# WILDLIFE LAW ENFORCEMENT RESEARCH — THE CONTEXT AND THE NEEDS *

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It has been said that there is no task more useful than restating the essential platitudes in fresh words. We take on the task in this paper and the additional labor of formulating several concepts of wildlife law enforcement, fearful that they too may become platitudes. Thus we do not apologize for what you may find here that you know already; we would be disappointed if it were not consistent with your experience. We do apologize, however, for the stress you may experience from the ideas presented. These are the ideas we think must be assimilated soon by wildlife law enforcement groups. Changes will be required; revisions will occur which can only be to the consternation of those wed to old-line, orthodox wildlife management. We seek no grief for anyone, yet we risk that which may be caused by our presentation. We assert that the grief from not changing will be greater than that from the changes we suggest.

Do not be too easily put off by our "over-statements." We are completely convinced that we sit on the brink of an environmental crisis, the likes of which man has never seen. That crisis is rooted in human population growth. You have heard of it; many of you "believe" it. We are concerned that the concept has not been translated into wildlife agency action. (Certainly we admit to some tardiness.) The point we wish to make is that when one lives on the brink of a catastrophy, he does not count many squirrel nests or allocate much precious time to supervising a hunt for a sheep-killing bear. The point cannot be made very effectively because there is always the tendency to argue ". . . well, but . . .?" We are aware of the arguments; our concern is that when the prospects for the quality of the "long-run" look so bad, when the future appears already to have been spoiled by the present, then any-thing other than drastic action and sharply allocated time seems very irrational. Continuance of past policies does not seem in the best interest of the public. Not engaging in what some would call "conceptually revolutionary action" seems wasteful and unwise use of the superior talents and capabilities now available in the wildlife resource agencies. It seems unwise to bet on a technological long-shot to get us out of "this mess." Toffler's (1970) *Future Shock* and Dubos' (1970) *Reason Awake* discourage hope for such a solution. Either to drop out or to actively work to resolve the crisis seems most rational. We are for the latter.

Wildlife law enforcement is many things to many people. What it is and has been is inadequate for the future. By attempting to see it wholistically, we think we can discern ways for it to achieve its potential.

Wildlife management is the science and art of making decisions and taking actions to change the structure, dynamics, and interactions of habitats, wild animal populations, and men to achieve specific human goals by means of the wildlife resource. If this definition is accepted, then wildlife laws are a major tool or force in managing wildlife. ("Laws" are used herein for laws, ordinances, and regulations.) Laws can increase or reduce demand for the resource, increase or decrease benefits derived from hunting or fishing, increase or decrease the costs to resource users, reduce or increase interpersonal or social stresses associated with resource use, and even effect future action of resource users. Laws can enable populations to increase, stabilize, or decrease. They can produce large fluctuations in populations, often associated with great "success" or very vocal public denouncements. They can result in range overuse or wasteful failures fully to exploit available supplies of forage. With the exception of burning and pollution laws, which are sometimes the responsibility of the warden, conservation officer, etc. (herein after called "the agent") most wildlife laws are associated with the user or consumer. What has not been fully appreciated in the development of the law is the three-way interaction—man, management, law development, and enforcement system is operating at management; effects of a bad fawning year can be overcome by a low population. Thus there is no *one* aspect of wildlife management. All are interdependent. Wildlife laws and their enforcement (for the effects of a good law can be counteracted by poor enforcement and even the reverse is true) are major *functional* aspects of a quality, balanced wildlife management program.

We wish to raise the concept of significant numbers once learned in elementary arithmetic to a position of importance in considering management "balance." It is improper to make one set of observations accurate to the *second* and another accurate to the *hour* and then treat them equally. The number of useful decimal points in the final analysis is the number in the least accurate observation. Thus in wildlife management it would seem to be a violation of our concept of *balanced significance* if biologists make sophisticated calculations of the bioenergetics of deer forage and desired kill down to the exact number of deer to be harvested (e.g. 2368) when another major aspect of the total management, law development, and enforcement system is operating at an unknown level of accuracy, or, if known, at a level that is highly variable. When hunting regulations are only approximately observed, perhaps only approximate habitat and population data are needed. The converse is probably true: more accurate enforcement data are needed.

