DYNAMIC DEPLOYMENT OF WILDLIFE LAW ENFORCEMENT MANPOWER — A DECISION AID [a]

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Abstract: A methodology for deciding how to deploy law enforcement personnel is proposed. A workload model is used. The methodology is consistent with the concept of management by objectives (MBO) and could serve as a focal point for achieving improved effectiveness in an enforcement division. Use of this model may require the creation of a statewide information system describing the geographical distribution of wildlife agent workload. Although primarily envisioned as an administrative decision aid at the statewide scale, the workload model could be integrated into deployment planning at the district and possibly county level. Major limitations of the model are that it is deterministic and assumes linear relationships among variables. Strategies developed by its application, however, would be superior to political criteria or pure administrative discretion.

Proc. Annual Conf. S.E. Assoc. Fish & Wildl. Agencies 31: 679-689

In recent years there have been numerous calls for improved methods of decision-making at the administrative level in wildlife law enforcement agencies. Giles et al. (1971), at a meeting of this same Association, presented the first comprehensive survey of such wildlife law enforcement research needs. Others have also attempted to stimulate further research in this area such as Bavin (1976:5) who stated, "There has only been limited research dealing with allocation of wildlife law enforcement resources .... Additional research, study, and critical analysis is vitally needed before the question of evaluating wildlife law enforcement is resolved". In wildlife law enforcement systems tremendous expenditures are being made to support personnel. However, the manner in which personnel are distributed geographically on a statewide scale is often based on intuition or political criteria, such as following county lines. There is a general feeling that alternative methods of formulating deployment strategies need to be developed to insure that maximum utility is obtained from these expenditures. Wildlife law enforcement is not alone when confronting this problem. Schelle et al. (1976), in discussing the needs of urban police agencies, stressed that among the highest priority research needs were studies of deployment decision-making.

This widespread concern for finding better methods of deploying manpower is primarily motivated by administrative desire for maximized effectiveness and productivity of enforcement agents. According to the national Advisory Group on Productivity in Law Enforcement (1973:2), given the uncertainties of police work, increasing productivity means increasing the probability that a given objective will be met. They go on to say:

> "The clearest example of increasing the probability of achieving intended impact is having personnel assigned when and where crime is highest or calls for service are heaviest. Simple observation can indicate the 'when or where' in general terms; useful analyses of available data can more accurately pinpoint the likely times and places of crime occurrence, thereby significantly increasing probability of putting officers where they are needed."

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[a] A contribution of the Southeastern Wildlife Law Enforcement Research Project. The financial assistance of the Wildlife Management Institute, American Petroleum Institute, National Wildlife Federation, Virginia Commission of Game and Inland Fisheries, South Carolina Wildlife and Marine Resources Department, Georgia Department of Natural Resources, and the Tennessee Wildlife Resources Agency is gratefully acknowledged.

This statement underscores the importance of well-planned agent deployment. It also suggests that explicit and properly stated objectives are a prerequisite to increasing probabilities of achieving impact. Management by objectives (MBO), or the systems approach, is becoming a reality in many government agencies. The purpose of this paper is not to promote or further describe MBO (writers such as McConkey (1975), or works by Ritter (1975) and Beattie and Cowles (1977) treat the subject comprehensively) but rather to describe an administrative decision aid which is compatible with MBO and which the authors believe could also serve as a catalyst for implementing management by objectives by those administrators who desire to do so.

Following a review of existing literature related to law enforcement deployment models, Cowles (1977) stated that in consideration of the needs of wildlife agencies and the information currently available, a deployment process based on the workload model (as compared to queuing, response time, and random search models) would probably be the most readily adapted and implemented of such models. The following discussion describes the workload model and our proposal of a methodology for using the model in the context of wildlife law enforcement. It should be kept in mind that the process, as it is described herein, is intended to aid decision making at top levels of wildlife law enforcement administration, on a state-wide, macro-scale. The model could be readily adapted to district or county applications as well.

