ANALYSIS OF FACTORS INFLUENCING DECISIONS TO ACQUIRE PUBLIC LANDS FOR WILDLIFE

by

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INTRODUCTION

Each year, millions of dollars are allocated to a variety of wildlife management activities grouped under the title of wildlife restoration. The concept of wildlife restoration involves such activities as: natural resource agency coordination; research studies; game stocking; habitat development; habitat maintenance; increased access for hunters and other recreationists; protection of sensitive habitats and species from disturbance; and acquisition of lands.

The money for wildlife restoration comes from several sources. Primary sources are: the sale of state hunting licenses and permits; other fees charged by states and counties; the sale of federal Duck Stamps; an 11% manufacturers' federal excise tax on sporting arms and ammunition; and states' general funds.

Congress appropriated money for land acquisition for wildlife habitat protection as early as 1924 (Salyer and Gillett 1964:499). In 1929, Congress passed the Migratory Bird Conservation Act, which authorized a waterfowl refuge system. Appropriations were made by Congress for the acquisition of lands for this purpose.

The Migratory Bird Hunting Stamp Act was passed in 1934. This act provided that the funds collected by the federal postal system in selling Duck Stamps, would be used in acquisition of and restoration of waterfowl habitat. Currently, refuges support hunting in varying degrees. The Duck Stamp money collected is now used strictly for land acquisition (Salyer and Gillett 1964:504; Schaeffer, pers. comm.). The sale of Duck Stamps produces millions of dollars of revenue an-

nually.

The Federal Aid in Wildlife Restoration Act was passed in 1937. This important act provides a federal source of income specifically for state game agencies. It also forbids the diversion of hunters' license fees from the state game agency of any state that wishes to participate in the program (USDI 1968b:18). This act is commonly called the Pittman-Robertson Act. Its companion act in fish restoration, the Federal Aid in Fish Restoration Act, is commonly called the Dingell-Johnson Act.

The Pittman-Robertson Act provides for the collection of an 11% manufacturers' excise tax on firearms, shotgun shells, and rifle and pistol ammunition. After the Secretary of the Interior deducts 8% or less to provide for the federal government's administration expenses, plus appropriations for Guam, Puerto Rico, and the Virgin Islands, the remainder is divided into two equal portions to be divided among the states. The one half is divided in proportion to area, and the other in proportion to the number of licensed hunters. Pittman-Robertson funds are available to pay up to 75% of costs on approved projects in the categories of coordination, surveys and investigations (including research), land acquisition, and land and water developments (including maintenance and management).

Land purchased under the Pittman-Robertson Act provides a variety of outdoor recreation opportunities. The relation of the supply of recreational lands compared to the demand by recreationists for such lands is a topic of great contemporary concern. Outdoor recreation centered about or enhanced by the availability of wildlife populations

is a fast-growing segment of the recreation complex.

The presence or absence of wildlife available to the public is of interest to hunters and "non-consumptive" users. Hunters are primarily interested in game species and a place to hunt them. But hunters are fast becoming aware of the importance of non-game species, proper wildlife habitat, and control for the well-being of the game resource (Nelson 1971:38).

The "non-consumptive" user may be involved in nature photography, bird-watching, mammal-watching, or plant and insect collection; or he may just gain an increase in the quality of a recreational experience from seeing wildlife or its signs. Lime and Cushwa (1969:1) placed the number of serious American bird-watchers at more than 8 million. They expressed the importance of wildlife to recreationists as a function of the chance to see or hear wildlife in any area. Wildlife was cited as being a "supplementary benefit to campers." In addition, increased education related to the wildlife resource would probably greatly increase the esthetic impact of wildlife on recreationists.

Extensively-used lands are required for some wildlife-related recreational activities. These have predominantly natural, although perhaps improved, wildlife habitat (Clawson 1959a+b). There remain millions of acres in the United States of wildlife habitat suitable for these uses. A good deal of it is in private holdings, and therefore, is often inaccessible for public use.

The need for recreational lands, the growing inaccessibility of suitable habitat and recreational sites, and the American interest in

the public wildlife resource have prompted governmental agencies to regard land acquisition for wildlife-related public use as a proper wildlife and recreation management tool. Clawson (1959a) pointed out the fast rate of increase in outdoor recreation as a land use.

Land acquisition is allowed in several important wildlife-resource-related acts of Congress. Each year, millions of dollars are allocated to wildlife restoration projects, and a considerable proportion of these funds is channelled into land acquisition. This acquisition is for habitat protection, habitat improvement, species protection, wildlife production and population maintenance, and for use by recreationists.

Those interested in the wildlife resource as well as those concerned with efficient allocation of public funds have raised some questions about public land ownership and further land acquisitions. Such concern prompted the formation of the Public Land Law Review Commission, and their recent publication on the status of the nation's federally-owned lands (Aspinall 1970).

Two points seem to be of prime interest: costs to the public and adequacy of the public holdings to meet actual and projected demands. How does one determine is sufficient lands have been acquired? What are the criteria for sufficiency? How does land acquisition compare with other projects when allotment of limited funds is made? How should it compare? What are the costs to the purchasing agency pursuant to land purchase? What do these "total" costs mean to the public? What have been decision-influencing factors in past public land acquisition for wildlife, and how will they influence future

acquisition policy? Is there any way to estimate future land acquisition for public wildlife-related recreation?