The senior author has reported elsewhere (Giles 1971:131) on the apparent importance of wildlife law enforcement. Over 150 federal agents and 5,500 agents and their supervisors patrol the states. They represent 31 percent of the personnel of the state agencies and expend up to 38 percent of the total wildlife agency budget. Surely the public no longer (if it ever did) takes pleasure in keeping a mere 5650 men "off the streets." It owes none of them a living. These facetious comments should not detract from the real question the public asks and will increasingly ask: What do we get for supporting you? Now? In the faster-coming future? How do you relate to other increasing police powers in an increasing stress-filled environment? Are you credible? Are you *really* needed? Play no word games with the source of funds or about who supports whom. The question to be faced now is: What are the cost-effective contributions that agents can make to a society fast approaching the convergence of five crises—population, moral, urban, environmental, and technological?

## SELF-STUDY AND OBJECTIVES

One important task will be to articulate what the law enforcement groups now provide. This should be no pollution-industry slick justification; it must be an in depth, behind-doors self analysis and for

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those groups too close to the problems to see themselves clearly may require the assistance of consultants. "Knowing thyself" is the task of the "now" and the "not yet." Who the agency *is* is not too difficult to establish; who it *may become* is very difficult. To do so will require agents to detail clearly the objectives and goals and evaluate all actions and decisions as they contribute to such goals. Such goals provide the basis for and can result, if acted upon (otherwise the activity is a futile exercise), in confirming and strengthening some existing roles, modifying others, dropping the paraphernalia of the ages, and identifying actions and areas of work needed but not previously envisioned.

For example, the questions must eventually be faced: If deterrence is an objective, are unmarked cars the best way to achieve this objective? How can deterrance be balanced with apprehension rates?

## MUTUALLY EXCLUSIVE ROLES

Another major task is to establish the proper role of the agent in light of modern behavioral psychology. We wish to exclude from our discussion the pathological person who persists in the "cops and robbers" syndrome. However, we do think their numbers will increase under the complex social conditions of reduced identity, increased boredom, increased leisure time, reduced interpersonal attention, increased discretionary funds, and increased proportions of youths and young adults in the population.

The basic task is to resolve the "educating" and "arresting" roles of the agent. Morse (1969) reported that 60 percent of agents' time, nationwide, is spent on law enforcement. The other 40 percent is spent in a host of other activities but a sizeable proportion is listed as "education." Modern educational science is geared to the concept that unless measurable behavioral changes occur (i.e. what the learner does differently as a result of an action, like broadcasting a radio tape or issuing a leaflet) then no learning has occurred. Educational systems should be developed to maximize learning. Now we suggest no new demands on agents to become educational evaluators but somewhere, somehow, we think the agency should ask (before someone forces it to answer) "what are we as a nation getting for our investment of about 1700 agent-years of 'education' per year?"

The yet more perplexing question is that of dual roles. It is inconceivable that quality education could occur if a teacher were also the truant officer. There are mutually inconsistent roles: the priest as a judge; the doctor as an undertaker. It is contrary to all educational psychology to attempt to elicit desired behavior, to encourage self-motivated actions, to promote willing obedience in an atmosphere of threat, fear, and risk.

Learning is best under conditions of positive reinforcement. Game law obedience, at best for a few people, has self-awarded positive benefits, is neutral for many, and for many is a negative threat or a risk-confused activity. The probabilities for being arrested for a violation are high if a resource user is "checked." In Virginia in 1970, 83,152 were checked out of 273,917 total hunters (30%). Of those checked, 2,975 were considered by agents to be in violation of the law. Thus, in general there is approximately a chance of 3 in 100 that if an agent is contacted, the experience will be unpleasant in some respect for the resource user. In California the chances are 12.8 in 100 (McCormick 1968). Game laws are notoriously complex and many violations are due simply to oversight. The probabilities of being 100% within the laws associated with land, county, permit, weapon, licenses, ammunition, garb, and season are indeed small. There are, of course, deliberate violations. The question remains: is it in the best interest of the total hunting population to cloud the hunting experience with negative aspects of the potential enforcement agent encounter? Surely the answer is "yes" but the next question, one remaining for research, is: how much?