DESCRIPTION OF THE WORKLOAD DEPLOYMENT MODEL

The initial development of the workload formula for law enforcement use was by Wilson, (1963). Also called the hazard or crime opportunity potential (COP) formula, the technique has been widely used by police departments in spite of certain limitations. In police applications, this formula combines a variety of indices of crime opportunity potential such as numbers of arrests, number of reported crimes, number of calls for service of particular types, number of accidents, number of doors and windows to check, number or businesses to check, etc. in order to compute a COP score for each area. In a wildlife context, given an amount (f_{ab}) of an area-specific level of a particular workload index (b = 1, . . . Q indices), such as miles of stream to patrol, the statewide amount, F_b, associated with P enforcement districts (a = 1, ... P districts), is:

$$F_b = \sum_{a=1}^{P} f_{ab} \qquad (1)$$

To determine the COP score H_a for each district, a subjective importance factor, W_b is assigned to each workload index as shown in (2).

$$H_a = \frac{\sum_{b=1}^{0} \left[W_b \frac{f_{ab}}{F_b} \right]}{\sum_{b=1}^{Q} W_b}$$

where:

H_a = the proportion of total manpower to deploy to a specific district

P = number of enforcement districts
a - 1,2, ... P

Q = number of workload indices
b = 1,2, ... Q

f_{ab} = area-specific level of a workload index

F_b = total amount of a specific index summed across districts

W_b = importance value of a workload index

Following computation of COP scores for each area, an optimum strategy would be to deploy agents among the districts in direct proportion to the scores. If a district has a COP score of 0.10, then 10 percent of the existing force should be deployed tere.

According to Griffin (1958) and Chaiken and Larsen (1971), the principal difficulty which confronts all plans of this type is the lack of an objective standard of the evaluation of the weights of the various factors to be included. We recognize the difficulty, but contend that these are value judgments and interpretations which are properly the responsibility of decision makers. These are not numbers to be discovered by observation or application of a standard. They are highly diversified and changeable human expressions of importance. In most applications, the judgment of superior, experienced administrators has been the basis for determining such weights (Griffin 1958), Kakalick and Wildhorn (1971) and Chaiken and Larsen (1971) listed several other limitations of the workload approach:

(1) Workload formulae assume a linear relationship among the factors and do not reflect the nonlinear and interactive characteristics observed in practice.
(2) Workload formulae often reflect past conditions rather than current or predicted conditions.
(3) Workload formulae attempt to depict a simple deterministic system in which many of the variables are probabilistic.

However, these workers stated that the model's use is superior to pure administrative discretion. The first limitation listed above can be overcome by future research. Use of forecasts for certain workload indices would serve to minimize the second limitation and multi-year averaging could reduce the third limitation.

A METHODOLOGY FOR IMPLEMENTATION

There are two basic problems posed by intended use of this decision aid: (1) How to determine the most appropriate workload indices, and (2) How to assign importance weights (values), W_h, to these indices. The solution to (1) is determined by the nature of agent work and the availability of data which represent measures of such work. The nature of agent work should be determined primarily by the wildlife law enforcement system's objectives (Beattie et al. 1977).

For descriptive purposes, the first-order objectives (agency goals) listed below are assumed to have been established for a hypothetical situation. An identifying abbreviation is shown in parentheses for each and these are used hereinafter in the text and tables. The number of first-order objectives, M, is 6 ($j = 1,2,..M$).

(1) To assure that desired levels of resource use are obtained. (DLRU)
(2) To attempt to distribute resource use or consumption equally among users. (DISRU)
(3) To protect public and private property from physical harm as a result of resource use. (PPPP)
(4) To protect resource users from physical harm as a result of resource use activity. (PPART)
(5) To protect non-resource users from physical harm as a result of resource use activity. (PNPART)
(6) To insure agency income by requiring users to pay for resource use. (INAIN)

Let us also assume for this example that administrators have decided that these objectives will be accomplished, more or less, by wildlife agents engaged in certain primary activities. Ideally there should be a workload index for each activity. As shown below, the number of activities or of workload indices, Q, for this example is 10. Abbreviations for each activity are shown in parentheses and hereinafter these also are used in the text and tables.

