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#### SIMULATION STUDIES OF QUAIL HUNTING SUCCESS ASSOCIATED WITH ECOLOGICAL SUCCESSION OF PLANTED PINE STANDS

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#### Abstract:

A concept paper of a methodology is presented for explaining past populations and predicting future populations of bobwhite quail (Colinus virginianus), as a function of forest changes. The methodology is applicable to large landholdings, regions, and states. It relates, using computer technology, the number of potential covey flushes per 100 acres per day to the age of forest stands or ecological succession curves. By summing quail flush curves over a large area, area-wide yields may be obtained. Flushes are modified by a shooting-quality factor and birds per covey. The computer-generated output tables provide an inventory, a historical overview, and projected populations. The results are useful for making forestry-wildlife tradeoffs, for explaining quail declines or increases as a result of forestry operations, and for improvements in allocating money to wildlife or forestry. The method is based on a similar system for big-game forage in the Pacific Northwest (2) and is now being developed.

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The primary wildlife management action is decision making (1). Highly effective rational decision making relies upon increasingly sophisticated tools of explanations and prediction. The quality of management of large land areas for wildlife is largely a function of the managers' predictive ability. The probability of being right when a manager of bobwhite quail populations says "If I expend these dollars, I will get these birds" is a measure of managerial skill and knowledge. Similarly, it is a measure of such skill for a manager to say with justified confidence: "Within the next 10 yr, the quail population will have declined 35%?" Such inputs are essential for improved decision making about changing practices or allocating management funds.

One aspect of this general problem is the need to predict bobwhite quail populations over broad areas such as regions, counties, or private landholdings of greater than 10,000 acres. One obvious need for

such prediction is to help bring sportsmen's expectations in line with their satisfactions. Other needs are to aid in formulating management action programs, to provide the basis for interagency policy formulation, and even to provide the basis for an agency's appeal to a court for an injunction against certain land-use practices.

The need for better prediction has become increasingly evident as more areas throughout the southern and southeastern United States have come under intensive use--whether for pulpwood or peanuts. In Virginia alone, 750,000 acres are reported to have been converted to pines. The South's Third Forest (3) documents plans for similar work elsewhere. These changes occur over thousands of acres, annually, in different soil types, having different growth potentials. In addition to the complexity, great size, and economic interest in such systems, they are very dynamic. Prediction in such a system is essential if the bobwhite quail manager is to be any more than a spectator. This paper presents the basis for and the methodology for a solution to a major aspect of this problem. We concentrate on the quail-timber interaction.

Planting pine in the East has become a large-scale business with private timber companies. The upward trend leaves much potential for recreational opportunities. So far, this potential has barely been tapped in terms of offering quality sport for the quail hunter. Many sportsmen think of pine plantations as "biological deserts," when, in reality, certain stages in the development of the latter can provide sufficient food and cover to greatly benefit the bobwhite quail (Colinus virginianus). By understanding which stages in the maturation of pine stands are associated with high populations of quail, the number of potential successful hunting man-days can be determined. Since quail hunting on small farms is rapidly becoming rare due to land consolidation, intensive farming, and posting lands, hunting in young pine stands owned by large timber companies and in public land may become the areas for opportunity of success for the majority of bird hunters. The purpose of this paper is to introduce the rationale for a computer simulations technique for evaluating pine stands for quail hunting quality in terms of past, present, and future potential. Such an evaluation was done for big game forage production in various habitats in Idaho (2). The approach used is a modification of their technique now developed as a computer program.

The first few yr of succession in a planted pine stand usually most important for quail production. The young trees have not completely shaded the ground, and competition for total available nutrients and water is not high. The available food for quail during these years is great. As the stand moves into the 10- to 20-yr-age class, quail food and cover production is curtailed greatly. We assume that potential quail populations are largely a function of cover and food, neither being in limiting supply during the early yr of the stand. Since cover and food production relates directly to the age of the stand, it can further be stated that the potential quail population is a function of the age of the stand. This study deals with the pine stand stages involved in producing quail populations, and not the specific environmental characteristics of each stage.

