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Piggery Perspectives on Wildlife Management and Research

David Fraser
Ontario Ministry of Natural Resources

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Three years ago I reluctantly ended my research on moose (*Alces alces*) and began studies of domestic pigs on an experimental farm. Agricultural research is a tame occupation compared to wildlife research, but the change gave me an opportunity to design experiments instead of stumbling upon them, to use standard statistical tests without blushing at the violations of assumptions, and to control confounding variables instead of wishing they would go away. As an unexpected benefit, I have found that the husbandry of domestic animals provides some valuable perspectives on the management of animal populations in general. This paper describes some lessons from the piggery which, I hope, may encourage wildlife managers and researchers to discuss and question some of their assumptions and strategies.

TECHNIQUES, SYSTEMS, AND THE MISSING MIDDLE

The difference between management techniques and management systems is a fundamental point. I would define a technique as a way of accomplishing a specific task, such as estimating the size of an animal population, reducing an annual harvest, or determining if a sow is pregnant. A system involves techniques, combined coherently to produce a product or benefit, such as a sustained annual harvest, a stable ecosystem, or a productive sow herd.

The distinction between techniques and systems highlights a major difference between wildlife and domestic pig management. Wildlife biologists appear to be preoccupied with techniques (field techniques, statistical procedures, actions to alter harvest rates), and management-oriented research is devoted to making these techniques more effective. Pig farmers welcome technical improvements, but their main concern is to combine techniques into effective systems.

A sound management system should consist of a beginning, a middle, and an end. The beginning involves collection of data on such variables as the number of piglets born per litter or the size of a hunted population. The end consists of the management actions taken, such as culling unproductive sows or shortening seasons in an over-hunted area. The middle of the system is the criteria for invoking or changing the management actions: the logic that ties data collection and management action together. On the farm, the criteria for action consist of the farmer's rules of thumb, and these are normally quite evident and explicit. For example, a producer may cull any sow that has 2 small litters in a row, or he may add straw to the pens if the ambient temperature falls below a certain level. In wildlife management, however, this middle component of the system is often absent or not apparent.

Many wildlife management agencies collect population data and regulate harvests without explicit criteria on how the data will lead to changes in the hunting quota or season. The biologists may acknowledge

that harvests should be curtailed if populations decline substantially; but when the data show a decline, they have to fight an uphill battle to justify any action. Is the apparent decline due merely to sampling error or to a fault in the design of the survey? Will a reduction in harvest really have a positive effect? With this kind of post hoc debating, time can be lost and a situation can deteriorate before action is taken.

Part of the problem in such cases is that the management system has no middle. Wildlife managers should have an explicit rule of thumb saying, for example, that the harvest will be curtailed according to a certain formula when the data show a defined change. Furthermore, the rule of thumb should be proposed, debated, and accepted before the management system is initiated. Thus, misgivings about the techniques should be recognized while the data collection is being planned, rather than after it has been in use for several years. Once the data show that the criteria have been met, management actions should be essentially automatic. Political pressure might still derail the process, but at least the onus is on the opponents to justify why an accepted system should no longer be followed, not on the wildlife manager to justify a change in the status quo.

THE SYSTEM DETERMINES THE DATA COLLECTION

A pig farmer does not collect information simply to understand his herd, but because the data are required by his system. If he culls sows based on litter size, then he must record litter size; if he adds straw based on ambient temperature, then he must measure ambient temperature. The rules of thumb dictate what data are to be collected.

Lacking clear rules of thumb, data collection is likely to be undisciplined and of little value. Many wildlife agencies collect information on population size and on the age-sex composition of harvested animals. After the information has been accumulating for a number of years, it may be integrated and interpreted. At this point, one finds that the data do not fit the assumptions of any available method of analysis, that unexpected biases have arisen, and that occasional "improvements" in the techniques have destroyed the continuity of the data. Data rarely can be used for a particular purpose unless collected with that purpose clearly in mind. The middle of the management system gives data collection its purpose.

DECIDING THE PRODUCT HELPS TO DECIDE THE SYSTEM

Not all pig breeders produce the same product. Some produce pigs for slaughter, some produce weaners to be fattened elsewhere, and some produce quality breeding stock for sale to other farms. In all cases, the choice of a management system requires a clear decision on the nature of the product.

Much the same is true with wildlife. The goal of a management system might be to produce a maximum sustainable cropping, a certain quality of hunting and viewing opportunities, or a population that will not damage forests and crops. Different goals dictate different management systems.

For typical ungulate populations, maximum sustained yield (MSY) is achieved at a population size well below the maximum carrying capacity of the habitat (Caughley 1976, McCullough 1979). Hence, management for MSY and for maximum carrying capacity--common goals of many wildlife programs—are incompatible. Furthermore, the different goals necessitate different forms of data collection. When attempting to keep a population near maximum carrying capacity, indicators of habitat condition are likely to be the most relevant data. The harvest may represent only a small portion of the total mortality in most years. Therefore, age data from the harvest are not likely to be representative of total mortality nor, because of the usual biases, of the living population. With MSY management, the harvest should represent a larger fraction of total mortality, and harvest age data (from a jaw collection, for example) may make a good approximation of all removals from the population (McCullough 1979).

