^2 = .76^{**}$$

$$\hat{Y}_{nr} = -14995.7 + \underset{(335.272)}{1777.09^{**} \, X_1} + \underset{(.792435)}{7.73890^{**} \, X_7} \quad ; \quad R^2 = .94^{**}$$

$$\hat{Y}_{nr} = -29495.1 + \underset{(680.330)}{935.534 \, X_1} + \underset{(.138134)}{.64929^{**} \, X_9} \quad ; \quad R^2 = .80^{**}$$

$$\hat{Y}_{nr} = -24885.9 + \underset{(2.62954)}{4.76773 \, X_7} + \underset{(.225888)}{.388985 \, X_9} \quad ; \quad R^2 = .82^{**}$$

*Significant at $\alpha = .05$.

**Significant at $\alpha = .01$.

Table 20. Prediction equations for number of nonresident hunting licenses issued (Y_{nr}) expressed in standardized regression coefficients, 1954-1966

$\hat{Y}_{nr}$ = 78.7740 + .599285* W_1^a ; R^2 = .36*

$\hat{Y}_{nr}$ = -13597.0 + .876538** W_7 ; R^2 = .77**

$\hat{Y}_{nr}$ = -32463.8 + .873249** W_9 ; R^2 = .76**

$\hat{Y}_{nr}$ = -14995.7 + .424145** W_1 + .781482** W_7 ; R^2 = .94**

$\hat{Y}_{nr}$ = -29495.1 + .223288 W_1 + .763252** W_9 ; R^2 = .80**

$\hat{Y}_{nr}$ = -24885.9 + .481451 W_7 + .457256 W_9 ; R^2 = .82**

[a] The W_j are defined as $\sqrt{CCSQ}_{nr}$ nr times the X_j in units of their standard deviation

$$\frac{X_j}{\sqrt{CCSQ}_{jj}} = \frac{X_j}{s_j}$$

The units of the Y_{nr} and original X_j are:

Y_{nr} = Number of nonresident hunting licenses.

X_1 = Pheasants sighted per mile.

X_7 = Real per capita personal income of the North Central region of the U.S.

X_9 = Human population of the North Central region of the U.S. in thousands.

to be the factor which best explained the downward trend in resident
hunting licenses. If this relationship between the percent of the Iowa
population living on farms and resident hunting licenses continues, the
number of resident hunting licenses will fall at the rate of approxi-
mately 7,000 per year. The percent living on farms is decreasing at a
decreasing rate and the same is expected to be true for resident hunting
licenses.

Increased real per capita income was found to be the best explana-
tion for the three-fold increase in the number of nonresident licenses
during the period examined. Nonresident hunters in South Dakota had an
average expenditure for hunting in 1959 of $178.39, exclusive of license
fees. This amounts to approximately $195 in 1965 dollars and a non-
resident fee of $17 such as Iowa has been collecting will raise the
average to $212. The average expenditure for all Iowa hunters was
$38.74 in 1955 which is about $47.00 in 1965 dollars (12, p. 10).
Nonresident hunters apparently make substantially greater expenditures
in pursuit of their hunting than do resident hunters. The increased
per capita income of residents in the North Central region is making it
possible for more nonresidents to make these expenditures to hunt in
Iowa.

Iowa real per capita income has increased 33%; from $1923 in 1954
to $2567 in 1966. The absolute and percentage increase has been greater
than for the North Central region. None of the regression coefficients
for Iowa per capita income were significant, but all were positive.
This indicates that increased per capita income will not reduce the
number of resident licenses and may increase the number.

The effect of human population increases has been much greater on the number of nonresident licenses than on the number of resident licenses. The population of the North Central region grew from 47.5 million to 54.4 million between 1954 and 1966 which has contributed to the increased number of nonresident licenses. The standardized regression coefficients for North Central population and North Central per capita income were approximately equal. This indicates that these two factors have been about equally important in determining the number of nonresident licenses. Iowa's population, however, has shown a net increase of only 120,000 over the 1954 population of 2,626,000, and has declined slightly since 1960. The positive effect on the number of resident licenses has, therefore, been negligible, and projected estimates indicate very little population increase in the future.