(1) Inspection of hunters (INSH)
(2) Inspection of fishermen (INSF)
(3) Inspection of boats and boating equipment (INBE)
(4) Court attendance (CA)
(5) Assist fish management (AFM)
(6) Assist game management (AGM)

(7) Maintain equipment (ME)
(8) Hunter safety education (HSE)
(9) Boat safety education (BSE)
(10) Non-specific public speaking (NPS)

In comparing the above activities, it is apparent that certain ones help to achieve many objectives, others only a few or a single objective. Also, certain activities are more effective in achieving a specific objective than others. Thus, an activity has an overall importance value in terms of the priority of the objective(s) it serves to achieve, and its effectiveness in achieving the objective(s). In short, the overall importance of an activity in serving to meet a set of objectives is a function of two variables, the objective priority weights and the expected effectiveness of the activity in achieving an objective. When evaluating workloads (potential amounts of activities to be performed) among districts, it would generally be desirable to place less emphasis on estimates of the amounts of activities considered ineffective in achieving agency objectives than on estimates of the amounts of activities considered effective in achieving agency objectives. The emphasis should be placed in direct proportion to measured activity importance. Thus, it is reasonable that the relative, overall importance value of each activity in serving to achieve the set of first-order objectives is the same value that should be assigned as a workload index weight, W_b, in the COP formula. Consequently, the workload index weight can be determined by assessing how well an activity achieves a set of objectives without actually specifying the identity of an index variable. Of the 7 major steps in the COP decision process, the first 3, shown below, determine the importance of an activity.

STEP 1. Determine the relative priority weights of first-order objectives, O_i, by Churchman-Ackoff (1953) or paired comparison techniques.

STEP 2. Determine the relative effectiveness of each activity in serving to achieve each objective, E_{hj}.

STEP 3. Compute an overall importance value, W_h, for each activity and associated workload index such that:

$$W_h = \sum_{j=1}^{M} (O_j \times E_{hj})$$

Completion of STEP 1 is relatively straightforward. Assume the results shown in Table 1 have been acquired by responses to questionnaires from top-level administrators. Completion of STEP 2s requires filling in values for a Q x M matrix such as shown in Table 2. In the case of an agency with a large number of objectives, this could be done in a stepwise fashion, where the respondent first enters scores for all activities as they relate to only 3 objectives. Then he carries the scores from 1 objective column to a new sheet listing that same objective and 3 additional ones. He does this until all objectives are weighted. Sample directions for evaluating effectiveness of activities are shown below:

> Listed below (Table 2) are several activities performed by wildlife agents in state X. Across the top of the table are 3 major objectives of the enforcement division of state X. Assume a wildlife agent spends one day doing each of the activities in an average state X county. In each box, place a score indicating how well you feel that activity (if maintained for one day in an average county) serves to achieve each of the objectives. Your response for each square should be made relative to all the responses in that row and column. Scores should range from 0 (not at all) to 10 (very well).

Table 1. Hypothetical priority weights, O_i assigned to first-order objectives by top level administrators.

	Objectives					
	DLRU (O_1)	DISRU (O_2)	PPPP (O_3)	PPART (O_4)	PNPART (O_5)	INAIN (O_6)
	0.24	0.21	0.13	0.10	0.13	0.19

Table 2. Hypothetical effectiveness values of each activity in achieving each objective, E_{bj}, as if determined by top-level administrators.