There is no question that enforcement is a valid wildlife agency function (although Oregon has the function within the jurisdiction of the

state police). This is not the concept in question; the question is that of: Is it effective (or efficient) to place upon one person two such psychologically antagonistic roles?

The more people, the less the apparent damage of any offense (in the eyes of the potential violator) (see Hardin 1968 and Odum 1971: 206-235) and the greater the number of social interactions and needs for regulation toward stability. Increased need for enforcement (an historical condition) and new needs for efficiency add to the argument that the two tasks should be increasingly divorced. Division of labor has been a "good thing" since the industrial revolution. Some advantages are relevant to the role of the agent.

This concept has recently been confirmed in a paper entitled, "Life Style Characteristics of the Hunter," R. Joseph T. Plummer of the Leo Burnett Co., Inc. presented before the American Association for Conservation Information in February, 1971. He reported an important finding: "One implication of this seeming ambivalence about authority [as determined from nationwide surveys] is that to depend on him to maintain hunting bag limits without the presence of a game warden or set of rules would be a mistake. He tells us that he needs control from outside himself, yet inwardly, he probably has a deep dislike for other authoritarian people such as the warden. This also suggests that the game warden is probably not the best communications channel for this man except to transmit basic guidelines."

## THE FINAL BENEFIT

There is a stressful idea that must be opened wide. It is a concept that must eventually permeate every nook of the wildlife agency. The concept is simply: a resource, by definition is a substance used by man and of benefit to him; an agency exists to preserve and develop a resource; an agency thus exists to create benefits for man. This is a concept that overrides or parallels the prevalent basis of operation: the agency exists to serve wildlife. Some contend there are no differences; there is not allowable time or space to complete the argument to the contrary. Responsible agencies will find the shift in policy will provide guidance to such problems as:

1. Should law A which will result in the harvest of 100 raccoons but generate 5600 additional hunter hours of recreation be passed?
2. Law B will ease enforcement, increase convictions, and reduce deer kill, but should it pass when it is hard for hunters to understand and thus may reduce the pleasure or benefits experienced from the hunt?
3. Where should the agent devote most of his time, to enforcing a squirrel regulation which has no measurable or significant effect on future squirrel populations, or should he spend his time investigating market hunting?

Agencies will discover in the future that a particularly useful and powerful formulation of goals is in terms of maximizing the sum and minimizing the variance of the net quality-ranked man-days of hunting or fishing (i.e. the utility function).

## THE BASES FOR CHANGE

It is easy for a scientifically oriented wildlife staff (or even a society) to assume research is the answer to all problems. We do not support this contention. In a paper to appear in the proceedings of this annual conference, Buffington and Giles report on decision making in the U. S. Wildlife Refuge System. It is increasingly evident that many aspects of natural resource management are *decisions made*, not *facts discovered*. Primary among the decisions are those of the objectives and goals—"what are we *really* trying to do?" Others include questions of levels of acceptable effectiveness, the segment of the public to which most activities are directed and by whom most payoffs are experienced,

and how important are inefficiencies, errors, or failures to the people of the state (or others)? Answers to these questions may not have been written but they are now alive and operating in daily actions of the agents. Perhaps present operations are satisfactory; but we suggest that upon critical analysis there would be some differences caused, that agents' personal policies might not just "happen" but could be more rationally developed, and that agency goals can be better achieved by coordinated group efforts directed at such goals. Then the dynamic interaction of rational decision and objective research can achieve a more optimal organization and function for the people of the state and the wildlife resource itself.

## RESEARCH TO MEET THE NEEDS OF THE FUTURE

Many problems can be solved by research which, in our opinion, is the primary method for producing major inputs to the decision process. Wildlife research in the past has been exclusively devoted to *population* and *habitat* of the threeway balance of population, habitat, and man. It is now time to readjust the balance and see that research is conducted on the social aspects of the total wildlife management act. One major need is in wildlife law enforcement research. The foregoing paper provides the context for the need for this research. The outlines presented by Giles (1971) will not be repeated here but major areas of importance will be emphasized, examples given, and particular needs suggested.