It would require a great deal of information to answer some of these questions. Some of them involve individual and group values as they influence decision-making and policy development. Such information is rarely articulated. Although techniques are not available to provide answers to some of these questions, research can provide answers to a few of the questions and suggest solutions to others. All answers, in their turn, may help improve public land acquisition decisions for wildlife-related purposes.

With these ideas in mind, it was decided to investigate factors which might be correlated to the expenditure of funds to acquire public lands for wildlife-related purposes under the Pittman-Robertson Act. The Federal Aid in Wildlife Restoration Act provides for a relatively closed economic system and one, therefore, that lends itself to analysis. The Federal Aid Division of the Bureau of Sport Fisheries and Wildlife has been funding coordinated research at Virginia Polytechnic Institute and State University. For these reasons, the effort to investigate the acquisition of public land for wildlife-related purposes was confined almost entirely to land acquisition under the Federal Aid program.

The first two steps in the study were: 1. to review the literature of public land acquisition for wildlife management, public hunting, and other wildlife-related activities; and 2. to obtain numerical data on public land acquisition for such purposes as stated above, from the literature and from information sources such as the

Division of Realty in the Bureau of Sport Fisheries and Wildlife. The objective of the study would be to identify apparent influences on acquisition decisions under the Federal Aid in Wildlife Restoration Act, and to analyze data on past land acquisition under this act.

LITERATURE REVIEW

There is a vast literature of land economics that treats the problems and concepts of land purchase, lease, and easement. Relatively little is directed, however, specifically to public land acquisition, much less recreational land. Some general references exist however (Ciriacy-Wantrup 1963; USDI 1969b; USDI 1970b).

There has been a recent surge of public interest in governmental lands. A large portion of the publicly-owned lands is either primarily dedicated to various forms of outdoor recreation or provides outdoor recreation opportunities as a by-product (Aspinall 1970; Clawson 1958). Clawson (1959a) pointed out that outdoor recreation as a land use was increasing rapidly. Lime and Cushwa (1969) examined some of the values that wildlife provides to certain outdoor recreationists.

Recreation lands are administered by a variety of public agencies. The National Academy of Sciences (1969:56) noted this in outlining outdoor recreation needs. They stated that "particular stress should be placed upon instances in which jurisdiction and interests are shared by several governmental agencies with each other or with private organizations."

Hubbard (1965) discussed public land policy. The Public Land Law Review Commission was formed in response to public interest in the investigation of federal land policies in light of public needs and wants (Aspinall 1970). But there has been little study of land acquisition under the Federal Aid in Wildlife Restoration Act. Therefore, reliance upon studies of land policy under other programs must be made

when studying land acquisition under this act.

This lack of research attention is not due to a lack of interest in the influences affecting budget allocations under the Pittman-Robertson Act. Within a very few years of enactment of the bill, it was recognized that, of all the types of projects authorized, land acquisitions were perhaps the most influenced by outside forces (Day 1939).

Federal Aid-approvable projects other than land acquisition are somewhat self-perpetuating. Coordination is a necessity each year. It has been recognized by many investigators as a high-priority expense (USDI 1968b:17; National Academy of Sciences 1969:56). Long-range planning is an important aspect of this high-priority expense. A lack of coordination may result in inefficient use of funds.

Research needs and possibilities are somewhat endless. Watson (1962) pointed out that the technical staff of the Federal Aid program was rarely affected by changes in political administration. However, an anticipated change in political administration has been noted to have effects on land purchase under the Pittman-Robertson Act (Day 1939).

Development and maintenance are also limited primarily by lack of funds. There are basic minimal annual costs pursuant to most managerial units of wildlife-producing land. In Virginia, this is approximately $25,000 per unit, minimal (Engle, pers. comm.). Day (1938) pointed out that those tracts which a state acquired under the Pittman-Robertson Act must be maintained by the state. That perpetual maintenance costs must by borne by the states may have prompted the

present legal limitation of Federal Aid money used for this purpose to a maximum of 25% of a state's apportionment. Likewise, management expenditures are limited to 30% (USDI 1968b:5).

Land acquisition is limited by several factors. The majority of state game agencies have singled out fund availability as the most influential factor limiting waterfowl land acquisition (USDI 1966). While funds have been limited, the average purchase price per acre of land has been increasing. In 1957, the average cost per acre for waterfowl lands purchased under the Federal Aid Act was approximately $30.00, and the same cost in 1966 was approximately $130.00 (USDI 1966).

Clawson (1965) stated that the budget of Federal public land agencies for any one year was reflective of appropriations made to the agency in the previous year. The relatively slow start that land acquisition had made under the Pittman-Robertson Act was attributed by Quinn (Day 1939), in part, to low initial Congressional appropriations. This produced an apprehension that there might not be sufficient income to justify land acquisition as a restoration tool Such limited appropriations were, in part, related to concern over the threat of war.

If funds for land purchase were unlimited, there would still be serious checks to expanded purchase programs. Whitesell (1960) stated that an experiment in Ohio indicated that certain pursuant expenses outweighed acquisition costs on several purchased or leased tracts used for pheasant hunting. These expenses made the tracts uneconomical to purchase.

Another limitation that is becoming more and more important is the decreasing opportunity to purchase large tracts of suitable land (Jorgensen et al. 1964:513). MacMullan (1968) predicted that Michigan's game land acquisition program would be eliminated within the next 30 years due to lack of land available for purchase. The USDI (1968c) stated that opportunity is "one of the over-riding externalities which constrain all our land acquisition planning."

