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COMPUTER ASSISTED EXTENSION PROGRAM ON GROUND SQUIRREL CONTROL

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ABSTRACT

Computers have become common place in virtually all phases of agriculture. Most individuals have access to microcomputers and the once apparent intimidation about using them is rapidly disappearing. Because of increased availability and public acceptance, it's no surprise that many Extension programs are using computers as an important component of their educational package. Recently, several computer models have been developed to assist Extension personnel and others in demonstrating proper wildlife damage control decision-making. We have developed such a model which is used to: 1) present ground squirrel control information to the grower, 2) take user (grower) input on production, yields, etc. and predict the potential impact squirrels may have on that grower's operation, and 3) present the potential cost effectiveness of the available control options.

KEY WORDS: computer model, control decision-making, cost and benefit, Belding ground squirrel.

Controlling wildlife damage in many agricultural crops requires a complex decision-making process. Among other things, this includes assessing current, future, and potential damage, and understanding the control options, biology of the pest species, and effectiveness of available control strategies. All too often, little emphasis is placed on the short- and long-term benefit/cost of specific control methods.

Computers can greatly assist in the control decision-making process. They allow us to keep up-to-date information on the biology of the animal and available control techniques. Computers let us explore control options by asking "what if" type questions. They also facilitate our ability to demonstrate to growers and others the impact of changing factors such as amount of damage, cost of control, or degree of efficacy for certain methods and materials. The computer can rapidly work through the benefit/cost equation for many control options, giving you up-to-date information. We can't assume the information from the computer is better than if developed manually because it is only as good as we make it. However, the speed, accuracy, availability and organization of the information may be improved tremendously.

Computers are increasingly important tools in extension programs throughout the U.S. (Long and Long 1984). They can assist in both program organization and delivery (Salmon _et al_ 1982). The expanding use of microcomputers for farm management has increased grower reception toward computer-assisted extension programs significantly (Jose 1984). These factors lead us to develop a ground squirrel control decision-making model for the microcomputer.

The Belding ground squirrel (_Spermophilus beldingi_) damaging alfalfa was chosen because this is a major regional problem in California and data on damage and most control materials are available. The objective of the model was to expand the current control decision model, especially in the area of damage prediction and cost/benefit.

PROGRAM DEVELOPMENT

The first step in developing the ground squirrel control decision-making model was to develop it completely on paper. Once the necessary information, data, and equations were put together, the computer program was written. To

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facilitate communication between the programmer and the technical specialists, meetings were held to establish the objectives of the program, as well as some concept about how it should look. It's essential that all parties work together in this process.

We divided the model into 3 separate components, each accessible independently from the other. These include: 1) ground squirrel biology, 2) damage potential caused by ground squirrels, and 3) currently available control options, including benefit/cost information on various control strategies.

STARTUP

If the model is used by clientele, or even extension personnel unfamiliar with computers, the program must be very user friendly (easy to use). We designed ours to take the user step-by-step through the entire model by reading the screen and answering simple "yes or no" type questions. If a wrong answer is given, i.e., "maybe" instead of "yes or no", the computer re-asks the question. This keeps the user on track.

To make the program more meaningful to the individual user, the computer asks for information on field size, average yield, anticipated crop value, and current squirrel infestation level. If the user is unsure or is doing this as a theoretical exercise, appropriate average values are given as the default option. At completion of the startup phase, the computer asks what section the user wants to do next. The 3 options are:

1. Biology
2. Damage
3. Control

Biology

This section deals with general biological information about the animal (Table 1). The model then takes information supplied by the grower on field infestation by squirrels and produces a graph of the future infestation if no control is conducted. Because population dynamics information for the

Table 1. The following biological information is displayed on the screen.

A. Background
1. Taxonomy and nomenclature
   Scientific name: Spermophilus beldingi
   Common names: Belding Ground Squirrel; Belding's Ground Squirrel; Oregon Ground Squirrel
   Subspecies: S.b. beldingi (Alpine meadows of Sierra Nevada)
   S.b. oregonus (Agricultural areas)
2. Description
   Adult weight: 227-340g (8-12 oz.)
   Length (total): 253-300 mm (10-11 3/4 in.)
   (tail) : 55-76 mm (2 1/4-3 in.)
   Color: Gray-brown above, with a broad buff-brown streak down middle of back, pale gray below. Tail buff-brown above, reddish to hazel on sides and below, with a black tip.
3. Geographic range
   Northeastern California, eastern Oregon, northern Nevada, southeastern Idaho, northwestern Utah.
4. Habitat
   Great basin rangeland, pasture, hay and grain crops, particularly in established alfalfa and irrigated pastures.
5. Sign
   Active during daylight, often seen in standing positions. Open burrows, mounds and occasionally runways. A chirp or several-noted whistle often heard.
6. Legal status
   Classified as a non-game mammal in the California Fish and Game Code. May be controlled when damaging or threatening to damage crops.