The pre-season index of pheasant populations is the number of pheasants sighted per mile in the August roadside survey. The state-wide average for this variable explains a significant amount of the variation in both resident and nonresident hunting licenses. Significant estimates for the effect of an increase of one pheasant sighted per mile range from 18,414 to 27,349 additional resident licenses, and range from 1777 to 2510 additional nonresident licenses. The average number of pheasants sighted per mile has ranged from a low of 1.28 in 1954 to a high of 2.72 in 1963. The greatest year to year increase was between 1962 and 1963 when the average count went up .80 pheasants per mile. Concurrent increases in licenses were 19,300 resident licenses and 2030 nonresident licenses. Prediction equations predict an increase between 1962 and 1963 of 6,422 resident licenses using the equation

$\hat{Y}_{r,1963} - \hat{Y}_{r,1962} = \Delta\hat{Y}_r = f(\Delta X_1, \Delta X_{10})$, and an increase of 14,425 resident licenses using the equation $\hat{Y}_{r,1963} - \hat{Y}_{r,1962} = \Delta\hat{Y}_r = f$ $(\Delta X_1, \Delta X_6, \Delta X_8, \Delta X_{10})$. The actual increase was 19,300 resident licenses which indicates that the regression coefficients for pheasants sighted per mile (X_1) underestimate the effect of changes in this index of the pheasant population. Prediction equations for nonresident hunting licenses predict an increase between 1962 and 1963 of 2008 nonresident licenses using the equation $\hat{Y}_{nr,1963} - \hat{Y}_{nr,1962} = \Delta\hat{Y}_{nr} = f(\Delta X_1)$, and an increase of 1816 nonresident licenses using the equation $\Delta\hat{Y}_{nr} = f(\Delta X_1, \Delta X_7)$. These estimates are very close to the actual increase between 1962 and 1963 of 2030 nonresident licenses. This increase was caused primarily by the increase in pheasant populations represented by the +42% change in the number of pheasants sighted per mile.

No significant estimate of the effect from increased resident license fees was found. The nonsignificant estimates for this factor ranged from -6,947 to -13,440 licenses per dollar increase in the price of resident licenses. Nonresident license fees were not analyzed because the range in nonresident license fees has been too small to yield a significant estimate on the effect of changes in the fee.

The regression coefficients for the variables selected to represent past hunting success did not furnish significant estimates of their effect on the following year's issue of licenses. This does not mean that past success is not important in determining the number of hunters who buy licenses to hunt pheasant. The pre-season survey results are released in terms of pheasants sighted per mile and percent change from

the previous year. For the survey results to have any meaning for pheasant hunters they must relate those figures to their past hunting success. Dissemination of information on the current pheasant hunting prospects is evidently so complete as to override the influence of actual success the previous season for both resident and nonresident hunters.

A variable for increased mobility was not included in the multiple regression analysis for lack of an appropriate measure. The effect of increased mobility is particularly real for the nonresident hunter. Interstate Highway 80 runs directly to the excellent pheasant hunting areas in southwest Iowa from the highly populated areas in Illinois, Indiana and Ohio. The effect on the number of nonresident hunters by the increased ease and speed of travel was probably largely accounted for in exaggerated regression coefficients for North Central region income and population.

Increased numbers, incomes, and mobility of nonresident hunters will cause an increased demand for pheasant hunting. The importance of the pheasant to Iowa's economy will depend on how well this increased demand can be exploited. In order to take advantage of the increased demand, a satisfactory quantity and quality of pheasant hunting opportunity must be provided.

SUMMARY AND CONCLUSIONS

The ring-necked pheasant supplies an important part of the outdoor
recreation opportunities in Iowa. However, the 232,000 licensed resi-
dent pheasant hunters in the 1966-67 season were less than 9% of the
total Iowa population. A 1955 survey of Iowa hunters found that only
17% were not licensed (12) so the unlicensed pheasant hunters would
probably not raise this percentage above 10%. The distribution of bene-
fits from pheasant hunting is much more limited than goods such as public
education. When the market system fails to provide incentives to insure
the desired number of pheasants, this goal does not warrant and in fact
does not receive appreciable financial support from state tax supported
funds.