Land price increases have accompanied decreasing opportunity. Clawson (1958:65) noted that the cost per acre paid for additions to state park lands was rising much faster than the cost per acre for all farm land. He also predicted that such a trend would continue. The USDI (1960:6) stated that, while the amount of money available for land acquisition was rather static, the average cost per acre for land was increasing. They also wrote that, "Land prices and available acquisition funds set the pace and limitations for a program of this type."

There are two additional impediments of consequence. They are: removal of land from tax rolls when purchased by the state and continuing maintenance costs that the state must bear on its wildlands. Clawson (1965) outlined the former problem, and Adams (1938) the latter. These will be discussed more fully later.

In some cases, a "seed" area is purchased with reasonable plans set to purchase surrounding areas available in the future. But public land acquisition is self-limiting. Most wildlife land-owning agencies on a variety of governmental levels have planning horizons for land acquisition goals.

Land acquisition for the benefit of wildlife populations has been a policy popular with the general public. Popular support accompanied early acquisition programs (Salyer and Gillett 1964). American hunters comprise a minority of the public (Anon. 1972). Many of them rely on state public shooting areas for their hunting. Leonard (1965) cited evidence that the financial support that the hunting public provides for wildlife restoration produces benefits for non-consumers also.

Wildlife restoration activities on the state level are financed almost entirely by the hunting segment of the population (Congress 1964). The money comes from the Pittman-Robertson program and from license and permit fees charged by the states. Therefore, American hunters have a financial interest in state game management as well as a personal and esthetic interest. Although a minority, their numbers do given them some political impact.

Adams (1938) considered hunter support of land acquisition both a blessing and a curse. He recognized that the administrators of the Pittman-Robertson program would need to temper the desires of the sportsmen with their own educated judgement to avoid inefficient use of money.

Many of the wildlife conservation programs in the United States are the result of hunter interest in the resource. Day (1938) stated that the purpose of the Pittman-Robertson Act was essentially to produce harvestable surpluses of game.

The USDI (1960:4) wrote that the lands purchased under the Pittman-Robertson Act were the only source of hunting areas for many sports-

men. This occurred even though the stated primary objectives of the Federal Aid program were defined basicly as restoration, with harvest as the secondary objective. However, hunting, as an outdoor recreation activity, was to have highest priority on Federal Aid-acquired or -supported areas (USDI 1968b:6).

Jorgensen et al. (1964) pointed out that states are the main promoters of providing opportunities for hunters. Although many wildlife management areas were initiated as refuges with no hunting on the premises, both they and federal refuges now support varying levels of hunting. Jorgensen et al. (1964) attributed this (in the case of waterfowl) to concentrations of game animals and surpluses on these areas, while pointing out an increased need for public hunting areas.

Durell (1962) pointed out that there is a definite need to provide satisfaction to the majority of hunters. This involves providing places for them to hunt game populations. He emphasized the importance of government, private landowner, and inter-agency cooperation to supply the wants and needs of upland game hunters. Kruzan and Harding (1970) stated that the opportunity for the general public to hunt on private land is decreasing. On the other hand, the opportunity to hunt for a fee on privately-owned shooting preserves is increasing.

Nicotera (1971) stated that, in Wisconsin, the primary method for providing public hunting areas was through land acquisition. The Federal Aid program is a vital source of funds for such acquisition. Watson (1962) pointed out that the acquisition programs carried out under Federal Aid funding are especially valuable in light of the pre-

dicted future scarcity of acquisition opportunities and increasing hunter demand.

Not all states have the ability to provide enough publicly-owned, huntable lands to meet the potential demand (Berryman 1957). Clawson (1959a) wrote that potential demand would not materialize unless recreational opportunities kept pace with the growing demand. He said that demand projections were of potential, not necessarily actual, demand. These would be equivalent only if enough facilities and areas were provided for use.

Berryman (1957) proposed a system for Michigan of landowner reimbursements to allow for public hunting on private land. These would maintain a high standard of habitat and hunting quality without the ability to acquire enough land to satisfy public demand potential. He also pointed out that there have been successful programs in the past to provide private land for public hunting. These operated both through the development of good relations between the landowner and the sportsman, as well as through a reimbursement.

Land acquisition may take several forms. Purchase in fee simple is not the only acquisition method provided for by the Pittman-Robertson Act. The USDI defined land acquisition under both the Federal Aid in Wildlife Restoration Act and the Federal Aid in Fish Restoration Act as, "the acquisition of lands, waters, or interests therein, by purchase, condemnation, lease, or gift."

Many of the previously mentioned papers were concerned mainly with purchase in fee simple. The USDI (1960:5) stated that outright purchase had been found to be a necessary acquisition tool for suc-

cessful restoration for certain species and management plans. This is particularly true in water resource-based habitats, and less so in upland game habitat.

Barlowe (1958:339) stated that fee simple ownership provided more complete rights on the land than did any other method of acquisition of rights and priviledges. Schaefer and Nobe (1969:18) noted that such rights were often important to long-range planning. They mentioned that levels of land management and use control necessary for different types and purposes of game management areas differ. Therefore, while leasing of partial rights on an area may suffice for one wildlife restoration project, outright ownership of the land may be the only acquisition that will suffice for another purpose. Yet, outright purchase of lands is accompanied by certain difficulties. These were discussed previously.

Leasing is an approvable method of land acquisition under the Pittman-Robertson program (USDI 1968b). Briggs (1963) wrote that in the southeast region alone, approximately 9 million acres had been leased under the Pittman-Robertson program, for management and hunting. Whitesell (1960:10) mentioned that for land which is to be used in a limited manner (for example, public hunting of pheasants), leasing was more economical than purchase.