ON NOT GOING WHOLE HOG

Pig farmers manage at different levels of intensity. Some use highly intensive systems which involve collecting data on ≥20 variables and exercising elaborate controls over feeding, breeding, and the environment. Others simply keep pigs in fenced fields with a minimum of interference. Intensive systems are more likely to produce large profits, but can also result in spectacular bankruptcies.

In establishing a management system, an important first step is to decide on a level of intensity of management that is appropriate to the product, the staff, and the budget. If funding is scarce, the system might involve no more than curtailing harvest in response to an indicator of population trend. With additional funding one may be able to maintain a desired herd structure through selective harvest, or to use a winter feeding program geared to an indicator of winter severity. I suspect that for wildlife as well as livestock, a simple system used well will generally be more satisfactory than an elaborate system that strains the limits of the staff and resources.

In some cases, wildlife agencies may find it worthwhile to operate a high-intensity system in 1 area and a distinctly different, low-cost alternative in another. This should allow staff and resources to be concentrated where they are needed most, and the greater success (one hopes) of the intensive system might help to convince the public that investment in wildlife management is of value.

THE GREAT ASSUMPTION

I have often wondered why wildlife biologists have such a remarkable capacity to collect data. Evidently there is a widespread belief that data collection eventually will lead to some good result. This belief, I suggest, stems from the "Great Assumption" of wildlife biology. According to the Great Assumption, wild populations can be managed intelligently given sufficient data. With this in mind, biologists compile information on population size, age structure, reproduction, habitat, and other variables in order to learn how the population responds to the various relevancies and, thus, manage it appropriately.

The first and obvious problem with the Great Assumption is the cost and complexity of applying it to wild populations. With heroic effort, an agency may be able to monitor population size, harvest rate, age-sex ratios, poaching losses, and relevant weather conditions. But what of predation, disease, habitat quality, abundance of competing species, and other factors? Apart from populations involved in special research projects, I doubt that many agencies could collect enough information to really understand the dynamics of most natural populations.

In cases where the Great Assumption is unworkable in practice, it is probably even worse in theory. McCullough's (1979) painstaking study illustrates the complex population dynamics that occur in a small, fenced deer herd with no immigration or dispersal, no predation, and relatively constant climate and habitat. Regrettably, many populations have to contend with such sources of variability as well as second- and third-order interactions among such factors. I would venture that most attempts at comprehensive understanding and prediction of population change are doomed to fail for reasons inherent in complex, multivariate systems, not for lack of resources to collect the necessary data.

For some areas, a third difficulty arises. Fundamental to the Great Assumption is the concept that an animal population is an entity with a discernible size, recruitment rate, and mortality rate. But how often is this tenable? Most geographic units, unless narrowly defined, are likely to contain several subpopulations, each with different rates of recruitment and loss as dictated by local variation in hunting pressure or habitat quality. These subpopulations may be subject to different biases in the data collection. For example, a harvest collection, used as an indication of age structure, will likely be dominated by the heavily hunted segments whose age ratios will not be representative of other segments. If one tries to

combine various sources of data using average values calculated as though a single population is present, one is likely to have a nonsensical combination of attributes, not representative of any of the segments, and not suitable for conventional population analysis.

In short, I suggest that the kind of data collected by wildlife managers usually will not yield a useful degree of understanding of the dynamics of a population. To be most worthwhile, data collection should be designed to serve a specific function-namely, to act as input for rules of thumb that give satisfactory results over the range of variation likely to be encountered.

A ROLE FOR RESEARCH

For research workers in both wildlife and livestock, the easy path is to study biology rather than management. As a result, pig research has aided specific tasks, such as formulating feeds and developing new genetic stocks; but management systems generally have been developed by farmers, not researchers. This approach has worked reasonably well, although there is a recognized need for management-level experiments on livestock. However, wild populations can be expected to show much greater variation and more complicated population dynamics. Consequently, effective rules of thumb for wildlife management will have to be more complex than those used in agriculture, and their range of applicability will have to be carefully defined. Under these conditions, research will be essential to develop and test workable management systems.

Management-system research would require a considerable change in attitude among researchers. Research would have to stop being an independent activity dealing with specific techniques and the basic biology of the managed species, and become an integral part of the management program. Such a change also would require a change of attitude for some managers. Macnab (1983) pointed out that wildlife management schemes are often presented to the public as " ... revealed truth resting upon a foundation of sound scientific principles." Wildlife agencies may find it difficult to acknowledge that the use of scientifically tested management systems is really in its infancy, and that management experiments will be badly needed for many years to come.

CODA

I am not, of course, entirely serious in advocating pig farming as a model for wildlife management. A pig farmer has many advantages, including the freedom to turn disgruntled constituents into pork chops. Also, many livestock management techniques are relatively simple and well established, thus allowing the farmer to take his techniques for granted and to concentrate on integrating the information to produce effective action. With the greater difficulties inherent in working with wildlife, a preoccupation with techniques was probably appropriate and inevitable for a time. That time, I suggest, is now past.

Instead, wildlife managers and researchers should direct efforts toward developing and testing rules of thumb to link data collections and management actions. Wherever possible, systems that stem from these rules should be stated explicitly as the plan of action at the beginning of a management exercise, not invoked after a problem has already arisen; systems also should be subjected to careful empirical testing. Finally, the level of intensity of management needs more attention as biologists work to develop systems that will give satisfactory results with limited resources and incomplete understanding.

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