October 1981

Computers and Vertebrate Pest Control

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ABSTRACT: Computers are affordable and usable by most individuals involved in vertebrate pest control. Their value as a research tool for vertebrate pest population modeling has been proposed; however, few, if any, are being used for field operations. Despite their ecological limitations, simulating models have been developed that are useful in wildlife management, including wildlife pest problems. Improvement of these or similar models could answer questions such as population effects from a control program, proper timing of control, and the impact of control on nontarget species. Vertebrate pest control information can also be stored, retrieved and disseminated via the computer. The primary advantages of electronic storage are information accessibility, the minimal physical storage space required, and the ability for continuous updating to keep information current. Finally, the value of the computer as an aid in the vertebrate pest control decision-making process is discussed.

There is no magic involved with a computer. Basically, it conducts tedious and oftentimes repetitious data manipulations at high speeds with little effort by the computer operator. It can also store large amounts of information for future retrieval. The noncomputer individual can think of a computer as an efficient and usually obedient assistant.

In the past, computers were large, expensive, and sophisticated, requiring highly-trained personnel for programming and operation. Their use was generally limited to large businesses, government agencies, and research institutions. In recent years, computer technology and use has advanced rapidly. The costs of computer hardware, the actual machines that process and output data, have decreased drastically, resulting in a greater availability of these machines to the computing public. There has been a tremendous expansion in the available software that guides the computer in its various tasks. With this software, inexperienced individuals can operate highly-sophisticated computers and carry out functions and tasks previously requiring the services of a computer programming specialist. For example, computer programs for most statistical tests are readily available and usable on most computer systems. In addition, many programs are interactive so an untrained individual can follow instructions given by the computer and obtain the desired results. As an illustration, an interactive program dealing with vertebrate pest control materials could run by typing a simple statement such as "control materials". The computer would then guide the operator through the program to obtain the information desired.

Mini-computers are small, self-contained units, often no larger than a small television. They are well accepted by small businesses, as well as homeowners and other individuals. In agriculture, the use of mini-computers is expanding in areas such as basic farm management, cost accounting, and analysis of production. Accounting, billing, and inventory can all be efficiently handled on mini-computers, making them quite useful for vertebrate pest control businesses (Anonymous 1981).
The central question is: Are computers useful for vertebrate pest control? Some specific nonbusiness uses have been proposed (Giles 1979); but, in general, three main areas appear promising for development in the field of vertebrate pest control. These are: 1) using computers as research tools for improving vertebrate pest control programs; 2) using computers as information storage and retrieval systems; and 3) using computers to assist in vertebrate pest control decision making.

RESEARCH

Computers are useful in organizing data and conducting large numbers of complex operations; these are requirements for modeling the dynamics of a vertebrate population. If the population can be modeled accurately, it can be used as a basis for control decision making. For example, questions such as when control is necessary or whether it will be effective, or a prediction of the response of the pest population to control, could be evaluated.

Simulation models are developed to mimic population changes. For example, a simulation model for a ground squirrel population should supply information on the number of squirrels present at any season of the year, the reproductive success as determined by various biological factors such as population density, environmental conditions, and any changes in these parameters resulting from changes in population density resulting from a control program. All models contain simplifications and good models only contain details of the modeled system that are understood (Stenseth 1977). The usefulness of mathematical models in ecology is controversial (Skellam 1972); however, they have proven useful in developing management programs for several wildlife populations (Walters et al. 1975, Medin and Anderson 1975, Williams 1981). These models dealt with exploited (harvested) populations and the authors felt they were useful tools for the management decision-making process. While management goals of a harvested wildlife population are usually opposite those of a wildlife damage control program, simulation models should work equally well in either case. Even if these models cannot determine the exact effect of a control program on a vertebrate population, we should be able to learn from the wildlife management simulation models to determine maximum sustainable yield. If nothing else, we want to design control programs to achieve the minimum sustainable yield, recognizing that eradication is not the objective of most damage control programs.