The expenditures in Iowa by nonresident hunters are expenditures
that for the most part would not have been made in Iowa for any other
purpose if hunting opportunities did not exist. Income accruing to Iowa
residents which is generated by these expenditures will act as a return
on investment in pheasant habitat within the state. The Fish and Game
Division of the Iowa Conservation Commission presently is a sportsmen
financed agency orientated toward providing maximum recreational use of
Iowa's wildlife resources. Its role in economic development of the state
remains underemphasized. Both objectives have common ends-in-view and
face common biological and economic limitations.

Pheasant Production and Marketing

Pheasant harvests which allow hunters to kill as many cock pheasants
as possible appear to be complementary with maximizing long run yields.

The most productive game management practices for the state and private firms are the improvements of the supply of nesting and winter cover. These habitat improvement practices call for deviation from land uses dictated by the dominant influence of agricultural production. While there is a readily available market for agricultural commodities, no such market was found to exist for pheasants produced in the wild. When the two uses for land come into conflict, competition leaves very little choice but to produce the agricultural crop and sacrifice pheasant production. To the extent that pheasants actually do have a value which isn't expressed as a market price, too much land is allocated to commodity production and too little to pheasant production to allow an efficient use of land resources. Income incentives were explored as a means to cause restoration of pheasant habitat in northern Iowa, where agriculture has become very competitive with pheasant production, and as a means to prevent a similar situation in the rest of Iowa.

The absence of a market for access rights to hunting areas causes a disassociation between the benefits received by the hunters and the business community and the costs incurred by farm firms. Costs to the farm firms arise from the actual outlays and opportunity costs of altering their use of land to uses which promote pheasant production rather than the uses dictated by the economics of agricultural production. There is also a disassociation of benefits and costs among time periods. The investments in pheasant production are not made during the hunting season, but must be made in the spring and summer of the year and in previous years. Failure to recognize the actual benefit-cost relationship because of the time separation will cause hunters to more strongly

resist payment of access fees. If a market for hunting rights is established, this still will not remove the time disassociation of benefits and costs. The farm firms must recognize that current costs must be incurred to produce future income from pheasants. Hunters and farmers acting individually will not be able to overcome these disassociations and may not even recognize them. There is a definite need for multi-hunter organizations and multi-farm organizations or a combined organization to insure that current benefits and costs are associated and that enough permanence is given to contractural arrangements so that benefits and costs continue to be associated over time.

The organization of farmers and hunters into cooperative game district organizations also offers an opportunity to take advantage of some economies of scale in marketing pheasants. The major marketing cost for farm firms acting individually is patrolling to prevent trespassing. To establish a market for pheasants on a per bird basis or through access rights to hunting areas, the farm firms must first be able to withhold pheasants from hunters. Due to the inability to withhold pheasants which travel onto road right of ways, a total withholding is physically impossible under the present laws which allow public use of roadsides for hunting. The other major limitation on the ability to withhold pheasants is that pheasants are never concentrated in small areas as are waterfowl. Pheasants are found in low densities, but over the majority of the area of the state. The writer made the estimate that only 25 cock pheasants per farm on the average could be withheld from hunter kills even in the better hunting areas of the state. Costs of patrolling to prevent hunter access throughout the 50-60 day season

relative to the expected returns present an economic limitation on the ability to withhold pheasants. These costs could be reduced by a cooperative effort among farm firms and would be greatly reduced if a multi-hunter organization assumed the major responsibility to prevent trespassing by hunters. An organization of several farms into a single game district firm will have the effect of bringing a greater number of pheasants under a single firm and provide the same marketability as is offered by waterfowl areas where access to large concentrations of water-fowl can be controlled by a single firm. It is doubtful that even a multi-farm firm would find it worthwhile to withhold pheasants for the entire season, but withholding pheasants during the first portion of the season appears much more promising. The number of cock pheasants available and the number of hunters are concentrated at the beginning of the pheasant hunting season. The period when marginal revenues no longer exceed marginal costs of withholding would probably occur before the season is over.