The USDI (1960:5) pointed out that many sizeable lease projects were conducted under "free" leases or low cost leases. This occurs particularly in the Southeast, where forest products companies own estensive acreages of forest and wood plantations. Haygood (1965:161) described land acquisition through no-cost leases. Schaefer and Nobe

(1969:22) wrote that the ability to pay for a lease over time was another advantage for a state game agency with limited funds. In comparison, purchase often involves a large layout of funds all at one time.

Temple (1951) wrote that in Oklahoma, the leasing by the state game agency of federally-owned lands for purposes of game management and public hunting was inexpensive. Leasing avoids certain pitfalls of fee simple purchase, such as removing additional land from the tax rolls. With reference to state waterfowl management areas, Jorgensen et al. (1964:513) stated that difficulties encountered in purchasing sizeable tracts in the Northeast had led to programs of long-term leasing of small project acreages on private lands.

Leasing by state game agencies from other governmental agencies ia practiced in some areas. Haygood (1965:161) listed agencies in Louisiana that leased land to the state game agency. These agencies included the Forest Service and the Army Corps of Engineers. In the majority of cases, the state paid nothing for the wildlife rights. In addition, the state leased tracts from commercial timber companies and private landowners. The total leased acres from these four sources were 10 times those owned by the state expressly for wildlife management.

A combination of leasing and purchase has been a successful policy in some areas. Whitesell (1960:10) stated that the use of different combinations of purchasing and leasing to provide public hunting provided flexibility not found in strictly-purchase programs. He included these factors in a consideration of how much of

each type is necessary under differing circumstances of current and projected needs, available money, efficiency of land management, and proportion of hunting needs that can be better provided for through alternative methods.

Schaefer and Nobe (1969:13) stated that Colorado required consideration of purchase, lease, and easement methods in all acquisition projects. They pointed out that this requirement was not always fulfilled. This neglect was mentioned as a factor contributing to suboptimal use of financial resources. The USDI (1960:6) wrote of a need to use all methods of land acquisition to meet rising demand for public hunting and fishing areas.

Berryman (1957) mentioned two states which combined purchase and leasing in their program of providing acres for public hunting. He commented that these two programs were considered successful. In Wisconsin, hunting privileges were leased for the public on sizeable tracts of land. Several of these leased tracts were adjoining state-owned game management areas. In Florida, the purchase of "key" tracts was followed by the leasing of large adjacent acreages for both game management and public hunting. This system provided approximately 3.7 million acres. The majority of these areas required a special $5.00 fee for the hunting season, to help provide money for game management and acquisition expenses.

Leasing, though, is not without difficulties. Nicotera (1971), discussing leasing in Wisconsin from 1959 through 1971, stated that Wisconsin experienced a decrease in the number of acres it leased with Pittman-Robertson money. This was attributed primarily to an in-

crease in bad relations between the hunters and the private landowners. In addition, changes in land ownership (increased absentee land ownership) and land use, and destruction of habitat contributed to the decrease in acres leased.

Whitesell (1960) wrote that, if renewal of an important lease was not possible, an inefficient distribution of hunters might result. However, he mentioned that, should there be purchased lands in the area, the hunting pressure imbalance might be "buffered" until redistribution of hunting pressure occurred to relieve the situation.

The Pittman-Robertson Act provides for improvements to be made on leased land, but only if the state game agency has adequate control on the area for the time-span of use of the improvement (USDI 1968b:13). Therefore, the need for improvements must be a consideration when leasing land. Radosevich and Nobe (1969) wrote that fee simple ownership provides the most flexibility in policy, planning, and implementation on land. On the other hand, Schaefer and Nobe (1969:20) mentioned that leasing provides rapid flexibility in the land supply base to meet changes in outdoor recreation demand.

A perpetual lease is an inexpensive way to expand public hunting acreage. However, Schaefer and Nobe (1969:24) pointed out that in Colorado there was little opportunity to obtain such an agreement. The lack of interest in this type of an agreement on the part of private landowners is due to economic reasons. Perpetual leases do not take tax increases or general inflation into account. Therefore, a perpetual lease is not attractive to the landowner.

The third general method used by the states to acquire game man-

agement and public hunting areas is the purchase of land easements. Easements involve only the purchase of certain rights on a property (Meyers 1971). As such, they avoid the removal of the property from the tax rolls (Schaefer and Nobe 1969:25). Easements are varied since the state may arrange for any combination of rights (Jordahl 1963:359). Meyers outlined some of the rights that may be purchased: preservation of habitat, hunting and fishing, and scenic rights.

The purchase of perpetual easements is a practice in many areas and by many governmental agencies. Ciriacy-Wantrup (1964) stated that the relatively low cost of easements meant that a perpetual easement may cost little more than a 20-year lease. Schaeffer (pers. comm.) stated that the majority of lands held by the National Migratory Bird Refuge System under either leasing or easements, was held under perpetual easements. The perpetual easement program in the system of federal refuges was begun in 1935. It has been particularly significant in preserving potholes and other small waterfowl breeding areas (Salyer and Gillett 1964:563). Meyers (1970) mentioned that perpetual easements had provided, or prevented the loss of, close to 6500 acres of public hunting land in 5 years in Wisconsin. The total number and acreage of easements held for game management purposes were 149 easements on 13,253 acres (as of October, 1970).