	Objectives					
Activity	*DLRU*	*DISRU*	*PPPP*	*PPART*	*PNPART*	*INAIN*
INSH	10	10	8	9	4	10
INSF	10	10	7	3	3	10
INBE	3	3	8	10	9	10
CA	8	8	8	5	7	9
AGM	2	2	2	0	0	0
AFM	2	2	2	0	0	0
ME	9	9	6	4	4	9
HSE	5	5	10	9	9	6
BSE	5	5	9	9	9	5
NPS	5	5	1	2	2	4

It is important that all administrators responding to such directions have a unified concept of an "average" county. Therefore, in practice, a particular county name may be specified. Further specifications regarding the particular month for which an activity should be evaluated may also be in order. When the above directions are completed, the overall importance values, Wb, can be computed as shown in STEP 3. From the hypothetical objective weights (Table 1) and effectiveness ratings (Table 2), the following importance scores were determined:

W_1 = 8.9	W_6 = 1.2
W_2 = 8.0	W_7 = 7.5
W_3 = 6.5	W_8 = 6.8
W_4 = 7.8	W_9 = 6.4
W_5 = 1.2	W_{10} = 3.6

STEP 4. Seasonal activity designation

Due to legal constraints and weather changes which normally dictate whether certain activities are possible or reasonable to pursue, wildlife law enforcement administrators are expected to designate when agents should perform certain activities. Although a monthly or irregular designation of the agents' activities to be pursued may be more useful, let us suppose, for example, that there are only 4 periods of interest, spring (SP), summer (SU), fall (F) and winter (W). Provided with an appropriate check sheet (Table 3), the administrator must indicate what the specific composition of the agents' activities is to be for each period. These designations would be made on the basis of his knowledge of existing statues (e.g. hunting and fishing season dates), normal user patterns of initiating and terminating resource use (e.g. initiation and termination of the water-skiing season), and other limiting effects of season on agent activities. The respondent places an X (Table 3) in each box indicating that an agent would be expected to emphasize performance of that activity during that period.

Table 3. Check sheet for seasonal activity designation with normalized weights.

	SP			*SU*			*F*			*W*		
Activity	*AD*[a]	*W*[b]	*NW*[c]	*AD*	W_b	NW_b	*AD*	W_b	NW_b	*AD*	W_b	NW_b
INSH		0	0.00		0	0.00	X	8.9	1.00	X	8.9	1.00
INSF	X	8.0	1.00	X	8.0	1.00	X	8.0	0.00		0	0.00
INBE	X	6.5	0.81	X	6.5	0.81		0	0.00		0	0.00
CA	X	7.8	0.98	X	7.8	0.98	X	7.8	0.88	X	7.8	0.88
AGM	X	1.2	0.15	X	1.2	0.15		0	0.00		0	0.00
AFM	X	1.2	0.15	X	1.2	0.15		0	0.00		0.	0.00
ME	X	7.5	0.94	X	7.5	0.94	X	7.5	0.84	X	7.5	0.84
HSE		0	0.00	X	6.8	0.85		0	0.00		0	0.00
BSE	X	6.4	0.80		0	0.00		0	0.00		0	0.00
NPS		0	0.00		0	0.00		0	0.00	X	3.6	0.40

[a] Activity Designation

[b] Activity Importance

[c] Normalized Activity Importance

that an agent would be expected to emphasize performance of that activity during that period.

It is conceivable that the respondent might think that every box should have an X in it. This may well be the case if we assume an *existing* system. However, when *designing* an objective-oriented management system, the administrator has every right (and many good reasons) to state that his personnel should only assist with fish management during time X or should only schedule nonspecific public speaking appearances for a certain time Y. Also, the purpose here is to designate the activities which should be emphasized by the agent. For example, although a limited amount of small game hunting may occur in summer, the agent may be expected to emphasize the enforcement of fishing regulations.