Membership in cooperative game organizations by all farmers in an area and by all who hunt in an area will not be realized and is not necessary. For example, cooperative grain and farm supply firms furnish a place of exchange for non-members as well as members. Particularly during the opening of the pheasant season there is a need by nonlocal hunters for information on hunting areas and an incentive for short term reservations of a specific hunting area. If an exchange for hunting rights was established it could provide this service for non-members through service fee arrangements.

A pheasant marketing district could be composed of many smaller

multi-farm subdistricts controlled by adjacent farm firms. All inclusive membership in these subdistricts would be necessary to allocate specific costs to increase pheasant production according to the revenue received from the additional pheasants. Without an all inclusive membership or without an organization at all, the costs resulting from application of game management practices are not shared in proportion to the revenues received. This will reduce the number of practices economically justifiable for farm firms.

From an examination of the marginal productivity of habitat improvement practices relative to their marginal cost, it was indicated that a price on hunting area pheasants up to the price received by shooting preserves would not provide enough income incentive to cause farm firms to undertake extensive investments and set aside wildlife areas to restore habitat. An income incentive would possibly justify improvement of windbreaks and would expand the application of this practice since it is being applied even without an income from game. The major contribution of an income incentive for pheasant production would be to retard or prevent the eventual development of nonagricultural land for cultivation and prevent unnecessary destruction of habitat on roadsides, farmsteads, boundary fence lines, idle crop land, etc.

An estimate of $83 was made for the increment in value of an acre of nonagricultural land if it was as productive as roadsides and the pheasants could be marketed at shooting preserve prices with an allowance for expected marketing costs. The use of this land primarily for game production is not competitive with agricultural uses on easily developed land with a potentially high value, but on land where the development

costs are higher and/or the potential value is lower, game production may be the most profitable use. A change in the existing structures affecting the price of agricultural land is a possibility which would change the differential between land values in game production uses and agricultural uses. Present Iowa farm land values are held at an artificially high level by federal price supports on grain and retirement of land. This is aggravated by the tendency of farmers to bid too much of their future incomes into land values. Saupe and Kaldor estimated that changing the structures causing these high land values to allow a more efficient agricultural industry would cause Iowa farm land values to decline at least 50% from their 1959 level (60).

With or without an income incentive, the economically efficient practices to increase pheasant production rely on a complementary relationship with other agricultural related purposes. Government agencies, however, are seldom able to take advantage these relationships except on road right of way and direct outlays for land and improvements would require a much higher value be placed on pheasants than is obtainable in any shooting preserve. A more productive role by the Iowa State Conservation Commission appears to be research into ways to increase the complementarity between pheasant production and other uses. A possible role for county conservation boards is to assume the management of abandoned secondary roads in order to prevent the conflict with agricultural uses from occurring.

Statistical Analysis

Analysis of national surveys indicates that the total number of hunters is increasing with the increasing population. The author's statistical analysis of the increasing number of nonresident hunters in Iowa indicates that increased per capita income has been even more important than the total number of North Central region hunters in causing the increase. For resident hunters there has been no significant population or income effect, and the migration from rural to nonrural areas is strongly associated with the decline in number of resident hunting licenses. While the decline in number of resident hunters may be caused by factors related to the migration from rural to urban areas, concentration of hunters in nonrural areas will make them nonlocal hunters when they hunt and more and more similar to nonresident hunters. This may eventually make withholding of pheasants easier and the demand for a service to locate hunting areas greater.

Both the number of resident and nonresident hunting licenses have been significantly affected by the size of the pre-season pheasant population which is indexed by the number of pheasants sighted per mile in the late summer roadside survey. This emphasizes the importance of providing an adequate supply of pheasants to attract nonresident hunters and to take advantage of the demand for good hunting areas. Efforts to widely publicize the results of the pre-season survey with emphasis on the better hunting areas of the state might attract additional nonresident hunters. Shooting preserves are an alternative means of providing pheasant hunting opportunity and at present supplement the hunting opportunity offered by hunting areas. The Iowa State Conservation

Commission appears to be giving shooting preserves adequate support by minimizing the legal and economic barriers to the shooting preserve operations. Shooting preserves will become more or less prevalent depending on the ability of naturally populated hunting areas to meet the demand for pheasant hunting opportunities.