## Development

A "unit" may be defined as a particular pine stand of a relatively uniform age. Each unit is assumed to have a potentiality for producing quail. A quail population curve exists for each unit and is expressed in the number of covey flushes per 100 acres per day. Such curves are dependent on factors such as pine seedling spacing, method of planting, and site preparation methods. Such factors will vary with the area involved and its location. The greater the research investment, the more precisely the curves can be determined (See Fig. 1). By summing these flush curves, the quail potential of an entire pine plantation with multiple units may be described historically, in the present, and for the future (Fig. 2 and 3). Production of these covey flush curves is accomplished by (A) determining which factors in an area (e.g. spacing) will tend to produce decidedly different curves and defining lands containing these factors as "units," and (B) censusing the different units to produce flush curves that will relate to age. The amount of censusing done will depend on the accuracy needed for the curves and the forest age classes available. In general, if the area is characterized by rapid early, pine seedling growth, then the quail populations will, in turn, rapidly decline. In this case, extensive censusing (e.g. with bird dog along transects) will be done in stands that are from 1 to 4 yr old. If seedling growth is slower, the censusing can be done less frequently and throughout more age classes.

Stands that have reached certain peak age will have their covey flush counts level off from that age until the end of the rotation period. The canopy blocks out the available sunlight and cover, decreasing food production for quail. The covey-flush curve then remains static in a plantation from 15 to 20 yr (approximately) until it is cut. It is generally useless to census quail populations in older stands. In older stands, the flushing curve of a unit could be changed to a flushes-near-edge curve, whereby covey flushes are measured in a zone along the edge of the stand. The width of that zone can be determined by the quail behavior (Fig. 4).

Having identified on an aerial photo a number of units, each having a particular covey flush curve associated with their growth, quail populations can be projected. The data needed for such projections are as follows: (A) acres in the stand, (B) yr stand originated, (C) flush curve that best fits the stand, (D) shooting-quality factor, and (E) covey-quality factor. The first 3 pieces of data are self-explanatory. Numbers 4 and 5 are adjustment factors needed to determine the potential quality of shooting taking place in particular stands.

The shooting quality factor is the time during which a covey may be shot. The time is a function of the cover. The factor could be based on the following: (These will be used as a first approximation).

- |                          |      |
|--------------------------|------|
| 1) 4 sec or over         | 1.00 |
| 2) 1 to 3 sec            | 0.75 |
| 3) No shots can be fired | 0.40 |

The quality factor could also be placed on a "singles found" index:

- |                            |      |
|----------------------------|------|
| 1) 3 or more singles found | 1.00 |
| 2) 1 to 2 singles found    | 0.75 |
| 3) No singles found        | 0.50 |

The above values are subjective ranks. Such values can be used to attempt to balance or better quantify such situations as those in which many birds are sometimes found in extremely dense cover, decreasing the chance of sport greatly. For example, a covey flushed in a stand where 4 sec were available to shoot but only 1 single was found would be equal to  $1.00 \times 0.75 = 0.75$  flushes per acre instead of 1.00. This would indicate that the shooting would not be as good as the flushes per acre indicate.

The second quality factor is dependent on the number of birds in the covey. This factor ranks those areas that can support the most birds per covey, and thus, the most hunting pressure and success. However, such an adjustment factor should be made before the hunting season. As in all cases, this factor could be eliminated when available research time is limited.

The above information, then, will be recorded on a standard form and keypunched. Other information to be recorded for reference purposes is (A) extent of canopy, (B) type of vegetation, (C) type of last disturbance, and (D) food types available. Codes for such data sheets may be taken from the Wildlife Surveys Handbook, FS# 2609.2, Region I, and additional information on coding procedures may be taken from Giles and Snyder (2).

#### Output

From the above data certain valuable output values can be computed. Total flushes per acre can be projected over an entire rotation period in a particular stand. From aerial photos, a flush curve for an entire plantation can be produced by the summation of these particular stand curves as shown in Fig. 3. By using the adjustment factors in the input, the quality of the hunting in an area can be determined in terms of adjusted flushes per acre. This, in turn, will provide information for improved decision making for the wildlife manager.

It should be evident that predicting quail populations in a particular year is not the objective of this concept. However, the general trends of quality-ranked quail activity will be extremely valuable to statewide management planning. In the past, such planning has been the product of human judgment, which is limited and often greatly biased. Using a sophisticated computer model, the planner will have a general working plan from which he can base his activities, compare alternatives, and make better informed decisions and explanations.