Schaefer and Nobe (1969) suggested that the use of perpetual easements for hunting rights might be an economical and equitable method of producing public hunting opportunity. Easements might also decrease landowner reluctance toward public hunting on private property in Colorado. Jordahl (1963:361) found the use of easements to

be the least expensive method of providing public fishing rights in particular instances.

There are problems associated with the use of easements. The Colorado Department of Game, Fish, and Parks (1967) studied easements in Colorado. They found that a reticence on the part of landowners to sell easements of fishing rights appeared to be due to the low price offered for easements. In addition, Jordahl (1963) mentioned that land value may decrease when perpetual easements are sold. This reduces the land's tax value and the economic incentive to the landowner to sell an easement. The ownership of part-rights may suffer from difficulties raised by neighboring landowners or destructive or offensive behavior by those recreating on the land under the easement (Schaefer and Nobe 1969:25).

Gifts can be considered as one additional form of land acquisition. This forms a tangible part of the acquisition process on a local level in some areas. Overall, it is rather insignificant in the Federal Aid program. The situation is somewhat different on federal refuges. There a formidable proportion of total refuge acreage was obtained through withdrawal of public domain, or as a result of laws that made lands belonging to different agencies available to the refuge system (Migratory Bird Conservation Commission 1969; Salyer and Gillett 1964: 503). Clawson (1958:65) in writing of state parks, cited that 38% of land acquisition had been purchases, 24% were gifts, and 30% were transferred from other state and federal agencies.

There are millions of acres of federally-owned and state-owned lands that could be producing recreation far in excess of what they

are now producing if adequate access were provided. The USDI (1957:5) stated that, "The best management and research programs are worthless to sportsmen without assurance of access to areas in which to fish and hunt." This concept applies to all wildland recreationists and all wildland recreation.

The problem of access if of two types. The first involves the access for the public to the boundary of publicly-owned lands. Hay (1960) revealed that, in Colorado, except in the case of main thoroughfares, access to the boundary of public lands that supported hunting lay across private property. Of the good-quality fishing and hunting areas, 12% were found blocked to "reasonable access." Reasonable access was defined as the absence of restricted or tolled public access, or necessity to travel extensively by foot or horseback from another entry point. In a nation-wide survey, involving replies from 46 states, free public access was denied to approximately 18% of the public lands (Hay 1960).

Hay (1960) cited reasons why private landowners denied the public free access to adjacent public lands. One was increased demand, resulting in need for control of numbers using private property as access. A second was increasing incidents of destructive or disruptive actions on private property. Economic potential in fee-charging and access control was another reason. Preservation of quality of the resource for personal or guest use and the cost of maintaining private roads used by the public constituted two more reasons. Many landowners charged some fee for access. When those who denied free public access across their land were asked if they would sell a right-of-way, only

13% agreed to sell or provide access. Of these, a large portion asked prices above a fair market value. Hay noted that there are adverse effects on the game population where hunters do not have suitable access, due to the absence of sufficient hunting pressure.

The USDI (1957:5) stated that acquiring access is most often accompanied by development and construction to realize benefits from the investment. Access acquisition, once completed, results in expenditures for maintenance and improvements over time.

The purchase of access sites using Pittman-Robertson funds is a fairly recent development. The USDI (1960:5) said: "Of recent importance has been the acquisition of access sites. Such sites are the key to opening vast acreages of public lands to fishing and hunting that were formerly isolated because of private land ownership around the perimeters or at other strategic locations."

In general, the literature reviewed revealed a lack of statistical analysis of wildlife-land acquisition on the national level. Some analysis was done on the state level (Schaefer and Nobe 1969; Hay 1960; Nicotera 1971; Whitesell 1960). Analysis carried out on the national level was generally concerned with federally-owned public lands, wildlife-oriented and otherwise (Clawson 1958; Aspinall 1970).

METHODS AND PROCEDURES

Variables were selected for analysis on the basis of the literature review and data availability. These variables were graphed against time to detect correlations. Regressions were then run on the data.

Wildlife Abstracts and the Wildlife Review were searched, and the Library Reference Service of the Denver Conservation Library was utilized. Most sources read did not deal directly with the Pittman-Robertson land acquisition program. However, they contained information about land acquisition programs, most of which were considered subject to similar factors.

The major source of information dealing directly with wildlife-land acquisition under the Pittman-Robertson program was the series of Pittman-Robertson annual reports for fiscal years 1947 through 1970. These reports contained both text and tables.

Between 1947 and 1956, the Federal Aid annual reports included extensive discussions of financial activities in each year in various categories. The reports also included information on hunting license sales and excise tax revenues. These provided a background for selection of variables to be examined. The numerical reporting through 1956, however, was not as complete or in a form as appropriate as in later years. The format of reporting was subsequently changed so that, from 1957 through 1970, the majority of the text was comprised of a short report on a particular phase of Pittman-Robertson activities, and a brief summary was devoted to financial aspects of the program.

The tabular information was, however, complete and detailed.

The type and extent of reporting varied over the years. Some information, available in one year, was not available for the next. Therefore, there was not only the need to investigate pertinent variables but also those consistently or reliably reported.

Variables Selected for Analysis

The following preliminary variables were chosen as desirable for analysis, based on the literature review:

acres purchased; cost; percentage of total obligations devoted to purchases;

acres leased or eased; cost; average lease or easement length; percentage of total obligations devoted to leases or easements.

The following were selected as independent variables:

Federal Aid dollars available for obligation;

other dollars available for land purchase and other projects;

year;

hunting pressure (in terms of hunter numbers).