## STUDIES OF VIOLATIONS AND VIOLATORS

The National Rifle Association, in a pioneer effort, awarded the senior author a grant to study certain game law violations in Virginia. One study by the second author is underway. In order to continue such research, computer-based reporting is needed to enable useful "information" to be extracted from the voluminous data in agencies. We now have a functional computer system useful for analyzing deer spot-lighting cases. It is possible to develop very efficient systems for providing law enforcement agency decision makers abundant useful information rapidly and inexpensively. We assert that many answers to existing problems now lay in files, virtually unused and unusable. Our preliminary analyses of some Virginia data and that from other states and shown in Table 1 are suggestive of what we think is needed and what can be obtained through pre-designed information systems. It is very difficult to "clean the files" but the need gets no smaller. The sooner automated systems are built, the less wasted will be the data; the less duplicated the paper work for the agent; and the more responsive can be the agency and agent to new problems.

TABLE 1.   Examples of the relevant parameters and some statistics from data now collected by many states. Such statistics can be readily developed by computer for counties, regions, or wildlife species as guides for improved attainment of agency objectives. The numbers shown are from Virginia (1969).

*General Statewide Indices*

Total annual arrests for game violations—3,142
Total annual licenses sold—273,917
Percentage of licensed hunters arrested.
Percentage of licensed hunters convicted.
Percentage of convictions per arrest (1964-69)—91
Percentage of licensed hunters contacted by agents (ignoring duplicate contacts)—29.3%
Percentage of arrests per hunter contacted—3.91%
Total estimated man days of hunting in the state.
Total estimated man hours of hunting in the state.
Total man hours of enforcement effort—143,071
Ratio of agent-hours to hunter-hours.

Average hours spent prior to each arrest—42 hr/case
Average hours spent in each court transaction—1 hr. 10 min.
Ratio of field-time to court-time—36/1
Average total hours per case—46.4
Average cost per case (1965-69)—85.35
Average cost per license checked (1965-69)—3.12
Total uncompleted cases.
Vilkitis—Index to estimated total violations.

*Inseason Activities*

Percentage of arrests for continuous violations (ACV) e.g., improper
    license.
Biennial rate of change.
5-year rate of change.
Projection.
Percentage of arrests for instantaneous violations (AIV) e.g., killing a
    doe in a *bucks only* season.
Biennial rate of change.
5-year rate of change.
Projection.
McCormick Rate of Compliance (100-((Percent of Arrests/contact)*
    ACV))
    ‾‾‾
    100
Biennial rate of change.
5-year rate of change.
Projection.
Mean inseason effectiveness rank of agents
    1. standard deviation
    2. standard deviations

*Out-of-season Activities*

Percentage of arrests for continuous violations (ACV) e.g., improper
    license.
Biennial rate of change.
5-year rate of change.
Projection.
Percentage of arrests for instantaneous violations (AIV) e.g., killing a
    doe in a *bucks only* season.
Biennial rate of change.
5-year rate of change.
Projection.
McCormick Rate of Compliance (100-((Percent of Arrests/contact)*
    ACV))
    ‾‾‾
    100
Biennial rate of change.
5-year rate of change.
Projection.
Mean inseason effectiveness rank of agents
    1. standard deviation
    2. standard deviations
Total Court Costs
Replacement costs (total all game)—$7,276.43
Suspended Costs
Actual costs to violator
Total cases appealed
Total costs involved in all appealed cases.
Mean costs involved in all appealed cases.
Total costs involved in all other cases.
Mean costs involved in all other cases.
Rate of change in cases appealed—1 year
Rate of change in cases appealed   5 years

With appropriate sampling of data from licenses and collations with arrest or conviction data (and occasional sub-studies) it will be possible to learn much of the violator. For example it seems possible to learn where or upon whom to concentrate activities to gain highest payoffs. For example 2.2% of California deer hunters contacted were in violation of laws and arrested (McCormick, 1968). Crime rates should be known among socio-economic strata. As population percentages in age and economic strata shift, prediction can thus be made in expected shifts in enforcement problems. We know there are major trends in national codes of ethics and morals. By learning of the psychology of the violator we think it possible to predict what problems will exist in the future and thus be better able to justify budget, manpower, or program changes.