An example may provide better understanding of the concept. Weyerhaeuser Corporation has a 40,000-acre tract which it wishes to lease to Virginia sportsmen for bird-hunting rights. Sportsmen want

to know whether the \$5.00 fee charged to them is worth the hunting opportunity now, and they will want to know the same in years to come. The Commission of Game and Inland Fisheries finds out the following about the area:

- 1) 20,000 acres is characterized by 6 x 6 spacing which will be designated as Unit A.
- 2) 20,000 acres is characterized by 8 x 8 spacing which will be designated as Unit B.

The procedure is then as follows:

- 1) The Commission either has or develops quail flush curves for the 2 units.
- 2) By aerial photos, tracts are divided on the 2 units according to year of origin (age).
- 3) The acreage is measured in each age-class tract.
- 4) Samples are taken from each of these tracts to obtain an adjusted flush count per acre to determine the quality of the hunting.
- 5) The data are then processed and a projected overall yearly flush count is printed by the computer for each unit. These flush counts are summed to get an estimate of the future amount of quality-ranked quail activity, plantation wide.

Thus, quail hunting success over huge acreages of land could be predicted well within the limits of confidence and precision needed by managers without them taking actual direct census counts. Past the initial cost of developing flush curves, the economics of this simulation method are minimal based on the amount of information produced. The system is being implemented at Virginia Polytechnic Institute and State University to provide insight into quail management for the future.

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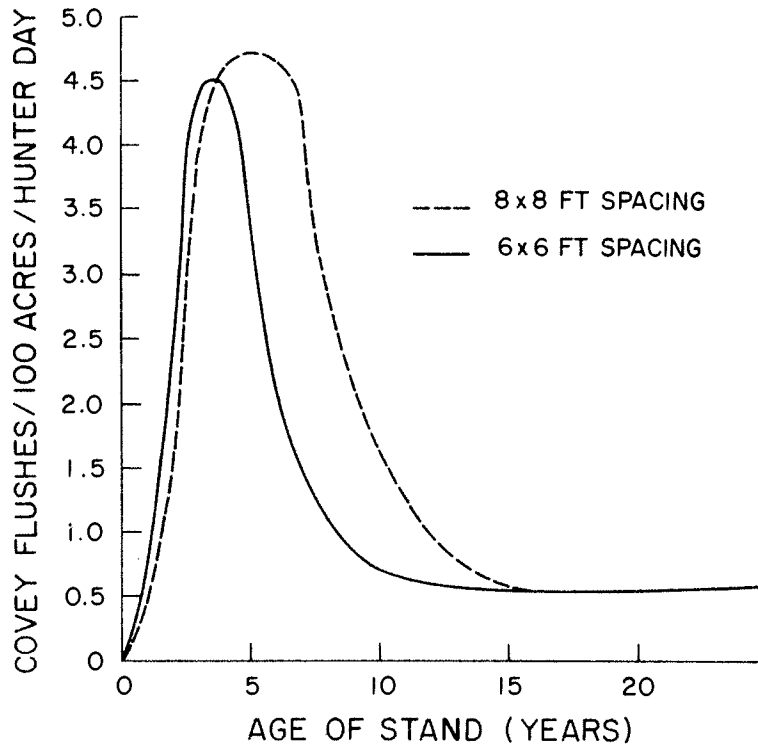


Fig. 1. Generalized effect of plant succession and tree spacing on bobwhite quail covey-flushes within an area.