STEP 5. Activity weighting and "normalization" of weights

After STEP 4 is accomplished, the remainder of Table 3 is completed. The numbers in the second column under each period, W_h, are the activity importance scores brought from Table 2 which correspond to only those activitites checked for each period. In the third column under each period are the "normalized" scores, NW_h, which are computed by dividing each activity score by the maximum activity score in that column.

STEP 6. Assignment of index variables as measures of workload for specific activities

STEP 6 is a critical step for which there are few rules and no easy solutions. In this step it is necessary to select the variable (measure of some attribute) which best represents the level of workload associated with each activity. STEPS 1, 2, and 4 have all required considerable judgment on the part of the decision maker. The values assigned to objectives and related activities have been formulated as results of years of experience and knowledge of "the way things are in state X". STEP 6 is no less judgmental, but the choices made here can render the previous judgments worthless. As an example, assume that the activity importance score for INSF during summer is the closest possible numerical representation of the importance of that activity which can be formulated. Ideally "Number of Active Fishermen Per Day in County" would be the appropriate workload index, but that is unavailable. Suppose also that the list of variables for which data exists includes "Number of Fishing Licenses Sold by County" and "Number of Boat Dealers in County". One of the latter 2 might then be selected. This choice must be made not only on the basis of how closely the variable represents the ideal, but also must be made with consideration of the manner in which the data were collected. If a variable is selected that neither represents the ideal nor is represented by accurate and reliable data, then the final computations will fail to suggest placement of personnel *where* they are needed in spite of how well the *value* of their activities was assessed. In short, STEP 6 is the foundation of the workload (COP) deployment method. A critic could state that this foundation is rather unstable given the limitations of existing data sources. However, this problem is nothing new. Information such as obtained from game check stations, results of strip census, pellet counts, input from public hearings, and wildlife sightings by agency personnel are all widely used indices of game population magnitudes or even of the extend of human benefits likely to be experienced. These indices are no less limited. Thus, history has shown that wildlife managers have long preferred data with limitations in preference to no data at all. One other major factor works to the favor of the law enforcement agency using the approach outlined here. That is that only *relative* values are needed. With a purpose of allocating fixed resources, the quest is not absolute values per se, but relative values which provide an ability to discriminate among areas and times. It is clear that information must be continually improved, but in the meantime improvement can be made in the decision processes.

There is one final point regarding the sixth step. In determining what variable should be used as an index of agent workload, consideration must also be made of the cost of acquiring data. Attempts to document environmental or demographic changes by region for entire states have proven costly. Nevertheless, those states which have done so are finding the benefits of improved planning in excess of the costs of maintaining statewide information systems. Wildlife law enforcement agencies have much to gain from tapping existing information systems or in supporting their creation. Cooperative efforts with other agencies will serve to keep data acquisition costs at a minimum.

To continue the example, let us assume ample consideration has been given the limitations of the data and that the workload indices listed in Table 4 have been selected. Although the sample computations herein will refer only to these indices, it should be remembered that each index can be replaced with alternatives and the system's sensitivity to such replacement tested.

STEP 7. Computation of COP distribution of wildlife agents

STEPS 1 through 6 have made it possible to compute deployment strategies for wildlife law enforcement agency manpower. To show how this would be done, Table 5 presents some hypothetical data which might be available for 6 enforcement districts in a state. Data for only 2 seasons are shown, summer and winter. Most of the index variables selected above would not change seasonally except "Miles driven previous year" and "Number of arrests, previous year", although annual changes would be experienced in most.

To compute the proportion of total manpower to deploy to District 1 for the summer period, the following computation must be made (See eq. (1)):

It is evident that the deployment strategies can be computed by simple arithmetic. However, the computations necessary for several districts or the counties of an entire state are quite tedious, particularly if many composite index variables such as used for INSF were involved. In order to facilitate use of the COP approach and to minimize computational effort, the authors have developed a comprehensive computer program for use by wildlife agencies (a copy is available on request). Given the necessary data inputs and access to computer hardware, the administrator must only supply the subjective values for first-order objectives and for the relative effectiveness of activities in order to produce the desired results. The present form of the program accommodates COP computations involving as many as 10 objectives, 52 activities, and 35 planning periods.