## STUDIES OF THE AGENT

Kennedy (1970) has shown that wildlifers and sportsmen do not have the same values or preferences associated with hunting success, hunters seen, and other aspects of the hunt. We have already quoted from Plummer's work. Since agents often exert major influence in forming and passing game and fish laws, comparative studies are needed to determine how to "weight" agent decision in the total effort to maximize user benefits, or, conversely, how to explain user dissatisfactions associated with laws developed with many agent inputs. Similar studies are needed of other inputs into the wildlife law formation process. Evaluations are needed of the effectiveness of special task-forces and specially trained agents, including where they are most useful, what is the agents' optimum group size, and what is the best duration of their mission.

McCormick (1970) reported on studies in California of deliberately altering the intensity of enforcement effort. Statewide he found the surprising result that a decrease in effort of 13.3% resulted in a 14.7% increase in contacts. Imposition of a 40-hour work week necessitated increased supervision and improved scheduling of enforcement efforts! As controls increased so did total arrests but the percentage of arrests per contact declined. In select counties where effort was modified, he found none of the assumed correlations between effort and contacts or between contacts and percent of arrests per contact. His studies point out the possibilities, some of the problems (such as the lag between agents efforts and when the effect shows up), and the great potentials for providing administrators a means to better evaluate operations and plan expenditures. For example, he concluded "consideration has been given to provide overtime payments to wardens. It appears that funds could better be used by increasing the number of wardens working a planned 40-hour work week."

Studies of manpower-needs can provide pictures of future employment, turnover rates, training needs, and manpower types and educational standards.

## STUDIES OF THE VIOLATION

Hesselton and Maguire (1965) have provided one way of estimating the bias in the reported deer kill to a known deer kill. They compared the reports of agent-checked hunters with actual data on the same hunters. Questionnaires such as used by Barick (1969) can provide "ball park" figures, but pooled estimates are dangerous for some uses. The "spy blind" technique has been very successfully used to estimate the amount of illegal waterfowl hunting.

A former student of the senior author, Dr. James Vilkitis, has stimulated deer poaching in both Idaho and Maine. The general concept is that the proportion of times the researcher is caught to the number of times he simulates poaching is an approximation of the relationship between contact declined. In select counties where effort was modified, he found (Vilkitis, 1970) that there were 15,825 illegal closed-season kills in Maine in 1970. In the same period there were 20,199 night hunting violations. In his study in Idaho (Vilkitis and Giles, 1970) he calculated that 2424 big game animals were illegally taken during the closed season. In both states he found the field detection of violators was identical (1.1% for

Idaho, 1.2% for Maine). His work holds great promise if the agencies do not fearfully and irresponsibly classify as secret the results of such studies.

The NRA study will gather primary data on the location and time of spotlighting of deer. The major thrust of this study is to provide the core data for application of sophisticated computer-based search strategies such as has been developed for military patrols and submarine warfare. We hypothesize that application of war-game strategies against poachers (where "leads" are non-existent) will allow the agent to "win" more times than previously over the long run.

Mechler (1970) showed that by analysis of deer harvest data over 20 years in Virginia he could explain over 90% of the variation in the kill by relatively simple equations for 70% of the counties. This observation indirectly reflects on the extent of poaching and suggests it is not great in the counties, is not correlated with the number of legally killed deer, or is not constant in all years. Other studies of these data are underway but the first analyses suggest that it is possible to get at law enforcement information "through the back door" of standard biologist-reported data just so long as it is done cautiously.

One of the most pressing problems for sophisticated game management is knowledge of whether illegal kills are proportional to existing populations, to the kill, or to neither, and are simply a function of the number of poachers (kill-independent).

Mr. Robert Curtis, a Virginia Tech graduate fellow, assisted in an analysis of data supplied by Mr. Joe Coggin and Mr. Mickey Morris, both of the Virginia Commission. They sought the relationship between known illegally killed deer, a rough likelihood estimate of the "correctness" of these data, and the reported legal kill. The equation developed was

$$y = 3.4 + 0.03x$$

where y is the illegal kill and x the deer harvest. The relationship was not useful since the harvest accounted for only about 19% ($R^2 = 0.19$) of the variability in the illegal kill. Making further analyses of counties in which Mr. Morris had great confidence in the data yield a much better $R^2$ value (0.84). The conclusion of the study was that the preliminary data do suggest that useful predictive or explanatory equations can be rapidly developed by computer to aid in evaluating the magnitude of the illegal kill problem (perhaps for improved allocation of agents' time), evaluating enforcement effectiveness, evaluating effects of different strategies of control, or simply assisting in improved calculations of allowable harvest or hunting permits to be issued.