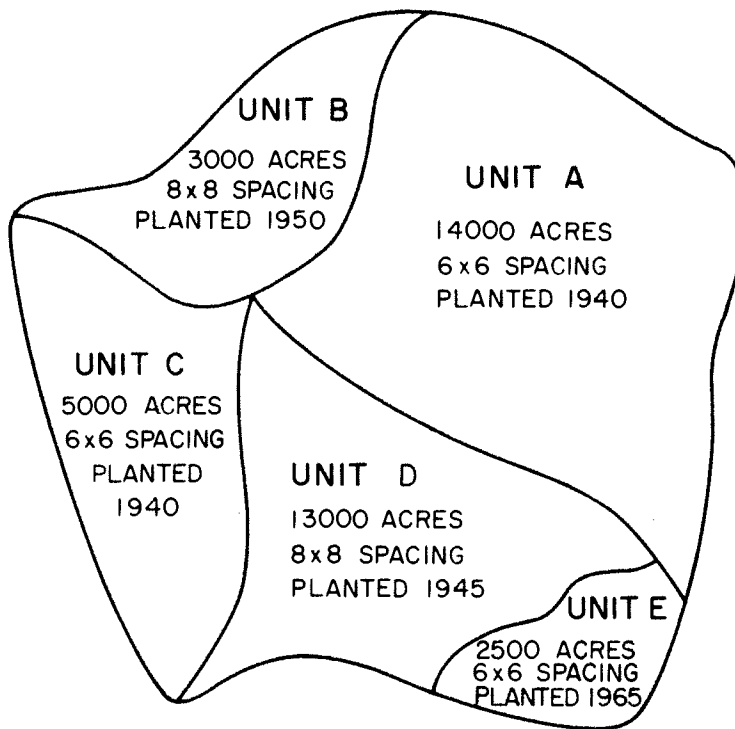


Fig. 2. An area of management, with four units, each with different characteristics, several having different dates of stand origin.

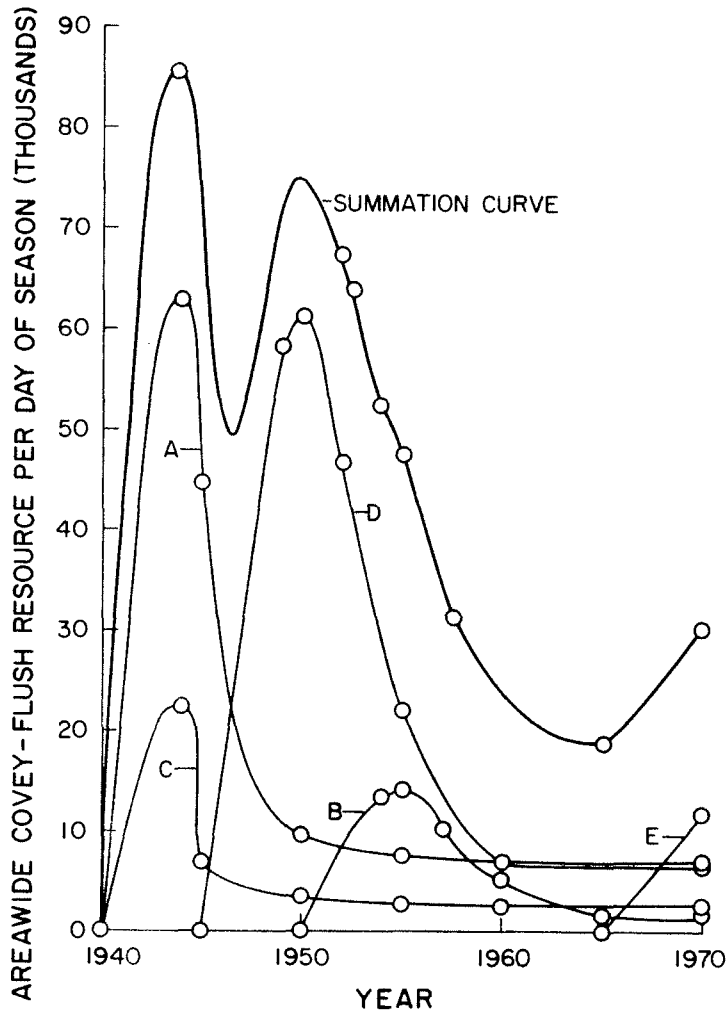


Fig. 3. Covey flush curves for the units shown in Fig. 2, with the summation curve representing the areawide covey-flush potential per day of the hunting season for the area.

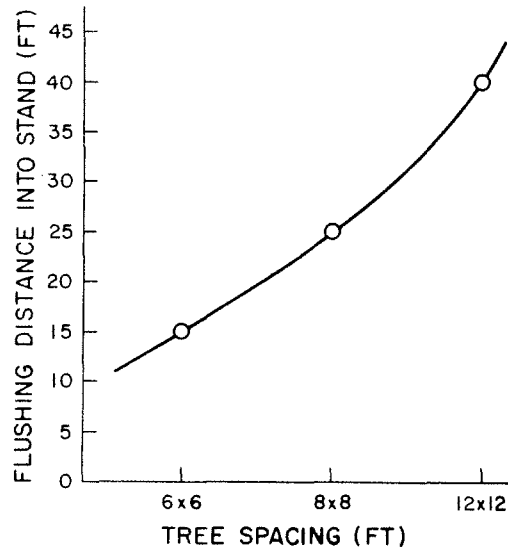


Fig. 4. Hypothetical covey flush counts within pine stands.