Recommendations for Further Research

In the course of this study, several instances occurred where additional source information would have been most helpful. There were also many instances where the source data and results of this study could have been used to provide a much more extensive treatment of the subject, but were not attempted in order to limit this study to a managable size. Further research in the following 5 areas will be helpful in research similar to this study and will allow an extension of the result of this study:

1) More intensive study of actual attempts to establish a market for pheasants produced on hunting areas would help to identify failure and success elements in these attempts. Markets for pheasant hunting rights in other states and markets for hunting rights of other game species in Iowa have developed with success elements, some of which may be applicable to a market for pheasant hunting rights in Iowa. Shooting preserves in Iowa are able to market pheasants for hunting and the services they offer may have to be partly duplicated to market pheasants from hunting areas. A survey of farmers in the Adair County area to determine why they haven't attempted to market hunting rights would be a helpful study. This would help to determine whether the reason is

the failure to recognize the income potential from the pheasant resource they control, a reluctance to charge for the right to hunt due to the support of the free hunting tradition, or lack of an effective organization to concentrate control over an area of adequate size to withhold hunting rights for a price.

2) An estimate of the economic impact of nonresident hunters on Iowa's economy is needed to give more meaning to the number of nonresident hunters. The most efficient and thorough way to do this is to develop a model for all types of outdoor recreation taking account of the multiplier effects of in-state expenditures and then estimate nonresident hunter expenditures for use in this model.

3) The value of Iowa's game resource to its residents is needed for use in benefit-cost comparisons between hunting purposes and alternative recreational purposes of public projects. The demand curve evaluation method advocated by Clawson and Knetsch (10) appears to be a promising technique. Returns from the annual postcard survey of hunters furnishes the origins and destinations of hunting trips which are needed for this method.

4) The information most lacking in the preparation of this thesis was estimates of added productivity from game management practices. These estimates are necessary before a marginal economic evaluation of proposed practices is possible. The author derived some very rough productivity estimates for this purpose, but a researcher with game management training would be able to derive more precise estimates for economic analysis from the same data. Research designed specifically to provide estimates of the productivity of game management practices

will greatly expand the number of possible applications of economist's methods to answer some of the unknowns of pheasant production costs and returns. Additional sophistication of productivity estimates to include a time factor and the effect of the size of the pheasant production area are required to evaluate the advantages of a multi-farm organization to promote pheasant production.

5) Finally, game district organizations composed of many farmers, many hunters or both offer the key to make pheasants a marketable product and to maximize the results of an income incentive. A very worthwhile study would be on the possible organizational structures to meet this need and an evaluation of the assistance possible and available from government agencies.

BIBLIOGRAPHY

1. Allen, Durward L. Our wildlife heritage. 2nd ed. New York, N.Y., Funk and Wagnalls Co. 1962.

2. Barnard, Jerald R. Design and use of social accounting systems in state development planning. Iowa City, Iowa, Bureau of Business and Economic Research, The University of Iowa. 1967.

3. Berryman, Jack H. Our growing need: a place to produce and harvest wildlife. Journal of Wildlife Management 21: 319-323. 1957.

4. Berryman, Jack H. The responsibility of state agencies in managing hunting on private lands. North American Wildlife and Natural Resources Conference Transactions 26: 285-297. 1961.

5. Bolstad, Roger Ardell. The ring-necked pheasant and pheasant habitat in central Iowa. Unpublished M.S. thesis. Ames, Iowa, Library, Iowa State University. 1962.

6. Bryant, Edward C. Statistical analysis. New York, N.Y., McGraw-Hill Book Co., Inc. 1960.

7. Bull, Leonard and Timmons, John F. Outdoor recreation enterprises: a new source of income in Iowa. Iowa Farm Science 21: 456-458. 1966.

8. Ciracy-Wantrup, S. V. Resource conservation, economics and politics. 2nd edition. Berkeley, Calif., Division of Agricultural Sciences, University of California. 1963.

9. Clawson, Marion. Private and public provision of outdoor recreation opportunity. Outdoor Recreation Resources Review Commission Study Report 24: 72-96. 1962.