There were several variables that were desired for comparison with Federal Aid data. These were:

acres purchased by the Migratory Bird Conservation Commission; cost;

acres leased and eased by the Migratory Bird Conservation Commission; cost; average length of lease or easement.

In order to have obtained Federal Aid data of the most accurate

and desirable type, it would have been necessary to consult with the five regional offices of the Federal Aid Division to collect the data from their files, or to follow the same procedure with all the states (Langenbach, pers. comm.). The ratio of costs in gathering such data compared to the greatest possible increase in accuracy was not thought to be sufficient to justify such a search (Salinas, pers. comm.). In addition, the availability of consistent data or improvements over that otherwise available, could not be assured.

The results of the data search are summarized in the following pages. There occurred discrepancies between figures given for variables in the Federal Aid annual reports. Judgments were based on substantiating evidence from other sections within a report or from other reports wherever possible. Sometimes, this involved the use of calculated figures, or figures arrived at indirectly through the use of other figures. Appendix Tables 1 through 4 show data for the four land acquisition variables (acres purchased, purchase dollars, acres leased or eased, and lease and easement dollars), and their sources.

Federal Aid-Supported Land Purchase Variables.

Acreage. It was desired to have the number of acres purchased by the states in a given fiscal year. However, the chain of events between initial project approval and final reimbursement by the federal government made the term, purchased, vague. The variety of values obtained is listed in Appendix Table 1.

The inception of Federal Aid involvement in a state project occurs when the state submits a project statement for approval (USDI 1968b:5).

If approval is granted, the second step is submitting a project agreement of greater detail. This, if approved, constitutes a contract between the Secretary of the Interior and the state. Following this "second" approval, the Federal Aid funds are set aside from the state's appropriation. This action is called fund obligation. Thirdly, the state proceeds with the project, requesting its reimbursement when completed, or at intervals satisfactory to the Federal Aid Division.

It was necessary to define the point at which purchase was considered complete, and to observe how purchase information was presented in the annual reports. Between 1961 and 1970, reporting was of the form defined as acres purchased. This was assumed to represent acres held in fee title by the states, or the end of the third stage as outlined above. This was the only type of purchase acreage figure given in these 10 years.

Prior to 1961, a major difference in reporting was seen. In the years 1959, 1958, 1957, and 1955, the acreages concerned with land purchase in fee simple were acres of land approved for purchase (otherwise titled, land purchases approved). The terminology used indicated that this approval was the "second" level of project approval, since the figures quoted for dollars to accompany the acres were quoted as dollars obligated.

In 1956, two different figures were given. One was land purchases approved (as above) and the other was of projects submitted for purchase. The latter figure was greater than the former. The former was chosen as being more similar to the data collected for the above years.

The two acreage figures given for 1954 were identical, although they were variously described as land purchases approved and acres submitted. They were assumed to be submitted and approved. In both 1955 and 1954, per acre prices were quoted as option prices. Just what particular stage that this represented was not ascertained.

In 1953, the two figures described as land purchases approved and as acres contracted for purchase (assumed to be the "second" stage approval and post-"second" stage approval, respectively) were identical.

In 1952, the two figures presented were as in 1953, and were identical. They differed only slightly from the figure I calculated from the 1953 report for acres contracted for purchase in 1952, being slightly less. The same discrepancy occurred for 1951 when I made calculations from the 1952 and 1951 booklets. However, the identical figures given in 1951, for 1951, were given as land purchases approved and as acres "tallied." In 1950, for 1950, the only figure given was for acres that the states bought.

Only one figure was given for 1949, and that was "almost 163,000" acres purchased. This rounded figure was used. In 1948, only two identical figures were given, and they were described as acres on acquisition proposals submitted and as land approved for purchase. The same figure for 1947 was given in 1947 and 1948 as acreage acquired or being acquired, respectively.

The 1948 and 1947 reports contained tables of land approved for purchase each year, and acreage acquired or being acquired each year, respectively, and cost in both cases, since 1939. There were discre-

pancies between most of the figures, with those given in 1948 being either equal or greater than those given in 1947. A note accompanying the 1947 table appeared to indicate that the figures given were equivalent to acreages approved for purchase. Data prior to 1947 were used sparingly in the analysis since they were available for only a few of the variables. However, they were used in graphical work. The 1948 table was used in preference to the 1947 table in the graphs. It appeared to be more consistent with the types of figures presented in later years.

Combined fish and wildlife projects are approvable under the Federal Aid program, but the acreages purchased for combined projects have not been included here. They were not included because there is no feasible way to differentiate between the Pittman-Robertson and Dingell-Johnson shares in the cost of these projects in this study, or the proportion of acreage that is of direct benefit to wildlife, be it 100% or less. They were always available as separate figures.

Costs. The gathering of cost figures for fee simple purchase was more complex than for acreage. There was less consistency between figures and more room for misinterpretation of data. A table for costs similar to that for acreage is presented in Appendix Table 2. This table will help clarify this section for the reader.

There were a variety of types of costs. A cost might be classified as federal and state combined, exclusive of overhead (actual "land cost"); federal share only (approximately 75% of actual "land cost"); net obligation of Federal Aid dollars (Federal Aid share of costs of

projects after savings from obligations have been subtracted); etc. The Federal Aid annual reports were sometimes vague as to the type of cost being reported.

Between 1961 and 1970, an accurate figure was available for use. This was the federal-state combined cost of land purchases in fee title, exclusive of overhead. These figures applied only to the acreages of wildlife lands purchased, as explained in the preceding section. Prior to 1961, however, such figures were not always so readily available.