There are two general types of simulation models, theoretical and empirical (Weigert 1975). Theoretical models attempt to provide insight into the organization and operation of the modeled system. They are used extensively by ecologists to contribute to ecological theory. Empirical models, on the other hand, are developed with no pretense of explaining the operation of a biological system. At best, they faithfully reproduce the behavior of the system modeled. Since they are developed directly from data representing known behavior of a system, they are confined to that data set. Their purpose is to predict the effects of perturbations applied to the system. Because the reality or the universal truth of the model is not an issue, the validation procedure is simply one of establishing the degree of accuracy with which the model predicts the system's behavior. In this sense, one cannot really validate an empirical model but only accept or reject its range of error in predictive ability.
Computer simulation models have been developed to answer questions regarding the impact of control on a coyote population (Connolly 1978, Connolly and Longhurst 1975), and a simple population model has been found to be useful in formulating control program decisions for voles (Spitz 1978). The impact resulting from a control program on nontarget species can also be studied with the aid of simulation models. For example, Powell (1979) investigated the effect of increased fisher mortality on their prey and concluded that controlling fishers would have a measurable influence on their prey. We have constructed an empirical simulation model for the California ground squirrel (Spermophilus beecheyi) based on published demographic data. However, it suffers from data gaps which exist in the literature, necessitating further field studies to fill these gaps and to establish a baseline for developing and improving the model. It is quite evident from this work that a theoretical model, while necessary and desirable for basic ecological research, is not practical for developing improved vertebrate pest control programs.

In cases like the California ground squirrel where little information is available, collection of basic demographic data can be very time consuming and expensive and, therefore, may not be practical (Geier and Clark 1976). While empirical models will not explain how a population responds to various environmental conditions, they will be useful for predicting population changes resulting from control programs. Fortunately, vertebrate pest control specialists have extensive experience in population manipulation and this improves their ability to develop empirical models. They have an advantage over other researchers because they have manipulated hundreds of populations of a given species and, therefore, they have an intuitive feeling for the results of an empirical model. For example, a survey of individuals involved in ground squirrel control in California indicated a 90% control program would lead to 3-4 years of control before the population had recovered to its original state. This is a crude verification of our California ground squirrel model since it mimics this phenomenon quite well.

The ground squirrel population model is designed to improve control programs. The model simulates ground squirrel population dynamics, making it possible to enter various control regimes and determine their anticipated effect. For example, the model can be used to determine the expected effect of controlling squirrels every other year, every four years, or with some other combination of control schedules. While it would be unwise to conduct operational control programs solely on the outcome of simulations, the results could be useful in revealing potentially promising control programs. For example, 10 to 20 years of control at various rates and under various control regimes is accomplished through computer simulation in a matter of minutes. Researchers can conduct many simulated control programs to determine which ones appear most efficacious, economical, etc. Evaluation of these, coupled with researchers' intuitive abilities, can guide selection of the final control program(s) to be field tested.

Population simulation models can also investigate the timing of a control program. For example, the question of controlling before or after reproduction is frequently asked. In the case of the California ground squirrel, control before reproduction is more difficult, time consuming, and expensive than is control after the young emerge. We know the biological advantages of controlling before reproduction, and the computer can help answer the cost/benefit question regarding timing of control.
Another objective of the ground squirrel model is to incorporate population dynamics and control timing into a complete decision-making model. This will be discussed later in this paper.

INFORMATION STORAGE AND RETRIEVAL

Vertebrate pest control information storage and retrieval is a simple but nonetheless powerful function of the computer. Data storage and retrieval is simply an electronic filing system and does not require sophisticated numerical processing. Both numerical and textual data can be stored indefinitely, updated when necessary, and retrieved rapidly on a screen or as printed copy. Various methods of storage include magnetic tapes, magnetic disks, and storage units within the computer. The computer actually performs no functions on stored data other than formatting the output. Storage, particularly of textual data, is no different than storing papers and books in your office, except it requires little or no room. This allows information to be available to individuals who do not have space to store large amounts of information in a readily-available location. Another advantage is the ease of updating or changing the information. This is a tremendous advantage over books or handouts since they become outdated rapidly. With the computer, information can be updated continuously so accurate and current information is always available to farm advisors, pest control operators, growers and other interested individuals.