10. Clawson, Marion and Knetsch, Jack L. Economics of outdoor recreation. Baltimore, Md., John Hopkins Press. 1966.

11. Clawson, Marion and Stewart, Charles L. Land use information. Washington, D.C., John Hopkins Press. 1965.

12. Crossley, S-D Surveys, Inc. National survey of hunters and fishermen: supplemental state report prepared for the state of Iowa. New York, N.Y., author. 1956.

13. Dickey, Charles. Shooting preserves in the United States. North American Wildlife Conference Transactions 22: 396-402. 1957.

14. Gottsegen, Jack J. Revised estimates of GNP by major industries. Survey of Current Business 47, No. 4: 18-24. 1967.

15. Graham, Robert E., Jr. State personal income in 1966. Survey of Current Business 47, No. 4: 9-17. 1967.

16. Green, William Edward. The development of experiemtnal management areas for the ring-necked pheasant, phasnianus colchicus torquatus Guelin, in Northern Iowa. Unpublished Ph.D. thesis. Ames, Iowa, Library, Iowa State University. 1948.

17. Held, R. Burnell. Recreation as use for excess acres. Farm Policy Forum 18, No. 1: 8-15. 1966.

18. Interagency Committee on Water Resources. Subcommittee on Evaluation Standards. Report of the panel on recreational values on a proposed interim schedule of values for recreation aspects of fish and wildlife. Outdoor Recreation Resources Review Commission Study Report 24: 57-58. 1962.

19. Iowa. Code, 1966: 109.2. 1966.

20. Iowa. Code, 1966: 109.40. 1966.

21. Iowa. Code, 1966: 714.25. 1966.

22. Iowa Crop and Livestock Reporting Service. Iowa Assessors Annual Farm Census. 1952 through 1966.

23. Iowa Soil and Water Conservation Needs Committee. Iowa soil and water conservation needs inventory. Ames, Iowa, Cooperative Extension Service, Iowa State University. 1963.

24. Iowa State Commerce Commission. Annual Report, 1965. 1966.

25. Iowa State Conservation Commission Biennial Reports. 1954 through 1966.

26. Iowa State Highway Commission. Iowa rural secondary road mileage. Ames, Iowa, author. 1967.

27. Klonglan, Eugene D. Ecology of pheasant production in southwestern Iowa. Unpublished Ph.D. thesis. Ames, Iowa, Library, Iowa State University. 1962.

28. Klonglan, Eugene D. Pheasant roadside nesting in northern Iowa. Iowa State Conservation Commission Quarterly Biology Reports 13, No. 1: 1-4. 1961.

29. Klonglan, Eugene D. Special report on pheasant situation following severe 1965 winter in northern Iowa. Unpublished mimeographed report to Fish and Game Division personnel, April 8, 1965.

Des Moines, Iowa, Iowa State Conservation Commission. 1965.

30. Klonglan, Eugene D. Surveys = prospects. Iowa Conservationist 25: 73, 75, 78-80. 1966.

31. Klonglan, Eugene and Nomsen, Richard. Iowa's late summer pheasant population - 1963. Iowa State Conservation Commission Quarterly Biology Reports 15, No. 3: 44-60. 1963.

32. Klonglan, Eugene D., Robbins, Russell L., and Ridley, Bromfield L. Evaluation of effectiveness of pheasant flushing bars in Iowa hayfields. Iowa Academy of Science Proceedings 66: 534-552. 1959.

33. Kozicky, Edward L. and Hendrickson, George O. Pheasant nesting and production in Winnebago county, Iowa 1940 versus 1954. Iowa Academy of Science Proceedings 63: 669-680. 1956.

34. Lauckhart, J. Burton. Wildlife population fundamentals. North American Wildlife and Natural Resources Conference Transactions 27: 233-242. 1962.

35. Lee, Ivan. Economic analysis bearing on outdoor recreation development. Outdoor Recreation Resources Review Commission Study Report 24: 1-44. 1962.

36. Leopold, Aldo. Game management. New York, N.Y., Charles Scribner's Sons. 1948.

37. Leopold, Aldo. Game survey of the North Central States. Madison, Wisc., Sporting Arms and Ammunition Manufacturers Institute. 1931.

38. Leopold, Aldo. A sand county almanac. New York, N.Y., Oxford Univ. Press. 1966.

39. Lerner, Lionel J. Quantitative indices of recreational values. Western Farm Economics Association Proceedings 1962: 12-18. 1962.