Clements (1971) in an elaborate study of raccoons and raccoon hunters reported that hunters indicated that an average of 35.5% of the hunters that they knew violated raccoon season regulations; wardens, biologists and game managers said that 31.1% violated. These close figures are probably good estimates of violations. Most violations are probably the training of dogs before opening of the season and hunting after the season closes. Wardens, biologists, and game managers estimated that 13.9% of the raccoon harvest was taken illegally. These numbers imply that about one-third of the hunters commit violations; that hunters know of more violations than agents; that agents and hunters are consistent in their estimates of violators; that while the number of violators is high, the impact of such violations on the population is low; and violators are also hunters whose violations only constitute a part of their time afield as licensed citizens.

C. H. Lobdell and H. S. Mosby have developed a computer model for studying the influence of hunting on wild turkeys (manuscript ). Lobdell suggests that a good argument can now be presented for strict law enforcement during the spring breeding season. Regardless of the effect that the poaching has on total annual mortality rates, the effect will be to lower the fall population by a number equal to the reproductive rate (immatures: adult female) times the number of hens time the percentage of the past-winter population. The reduced population, in turn, re-

duces the potential number of successful man-days of turkey hunting per sportsman.

## RECOMMENDATIONS

We are witnessing the birth of a science of wildlife law enforcement. All such activities have progressed from primitive efforts, to an art, and eventually, increasingly to a science. We are leary about what will happen when an institution such as wildlife law enforcement is subjected to rational examination and even experimentation. Classically, the weakest institutions are those that have the best defenses against such study. There is a prevalent idea that it "'taint fittin" to study certain subjects. We think it is fitting, no matter what the problems. The future risks of not doing so seem to exceed the consequences of knowing now. We think that significant inroads can be rapidly made in gaining knowledge for such a science. These inroads can be made by research contractors, by interested agents assigned to special duty, by university wildlife graduate students, interested individuals, and especially by coordinated, well planned data-collection by agents. We see the need for no major technological breakthroughs. The breakthrough must be in the barriers of research and on the edges of enforcement "territory." The needs are to guard carefully to assure research efforts, especially the early ones, are unflawed; and to built solidly and synthetically on existing foundation knowledge in psychology, economics, criminology, operations research, and computer science. Coordination within the southeastern states can provide data for decision-making in each state and yet provide special non-duplicative studies needed by all states.

There are apparent needs for improving wildlife law enforcement administration. There are questions about the effects of the enforcement activity itself and whether it contributes optimally to the state wildlife agency objectives. There are questions about optimizing agent effectiveness and efficiency. A combined research and development (R & D) program can achieve significant answers to these problems in a short time and can provide continuing services. We recommend that a central R & D center be established, similar to that of the Institute of Statistics at North Carolina State for dealing with the statistical problems of the southeastern state wildlife agencies. The function of the center would be to develop preliminary research and the auxiliary support to provide first answers to the above questions and problems. Modern uses of the computer, other than as a large accounting machine, are virtually unexploited in most state game agencies. Applications in information retrieval, land and resource inventory systems, optimal search procedures, simulations of effects of various laws (or levels of enforcement) on wildlife populations, talent-to-job matching, manpower allocations, maximizing equipment use and minimizing agency costs, sophisticated inventories and transportation models of radios, cars, boats and parts, and a host of other applications are on the horizon, hardly seen by most agencies. Soon the cost of not-knowing will be prohibitive. It is conceivable that the public manager may soon be liable for suit for mismanagement of limited public funds. Waiting for the expected "worst" no longer seems rational behavior. The proposed center would function for about 5 years with support from each participating agency. The center would not deal with case-oriented problems or attempt to duplicate the services now provided by the FBI and state police agencies but would develop a body of knowledge around such questions as proposed in this paper. It would be oriented toward providing computer software for the agencies—either to be run by themselves or by expanded arrangements with the North Carolina Institute. The Division of Forestry and Wildlife Sciences of Virginia Polytechnic Institute and State University invites the development of such a center on its campus in conjunction with the Virginia Cooperative Wildlife Research Unit, the Center for Public Choice, and the Center for Environmental Studies.