Electronic storage also improves dissemination of information. The California Cooperative Extension Service maintains a computer system based in selected counties and this will be expanded to include all counties in the near future. This system will allow Farm Advisors to access the computer for the latest information on various aspects of vertebrate pest control. When a new product is registered or a regulation specific to vertebrate pest control is enacted or changed, this information can be disseminated to all county offices immediately. Without a computer system, dissemination of important information must be accomplished by telephone, newsletter, leaflet, or letter.

With electronically-stored information, it is easy to develop interactive programs, making information accessible to those unfamiliar with basic computer operations. As a hypothetical example, an individual desiring information on vertebrate pest control types "vertebrate pest control" on the computer terminal. The computer responds with a series of questions. For example, what animal are you interested in? It could even provide a list of possible animals to choose from. The computer might then ask if control information is desired for the species selected? If yes, it would list a basic control program or other information important for control. It may then list specific control materials and supply sources, including registered pesticides, appropriate for the specific situation.

VERTEBRATE PEST CONTROL DECISION MAKING

The ultimate use of computers in vertebrate pest control would be to develop and/or assist control decision-making processes. There are many aspects of decision making, some of which can be quantified and others which are too subjective for quantitative analysis (Batcheler and Bell 1974). For those that can be quantified, e.g., cost/benefit determination, the computer can be quite successful in conducting computations as well as illuminating areas for further consideration.
The development of integrated pest management (IPM) programs has increased interest in cost/benefit determinations for pest control. Cost/benefit is extremely important to agricultural producers and is the foundation of a decision-making model. Unfortunately, the economics of vertebrate pest control are not well defined; however, there is little question that the benefits of most control programs greatly exceed their costs. The economic injury level, the level of a pest population causing sufficient injury to allow cost-effective control, has not been determined for most vertebrates. But, when it is, collating this with population prediction models will be important in determining the overall cost/benefit of a control program.

In the area of simulation modeling for pest control decision making, insect models appear to lead the field. A number of models have been developed that incorporate population models with current climatological and biological information (Haynes and Tummala 1975). They predict population fluctuations and determine economic injury and threshold levels, thus allowing on-line assistance in control decision making. Similar programs in vertebrate pest control are only in their infancy.

Another area where computers can assist in the decision-making process is in integrating vertebrate pest control with other farm-management operations. In many cases, vertebrate pest control is relegated to times when little or no other work commitments are pressing. This frequently leads to control programs that are ill-timed and understaffed. By incorporating the vertebrate pest control program into overall farm management, scheduling can be improved and the importance of the control program, particularly the need for control at a specific time, can be emphasized to management personnel.

Finally, a computer can be an extremely useful tool in guiding an individual through an existing vertebrate pest control program. Basically, the type of models developed for house mouse control (Timm 1980) and ground squirrel control (Salmon 1981) are simple examples of a pest control flow chart or decision-making model. These can easily be developed into an interactive computer program to be combined with other information such as cost/benefit and population dynamics. Information retrieval can also be added. The end result would be an overall vertebrate pest control decision-making model.

We now turn back to the original question: Are computers useful to vertebrate pest control? We believe they are, especially in the following areas:

1. As research tools for developing new and improved vertebrate pest control programs.
2. As information storage and retrieval systems.
3. As an aid to vertebrate pest control decision making.

Computers are affordable and usable by most individuals involved in vertebrate pest control. They, alone, are not going to solve vertebrate pest control problems. Computers can be of great assistance to vertebrate pest control specialists in helping develop and refine control programs and assist in control decision making.

LITERATURE CITED


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