40. Mark, Ruth and Myers, Sumner. Outdoor recreation. In Dorfman, Robert, editor. Measuring benefits of government investments. pp. 77-101. Washington, D.C., The Brookings Institution. 1965.

41. MacMullen, R. A. Ring-necked pheasant habitat management in the United States. North American Wildlife and Natural Resources Conference Transactions 26: 268-272. 1961.

42. Maki, Wilbur R. Projections of Iowa's economy and people in 1974. Iowa Agricultural Experiment Station Special Report 41. 1965.

43. Marshall, William H. A survey of farm-game habitat restoration programs in fifteen states. North American Wildlife Conference Transactions 18: 390-411. 1958.

44. Matson, Arthur James. Improving productivity of South Dakota land resources for upland game birds and waterfowl through adjustments in institutions. Unpublished Ph.D. thesis. Ames, Iowa, Library, Iowa State University. 1965.

45. McNeely, John G., Jr. Statistical estimation of demand for selected recreational activities. Unpublished Ph.D. thesis. Stillwater, Oklahoma, Library, Oklahoma State University. 1967.

46. Mead, Margaret. Outdoor recreation in the context of emerging American cultural values. Outdoor Recreation Resources Review Commission Study Report 22: 1-25. 1962.

47. Michigan, University of. School of Natural Resources. Department of Conservation. Hunting in the United States: its present and future role. Outdoor Recreation Resources Review Commission Study Report 6. 1962.

48. Moorman, Robert B. and Kowalski, Robert E. Improved habitat means better hunting. Iowa Farm Science 21: 466-468. 1966.

49. National Planning Association. Regional projections to 1976. National Planning Association National Economic Projections Series Technical Supplement 8. 1958.

50. Nomsen, Richard. Iowa's late summer pheasant population - 1964. Iowa State Conservation Commission Quarterly Biology Reports 16, No. 3: 39-46. 1964.

51. Nomsen, Richard. Iowa's late summer pheasant population - 1965. Iowa State Conservation Commission Quarterly Biology Reports 17, No. 3: 15-22. 1965.

52. Nomsen, Richard. Iowa's late summer pheasant population - 1966. Iowa State Conservation Commission Quarterly Biology Reports 18, No. 3: 59-65. 1965.

53. Nomsen, Richard. Pheasant nesting success in roadside cover Franklin County, Iowa. Iowa Conservation Commission Quarterly Biology Reports 12, No. 4: 38-39. 1960.

54. Ogg, Wallace E. Recreation and resource development. Farm Policy Forum 18 No. 1: 2-8. 1966.

55. Outdoor Recreation Resources Review Commission. Economic evaluation of outdoor recreation benefits. Outdoor Recreation Resources Review Commission Study Report 24: 49-69. 1962.

56. Outdoor Recreation Resources Review Commission. National recreation survey. Outdoor Recreation Resources Review Commission Study Report 19. 1962.

57. Outdoor Recreation Resources Review Commission. Prospective demand for outdoor recreation. Outdoor Recreation Resources Review Commission Study Report 26. 1962.

58. Robertson, William B., Jr. Investigations of ring-necked pheasants in Illinois. Springfield, Illinois, Illinois Department of Conservation. 1958.

59. Robinson, Warren C. The simple economics of outdoor recreation. Land Economics 43: 71-83. 1967.

60. Saupe, William and Kaldor, Donald. An income-efficient commercial-farm industry in the North Central States. Journal of Farm Economics 48: 578-596. 1966.

61. Sheruerhorn, Richard W. and Starkey, William K. Shooting preserves in Maryland, an economic feasibility study. Maryland Agricultural Experiment Station Miscellaneous Publication 584. 1966.

62. Stokes, Allen W. Population studies of the ring-necked pheasants on Pelee Island, Ontario. Ontario Dept. of Lands and Forests Technical Bulletin, Wildlife Series 4. 1954.

63. Streedby, Larry Lee. Iowa's county conservation board program. Unpublished M.S. thesis. Ames, Iowa, Library, Iowa State University. 1965.