## CONCLUSION

We have outlined the concepts of a fast-approaching future, of good laws, of agents whose social usefulness is being judged on the basis of

their effectiveness in achieving specific goals, of agents attuned to and anxious to eliminate powerful psychological barriers to their effective goal-oriented operation, of increased needs for agent action, of the agent as active in maximizing benefits to man, and of the real needs for discriminating between what problems can be solved by pure decision and what can be answered by research. We have suggested the needed research.

It is evident that our knowledge gained from research into population dynamics and habitat management have exceeded that "state of the art" of law enforcement. It is not our intent to label game law enforcement agencies for failure to maintain a level of advancement comparable to the other areas of the wildlife management system. Research into law enforcement effects and methods has been neglected, undoubtedly due to a lack of funds, scarcity of a research attitude among the agents, and time.

Wildlife management is a system composed of the relationships of many variables. Among the basic factors usually considered are the areas of habitat, populations, and man. Education and enforcement are classically the programs oriented toward man. The principle of limiting factors states that the strength of a system is determined by the strength of the weakest variable of that system. In addition, agency goals have not previously been precise enough to do good studies on effectiveness since the criteria of "goodness" were missing. We feel that enforcement may be a limiting factor in the wildlife management system of the future and that it should be the future site of much research and evaluation.

In this paper we have set forth a number of ideas that can aid the departments in improving their operations. The first step is to formulate clear, concise, and justifiable statements of objectives based on what is presently required and what is anticipated for the future.

Next is needed an analysis of the present wildlife legal system. Those laws currently on the books that fail to support, or are contrary to stated objectives should be reappealed or amended. Once such a program of laws is designed, they should be distributed and explained to those utilizing the resource. Patrol and enforcement strategies can then be devised, based on computer analysis of violators and violation characteristics, to effectively and efficiently enforce the legislation. With present computer techniques we can simulate violations and evaluate the characteristics involved in each arrest. Analyses of violations and violators can allow us to develop improved strategies of detection and apprehension.

The loss due to illegal hunting has been shown to be greater than generally believed. For example, using a formula developed by Vilkitis (1970) the minimum predicted illegal deer kill in Virginia in 1970 was 50,758 animals. When a monetary value of $100 as charged by the court for the replacement of each of these deer is assigned, then the violations may comprise more than a $5 million drain on the state wildlife resource. The need for enforcement improvement can thus be justified monetarily as well as ecologically and sociologically. There is deterent value in knowing that one's chances of being arrested for a violation are high. When these chances become greater than in the past due to increased effectiveness, deterrence will increase. We think the increases will tend to be logarithmic. Certainly, violations by opportunist violators will decrease. To what extent the decreases will occur depends upon the new level of effectiveness obtained.

Further steps to attain our goal of efficiency and effectiveness should be the allocation of new funds, or a reassignment of a small portion of current funds for population and habitat research, to law enforcement research. Enforcement is a very costly tool of management. We should be knowledgeable about what we are presently getting for our investment, and what can be done in the future to increase our dividends.

We have suggested that local efforts as well as a law enforcement research and development center can enable us to attain our goals with a minimum of expense and duplicated effort.

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# THE LAW ENFORCEMENT ADMINISTRATOR'S ROLE IN MEETING THE CHALLENGE OF THE 1970's

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"Watch out fellows, the damn game warden's a-coming!"

Surely, those of us engaged in natural resource law enforcement have heard that quote at some time during our careers.

Don't be angry with the offender. Pity him! Until his relationship with the earth changes he will, through ignorance, continue to defame those who, through concern for the rights of others, make a sincere effort to protect man's natural resources and control his environment.

Barring an international catastrophe, there exists no greater threat to man's survival than the abuse of our natural resources and environment.

Man is a wanting animal, striving from birth until death to satisfy his needs. He possesses the following three basic needs:

(1) Saftey—which consists of food, clothing, shelter and freedom from danger.

(2) Social Needs—which consist of a standard of living and public acceptance consistent with that enjoyed by his neighbors in the community where he lives.