Table 1 (continued)

Biology

B. Life Cycle - Much of this information was obtained at a study plot near Alturas, California (1982-83). Dates of various occurrences can vary with location and also from year-to-year.

1. Emergence from hibernation: Mid-February (late January to early March). Emergence of males proceeds emergence of the females by 1-2 weeks.
2. Mating: Early March (late February to Mid-March).
3. Gestation period: 21-23 days.
4. Juveniles born: Late March (Mid-March to early April).
5. Lactation period: 25-28 days. The juveniles remain below ground during this time.
6. Juvenile emergence: Late April (Mid-April to early May).
7. Enter estivation (Summer hibernation): June through September. Adult males enter first, followed by females, and finally juveniles.

C. Fecundity

Annual breeder in early spring with embryo counts averaging 8-10 per female. The mean number of juveniles weaned per female varies from 3-8.

D. Longevity

Males: 3-4 (to 6) years
Females: 4-6 (to 11) years
However, most young squirrels do not survive to adulthood.

E. Mortality

Variable, with over-winter mortality accounting for the greatest losses in uncontrolled populations. In our studies, over 40% of the squirrels died during the winter.

F. Feeding habits

Basically herbivorous, feeding primarily on the green vegetation of grasses and forbs. S. beldingi tends to be less granivorous than other Spermophilus species. Cultivated alfalfa provides an ideal food source. Some animal matter, including insects and carrion, is reportedly consumed, however, this is of minor importance.

Belding ground squirrel is limited, we use a generic model developed for a similar species, the California ground squirrel (S. beecheyi). The main point is to demonstrate to growers the potential problem of letting a rodent pest remain in a suitable habitat, i.e., alfalfa, without control. We also model population responses to certain levels of control. For example, a graph of the population recovery from 90% mortality demonstrates to growers the ability of this species to recover (Fig. 1).

Damage

In this section we present general information about ground squirrel damage to alfalfa. We use published data to develop an equation showing damage caused by each squirrel. We then assign a population density according to the growers estimate of squirrel infestation to project damage to this year's alfalfa crop (Fig. 2,3).

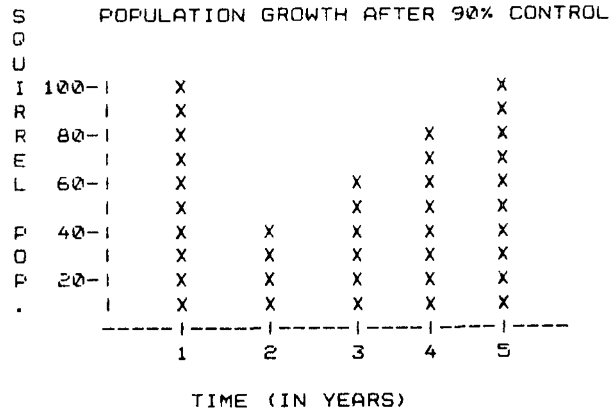
Control

This section presents the control options available to growers in this region for Belding ground squirrel control. General information on the control material, as well as relevant information on timing, effects of weather, and anticipated efficacy are presented. We also allow the grower to alter anticipated efficacy so he can make the information relevant to his own experiences. For example, we assume gas cartridges are 85% effective

Population Growth

In agricultural crops, Belding ground squirrel populations can grow rapidly. Even with control programs, the populations can reinfest a field in a surprisingly short period of time. Because of this, it is important to understand how rapidly squirrel populations grow and what impacts control programs can have on them.

The estimated population regrowth after a 90% reduction (based on data from S. beecheyi).



Note: Despite 90% control, population recovers by birth and immigration so by the end of the first year, the squirrels have already recovered to 45%.

Fig. 1. Screen showing population growth.

Research by biologists from the California Department of Food and Agriculture demonstrated a 64.7% reduction in alfalfa yield caused by 123 squirrels per acre in just 44 days (up to first cutting). This represents per squirrel damage of 0.5% of the alfalfa in 1 acre. Thus, the damage rate(r) can be estimated as 0.5 and the following graph can be drawn.

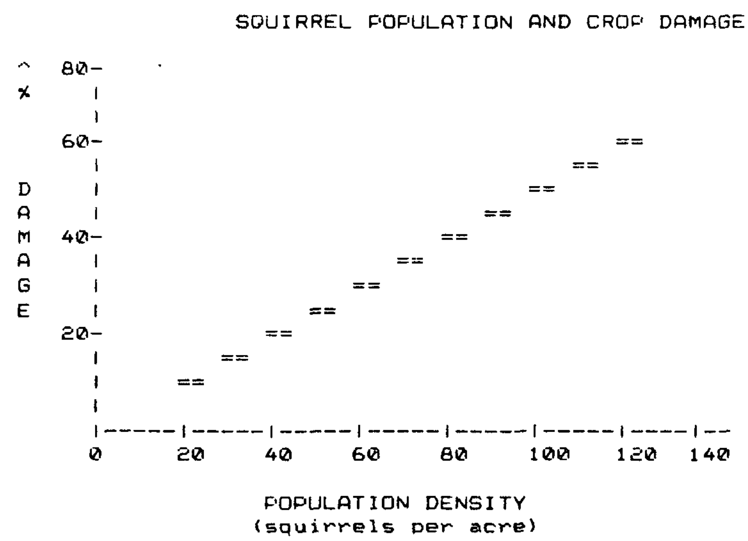


Fig. 2. Screen showing squirrel population and crop damage.