From 1957 through 1960, the only land acquisition cost figures available were for Federal Aid net obligations to land acquisition. Net obligations to land acquisition include both acquisition in fee title, and by lease or easement, as well as combined fish and wildlife projects. As of 1970, all combined acres only equaled 3.31% of Pittman-Robertson-only wildlife acres. Their cost was 8.47% of all state and federal combined costs. Their average cost per acre did not appear reflective of "normal" wildlife land costs. The values of net obligations to land acquisition should be in excess of those Federal Aid dollars actually applied to wildlife land purchase only. In addition, a multiplicative factor of 1.33 times the Federal Aid net obligations to land acquisition is used to approximate federal and state combined costs, since the state generally pays no more than 25% of most project costs (Salinas, pers. comm.; Engle, pers. comm.).

For 1953 through 1956, land purchase costs were calculated by using the average option price per acre given, times the acreage given. For particular years these were given in more than one report. When

this occurred, the prices calculated differed by only 1 or 2 percent.

For 1951 and 1952, only the net obligations to land acquisition were available, while in 1949 and 1950 price per acre was given. Adjustments were required, as was discussed earlier.

Land purchase cost figures (fee title costs only) for 1947 and 1948 came from tables in those two annual reports.

In summary, a major inconsistency in expenditures for land purchase was seen for the years 1951, 1952, and 1957 through 1960. In addition, minor reporting inconsistencies occurred or may have occurred between other years. Refer to Appendix Table 2 for the data used for this variable.

Dollars per acre cost of land purchase. This figure was calculated simply by dividing the cost variable by the acreage variable discussed above. The accuracy of this variable was judged adequate for this study. It was the only feasible estimate of average cost per acre purchased under the Pittman-Robertson program each year.

Federal Aid-Supported Lease and Easement Variables. There were data given in this category in most reports, but not for all the variables considered, each year. Where figures were present, they were considered accurate, although inconsistency between years was found. There was no way provided in any year to account for proportions of leases to easements, for the time spans involved with different acreage and price agreements, or for free leases. Therefore, no attempt was made to differentiate at all between types of agreements entered into, their average length, or their average cost per year of agreement.

Acreage. Three main problems accompanied gathering values for this variable. Most obvious was that there were no values available in the annual reports for 1951 and 1957 through 1959. It was assumed that there were acres leased or approved for lease in these years.

Between 1961 and 1970, the acreage given in the reports was for approved lease and easement purchase. This is assumed to be the "second" stage approval, as before. The figure given for 1960 was titled leased area land acquisition. The 1956 and 1954 values were cited as for projects submitted, while that for 1955 was for acres approved for lease. The 1947 through 1953 values were given as acres leased. The different data found for this variable are tabulated in Appendix Table 3. The assumption was made that the figures quoted for any one year involved projects that were "actively" negotiated during that year.

The second problem was less obvious than the first. During the 1960's, New Mexico was leasing the hunting rights on over 9 million acres of school trust lands. In 1963 and 1965, there were no entries for this acreage in the annual reports. In addition, in 1969, Virginia, Mississippi, and Florida leased a combined total of about 6 million acres. These figures were greatly in excess of the acreages leased in other states and in other years under study. In addition, the average price paid per acre for these lands was much lower than that paid for other lands. It was the advice of Federal Aid officials that the acreages in these states in the relevent years be dispensed with.

The third problem was differentiating between combination fish and wildlife acres, and wildlife-only acres in certain years prior to 1960.

Cost. This variable was accompanied by a problem similar to that of the previous variable. Prior to 1960, there were no values given or accurately calculable for this variable. There was no difficulty in discriminating between combined fish and wildlife and strictly-wildlife projects in the years for which data for this variable were available. The values found for this variable are presented in Appendix Table 4.

Federal Aid-Supported Waterfowl-Oriented Land Purchase Variables. The acreage and cost data for waterfowl-oriented land purchase were found in the 1966 annual report, covering the years 1957 through 1966, and for each succeeding year from each succeeding booklet. These figures applied to acres purchased. Cost per acre data were derived as described for the preceeding variable. These variables were desired for comparison with Migratory Bird Conservation Commission variables.

Federal Aid Net Obligations. In several years, booklets contained a table titled net obligations by type of projects. The latest one published was in 1967 (USDI 1967:17). It contained entries for each year since 1939. The information supplied from these tables was the net Federal Aid dollars and percent of total net Federal Aid dollars obligated to each of the four categories (surveys and inventories, land acquisition, development, and coordination). Total net obligations was also given. The definition of net obligations (USDI 1967:17) was given as "the result of deducting savings on projects closed during the year from obligated amounts...." The table lists Federal Aid dollars only, deduced from comparisons with figures given in various textual refer-

ences. I assumed that these land acquisition values included all types of acquisition.

Net obligations should also include money spent on combined fish and wildlife projects. This net obligation for combined fish and wildlife projects cannot be isolated as such, but in many instances, land purchase costs exclusive of combined projects were available. This fact must be kept in mind when using the figures just mentioned. For reasons given in a previous section, efforts were made to exclude combined projects from this study.

Federal Aid Dollars Available for Obligation. This variable was composed of several variables, Federal Aid apportionment, unobligated balance, working budget, and reversions to the Migratory Bird Conservation Commission.

Apportionment. This variable was readily available for each year, and also for each state. Hawaii, Guam, Puerto Rico, and the Virgin Islands made no use of Federal Aid money for land purchase and leasing or easement. They and Alaska were included in the total used for this figure each year, since it was not always possible to factor out their contributions from several variables. Their financial impact as territories was minor. The impact for Hawaii as a state was only 1% of that of Texas, for example. The financial impact of Alaska as a state was considerable.