64. Taber, Richard B. and Bolle, Arnold W. Economic aspects of wildlife abundance. North American Wildlife Conference Transactions 27: 255-267. 1962.

65. Timmons, John F. and Fischer, Loyd K. Progress and problems in the soil conservation districts program. Iowa Agricultural Experiment Station Research Bulletin 466. 1959.

66. Trice, Andrew H. and Wood, Samuel E. Measurement of recreation benefits. Land Economics 34: 195-207. 1958.

67. U.S. Agricultural Stabilization and Conservation Service. Iowa Agricultural Conservation Program, 1966. U.S. Department of Agriculture Publication ACP-1966-Iowa. 1966.

68. U.S. Bureau of the Census. 1964 Census of Agriculture. Iowa, Vol. 1, Part 16: 8, 9. 1967.

69. U.S. Bureau of the Census. Illustrative projections of the population of states, 1970 to 1985. U.S. Bureau of the Census Current

Population Reports Series 326: 25. 1965.

70. U.S. Bureau of Sport Fisheries and Wildlife. 1965 national survey of fishing and hunting. U.S. Department of the Interior Resource Publication 27. 1966.

71. U.S. Economic Research Service, Farm income state estimates, 1949-1963. U.S. Department of Agriculture Publication FIS-195 Supplement. 1964.

72. Wagner, Frederick H., Besadny, C. D., and Kabat, Cyril. Population ecology and management of Wisconsin pheasants. Wisconsin Conservation Department Technical Bulletin 34. 1965.

73. Wallace, Robert F. An evaluation of wildlife resources in the State of Washington. Washington State College Bureau of Economic and Business Research Bulletin 28. 1956.

74. Waller, David W. and Errington, Paul L. The bounty system in Iowa. Iowa Academy of Science Proceedings 68: 301-313. 1961.

75. Wiegans, Howard L. and Agee, Phillip C. Can more pheasants be produced. Nebraska Experiment Station Quarterly 9, No. 1: 20, 21, 24. 1962.

76. Wright, Vernon and Otte, Paul. A central Iowa pheasant nesting study, 1961. Iowa Academy of Science Proceedings 69: 252-259. 1962.

77. Wunderlich, Gene. Private costs from public benefit projects - a case study of waterfowl depredations on small grains in North Dakota. Unpublished Ph.D. thesis. Ames, Iowa, Library, Iowa State University. 1951.

ACKNOWLEDGMENTS

APPENDIX

June 1967

TO: Conservation Officers

FROM: Harry M. Harrison, Supt. of Biology & Kenneth Kakac, Supt. of Officers

SUBJECT: Survey of Extent of Leasing of Hunting Rights

Dear Men:

We are cooperating with Iowa State University in a project aimed at providing the economic value of game. As one phase of this we have been requested to provide basic information about hunting areas in your county (counties) which are open only for a fee or on a lease basis. This information will provide a contact list for a survey of the individuals involved to provide one type of estimate of the economic value placed on Iowa game species. Enclosed are 5 copies of the form to be used (use one for each case).

You need not report licensed shooting preserves, since detailed information on these is available. Sales of hunting rights on a daily or yearly basis for pheasants produced under natural conditions are of particular interest.

If more forms are needed, so indicate when the first ones are returned. Please return the completed forms to the Biology Section % Des Moines office.

Sincerely yours,

Harry M. Harrison
Supt. of Biology

Kenneth Kakac
Supt. of Officers

HMH/KK/dh

Questionnaire on Leasing of Hunting Rights

A. Name of Operator (please print)_____

B. Address:_____ County_____

C. Type of Hunting Provided (check those which apply)

    1. Pheasant_____   2. Waterfowl_____

    3. Quail_____   4. Deer_____

    5. Other_____

D. Characteristics of financial arrangement (Check those which apply or insert amount
    if known)

    1. Daily fee _____   2. Per Bird_____

    3. Per deer _____   4. Annual lease_____

    5. Membership_____   6. Others:

E. If on a lease basis:

    1. Name of leasing party (lessee)_____

    2. Address of leasing party _____

F. Habitat improvement in respones to income incentive (check applicable description)

    1. None _____

    2. Slight_____

    3. Significant_____