Table 6 shows complete deployment plans for both summer and winter periods based on the hypothetical data in Table 5. Thus, not only would 18 percent of the manpower be deployed to District 1, but 21, 19, 15, 17, and 10 percent to Districts 2, 3, 4, 5, and 6 respectively (during the summer period). Note that due to changes in the activity mix and index levels, the plan varies from that of the winter period. Increases for winter are recommended in Districts 1, 3, and 6 and decreases in the other districts, as compared to the summer plan (Table 6).

Table 4. Hypothetical indices of agent workload.

Activity	*Workload Index*
INSH	Acres of woodland
INSF	Acres of open water plus 100 times miles of stream
INBE	Number of boats registered, previous year
CA	Number of arrests, previous year
AGM	Acres of state game management areas
AFM	Number of streams stocked previous year
ME	Miles driven previous year
HSE	Estimated total children aged 12-14
BSE	Number of boats registered previous year
NPS	Number of local sportsmen clubs

Table 5. Sample data for input to COP deployment process, summer period. Numbers in parentheses represent winter values if different from summer.

Variable	*District* 1	2	3	4	5	6
Acres of Woodland	138,006	46,000	140,000	95,000	8,900	12,436
Acres of Open Water	20,000	5,000	15,000	4,000	30,000	200
Miles of Stream	180	900	760	538	240	60
No. Reg. Boats, Prev. Year	7,260	6,500	4,800	1,250	7,400	65
No. of Arrests, Prev. Year	180 (275)	433 (638)	302 (426)	250 (210)	602 (790)	203 (460)
Acres of Game Mgmt. Area	0	6,500	0	4,850	1,720	0
No. of Streams Stocked Prev. Yr.	6	12	25	14	6	1
Miles Driven Prev. Year	4,000 (3,426)	2,430 (2,900)	2,630 (3,940)	2,970 (2,370)	1,526 (1,932)	2,990 (4,634)
Total Children Aged 12-14	1,263	498	970	870	254	958
No. of Local Sportsmen Clubs	8	12	7	5	2	6

$$H_1 = \left[\frac{w_1 (f_{1+1})}{F_1} + \frac{w_2 (f_{1+2})}{F_2} + \ldots\ldots\ldots + \frac{w_{10} (f_{1+10})}{F_{10}} \right] \Big/ \sum_{b=1}^{10} W_b$$

$$H_1 = \left[\frac{0(138{,}006)}{440{,}342} + \frac{1.0\,(20{,}000 + (100 \times 180))}{74{,}200 + (100 \times 2{,}678)} + \frac{.81\,(7{,}260)}{27{,}275} + \frac{.98\,(180)}{1{,}970} + \right.$$

$$\frac{.15\,(0)}{13{,}070} + \frac{.15\,(6)}{64} + \frac{.94\,(4{,}000)}{16{,}546} + \frac{.85\,(1{,}263)}{4{,}813} + \frac{0\,(7{,}260)}{27{,}275} +$$

$$\left. \frac{0\,(8)}{40} \right] \Big/ (4.8)$$

$$H_1 = 0.18$$

Table 6. Deployment strategies for summer and winter periods based on hypothetical data shown in Table 5.

PERIOD	*DISTRICT* 1	2	3	4	5	6
Summer	0.18	0.21	.19	0.15	0.17	0.10
Winter	0.20	0.18	0.22	0.14	0.12	0.14

CONCLUSIONS

The workload model described herein will be most effective in organizations which have adopted MBO, at least at the upper administrative levels. Since the implementation of MBO has been most successful from the top down (McConkey 1975), not only can use of this model help in deciding optimal deployment strategies, but it can also serve as a beginning point for those wildlife enforcement administrators desiring to experiment with MBO.