ESTIMATING DAMAGE ON YOUR PROPERTY

To estimate the damage on your property, we have assigned ground squirrel population densities according to the level you indicated. We then used the previous formula to estimate the percent yield reduction and dollar loss for the area infested by ground squirrels and also for the entire field.

The following damage figures indicate the estimated damage caused by ground squirrels to your crop between initiation of plant growth and the first cutting. We assume most ground squirrel damage subsides after the 1st cutting since many of the squirrels become inactive. However, accurate assessment of damage at this time in crop development is not available.

Number of acres: _____

Potential yield/AC: _____

Estimated Value/AC (in tons): _____

Percent of field infested
at beginning of season: _____

Density of squirrels:

high=50, medium=30, low=5 (squirrels/AC): _____

Estimated loss at infested site: _____

Estimated tonnage loss/AC at
infested site: _____

Tonnage loss/AC in entire field: _____

Estimated dollar loss/AC: _____

Total dollar loss: _____

Fig. 3. Screen showing damage estimate.

in controlling Belding ground squirrels. The grower may have used them and found cartridges less (or more) effective. If we force him to use 85%, he immediately rejects the outcome of the model because it is not valid, at least in his case. By allowing alteration of anticipated efficacy, we make the model more meaningful to each user.

In this section, we also develop information on the benefits and costs of various control options. This information is then applied to the specific case to determine the net result (economically) of the options available (Fig. 4).

USE OF THE MODEL

The primary use of the model is as an educational technique. The first aim is to demonstrate damage and potential damage and, therefore, establish the need for control. The second aim is to use solid information to systematically evaluate control options. We recognize that biological events are somewhat unpredictable. The model only demonstrates our best information about what might happen with a ground squirrel population in an alfalfa field. We stress that the model is an educational program and is not intended to predict the actual dollars saved if certain control options are selected.

We are also limited by this model because it looks mainly at current populations and immediate damage. Unfortuately, we have little data on population growth over time for Belding ground squirrels so we are generally

CONTROL STRATEGIES

By combining information on control costs, their effectiveness and the estimates of damage related to given densities of ground squirrels, we can get a picture of the costs and benefits of various strategies. The following uses the information you supplied to calculate costs and benefits of various control strategies for your alfalfa field.

Total Acres _____

Acres Infested _____

Control Strategies for your field

strategy *	treatment cost	total tons saved	total dollars saved
1080	$______ /AC	_____ tons	$_______
STR	$______ /AC	_____ tons	$_______
G C	$______ /AC	_____ tons	$_______
1080 + G C	$______ /AC	_____ tons	$_______
STR + G C	$______ /AC	_____ tons	$_______

*1080 = Compound 1080

STR = Strychnine

G C = Gas cartridges

Fig. 4. Screen showing costs and benefits of various control strategies.

unable to predict the impact of our control programs in future years. This is a necessary area for future development since it will assist the decision-maker in looking at the best long-term solutions to the squirrel problem.

EVALUATION OF THE MODEL

Before the decision-making model is implemented on a wide-scale, an evaluation program should be developed. In our case, base-line information on the general ground squirrel situation and current control techniques needs to be established. Once the model is implemented , the two major areas that need evaluation are: 1) acceptance of the model by users, and 2) improvement in ground squirrel control in the area. Each of these is an important component of the model's evaluation. Obviously, if the model isn't accepted, it will have little impact on ground squirrel control in the region. However, complete acceptance has little meaning if ground squirrel control programs don't improve, or if damage isn't reduced, by the decision-making model.

BENEFITS OF THE DECISION-MAKING MODEL

The computer ground squirrel decision-making model allows us to present complete and more up-to-date information about ground squirrels and their control. It can lead to increased involvement in wildlife damage control by extension and other agency personnel, and the growers. The use of microcomputers has a certain degree of novelty and often people want to work on them because they are new and exciting. We need not shy away from such excitement since we can use it to our advantage to expand our often understaffed programs.

One of the most beneficial aspects of the decision-making model is it gets people thinking ahead. It helps take the decision-maker out of the reactionary mode-dealing with an immediate wildlife problem and into a mode of looking at "what if" situations and planning ahead to develop cost effective control strategies. As a final benefit, decision-making models help us develop more complete control programs. If developed properly, they will also sharpen our recommendations and make them more responsive to changing economic situations.

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