Although the computed strategies may seem a worthy achievement in themselves, distribution of manpower according to the computations should not be considered the final step. At the minimum, the field personnel should also be informed about the agency goals, the appropriate activity mix, and the importance of the activities as perceived by administration. In an agency totally committed to this system, field personnel would be encouraged to assist in formulating second-order objectives (consistent with the first-order objectives) and effectiveness measures. Although the example herein included the activities "Court Attendance" and "Maintenance of Equipment" for descriptive purposes, routine activities such as these probably would be considered part of a base standard of performance and therefore of questionable relevance to the distribution question.

Another important consideration, particularly in the case where there are many planning periods (e.g. a re-deployment every month), is the cost of moving personnel. Once it is known where individuals should be, the next question is how to achieve that distribution at least cost. The administrator would conceivably be concerned with costs of travel, motels, meals, or patrol time lost in transit. When one considers all the possible ways in which a recommended distribution could be achieved, this seems an immense problem. However, decision problems of this kind can be modeled in a linear programming form and we have begun work on this extension of the deployment question.

In conclusion, we have presented here what we believe is a reasonable approach that the wildlife law enforcement agency should consider when planning the deployment of personnel on a statewide scale. We think it is a good method, the best currently available. We do not begin to say that it is the best approach for every agency. Certainly there are other ways to accomplish many of the same ends. However, regardless of what method an agency prefers, the human-value concerns and data needs will probably be no less than these required by the COP method.

LITERATURE CITED

Advisory Group on Productivity in Law Enforcement. 1973. Opportunities for improving productivity in police services. National Center for Productivity and Quality for Working Life, Washington, D.C. 76pp.

Bavin, C. R. 1976. Wildlife law enforcement. Address presented at National Symposium on Wildlife and America, Washington, D.C. 6 pp.

Beattie, K. H., C. J. Cowles, and R. H. Giles, Jr. 1977. Objectives of state wildlife law enforcement divisions. Proc. 31st. Annual Conf. Southeastern Assoc. Fish & Wildl. Agencies. (In Press).

Beattie, K. H., and C. J. Cowles. 1977. The wildlife law enforcement system. In R. H. Giles (ed.) Wildlife Management Systems (In preparation)

Cowles, C. J. 1977. Optimum deployment of wildlife law enforcement agents: A problem analysis. Bull. of the Southeastern Wildl. Law Enforcement Res. Proj. 31pp.

Chaiken, J. M., and R. C. Larsen. 1971. Methods for allocating urban emergency units. The New York City Rand Institute, New York. 55pp.

Churchman, C. W., and R. L. Ackoff. 1953. An approximate measure of value. Opr. Res. 2:172-187.

Giles, R. H., Jr., M. Kaminsky, and J. McLaughlin. 1971. Wildlife law enforcement research — The context and the needs. Proc. Annual Conf. Southeastern Assoc. Game and Fish Comm. 25:677-687.

Griffin, J. I. 1958. Statistics essential for police efficiency. C. C. Thomas Co., Springfield, Ill., 229pp.

Kakalick, J. S. and S. Wildhorn. 1971. Aids to decision making in police patrol. A report prepared for Dept. Housing and Urban Development. R-593-HUD/RC. The Rand Corporation. 93pp.

McConkey, D. D. 1975. MBO for nonprofit organizations. AMACOM, New York. 223pp.

Ritter, A. F. 1975. Objectives and performance criteria for state wildlife law enforcement agencies. M. S. Thesis, Virginia Polytechnic Institute and State University, Blacksburg. 199pp.

Schell, T. H., D. H. Overly, S. Schack, and L. L. Stabile, 1976. Traditional preventive patrol. A design for phase II research. National Evaluation Program Phase I Report. The University City Science Center, Washington, D. C. 29pp.

Wilson, O. W. 1963. Police administration. McGraw Hill Co., New York.