The apportionment variable must not be confused with the Federal Aid receipts from the previous year. Prior to apportionment, a portion of the receipts, generally about 5%, was set aside for use by the Fed-

eral government in meeting its expenses in administering the act. The apportionment could, however, be taken as a fairly accurate index of receipts, so long as one recalls that between 1956 and 1960, apportionments each year were increased by about $2.7 million of "backlog" funds from the first 9 years of the program.

Unobligated balance. Under the terms of the act, a state has 2 years in which to obligate an apportionment. For example, in fiscal year 1956, any money remaining from the previous (1955) fiscal year's apportionment was available for obligation in addition to 1956's apportionment. At the end of the fiscal year, 1956, any unobligated money remaining from the apportionment of the preceding fiscal year (1955) would be transferred to the Migratory Bird Conservation Commission. This reversion of unobligated funds followed the requirement that funds be available for obligation by the states for only 2 years. The balance was readily available, being found in the same tables as the Federal Aid apportionment data.

Reversions to the Migratory Bird Conservation Commission. This money is the unobligated balance from 2 years previous to a year in question. It was chosen as a variable because it accounted for the only flow of money out of the Federal Aid in Wildlife Restoration program other than federal government expenses in the program. Therefore, it accounted for the loss of money from the system not accounted for by expenditure. It also might be taken as an index of the ability of the states to provide money for wildlife expenditures exclusive of its appropriation. Money generally reverts for one of two reasons: either the state cannot or will not match its appropriation, or approved

projects fall through and the money is not obligated elsewhere.

Working budget. This was a variable calculated by adding the Federal Aid appropriation for any one year and the balance remaining available for obligation from the previous year. It was more representative of money available for obligation in any one year than was the Federal Aid appropriation alone.

Variables Related to Hunters. These variables included the numbers of hunters, the revenue from state license and permit sales to hunters, and the averages of hunters per acre of the United States and dollars of license revenues per hunter.

Hunting license holders. This variable must not be confused with the number of hunting licenses sold. The number of licensed hunters is not truly representative of the number of individuals who bought hunting licenses. A license holder is one hunter, regardless of the number of licenses he bought. However, all states count non-resident license-buyers as license holders, in addition to the resident license-buyers. The non-resident may have also purchased a license in his state of residence, and so been counted already as a license holder. When totaling on the national level the number of license holders reported by the states, some number of hunters will be accounted for more than once, since they hunted in more than one state. The discrepancy thus produced was considered to be minor.

The reported hunting license holders used in the Pittman-Robertson apportionment process was available for all states (not territories) in all years concerned, except for Colorado, Michigan, Missouri, and

Wisconsin in 1959 through 1961. The annual reports listed these four states' values in these three years as being unavailable at the time. This is not consistent with the stipulation that certified licensed hunter figures are to be furnished for fund apportionment. The Washington office of the Federal Aid Division did not have these data. Letters were sent to the four states, requesting the missing information as part of the interval from 1953 through 1963. The results varied.

No reply was received from Colorado. Minnesota was the only state to send their hunting license certified figures (equivalent to hunting license holders) as requested, and as required by the Pittman-Robertson Act.

Wisconsin sent a listing of licenses sold, according to category of license. The reply stated that, for the interval requested, 1953 through 1963, the figures requested were not available. This was not consistent with Wisconsin having submitted a certified figure for licensed hunters in years previous to 1959 and after 1961. Figures reported in the Federal Aid annual reports were for the year 2 years previous to the report prior to 1960, and for 1 year previous to the report after 1959.

Michigan replied that the information requested was not available for most of the years requested, and sent a listing of licenses sold. However, the reply also stated that the sum of licenses sold in any one year, when multiplied by 0.72, should approximate the number of licensed hunters. This was based on experience in recent years. The calculation was made. The discrepancy of state-certified figures for

pre-1959 and post-1961 reported in the Federal Aid annual reports existed in this case also. Appendix Figs. 15 through 18 show the Federal Aid-reported licensed hunters and license sales, and data supplied by the states, for each state.

Cost to hunters. This figure was defined as the total cost that hunting license holders paid for state-issued licenses, permits, and other fees. It was obtained from the same source as the previous variable.

As was discussed in an earlier section, the Pittman-Robertson Act provided for the guarantee of license and permit receipts not being diverted from a state's game agency. These revenues, in many states, accounted for all or almost all of the game agency's income, exclusive of Pittman-Robertson funds. In some states, Michigan for example, these revenues go to the natural resources or conservation agency (Bell, pers. comm.).

Average license expenditure per hunter. This variable was simply derived by dividing the total costs to hunters for state-issued licenses and permits, etc., by the number of licensed hunters in each year.

Migratory Bird Conservation Commission Data. The Migratory Bird Conservation Commission has published an annual report for each fiscal year since 1955. Prior to 1955, the National Migratory Bird Refuge lands were reported along with all other national refuge lands. The following procedure was used in gathering data from these earlier reports, on the advice of Ben Schaeffer, Chief, Division of Realty, Bureau of Sport Fisheries and Wildlife. The data in these years were

given cumulatively. First, in each year, non-migratory bird refuge lands were subtracted from the total acres in refuges. Secondly, the value so obtained in any one fiscal year was subtracted from that of the succeeding fiscal year. This produced, for the succeeding year, the increment acquired in that year. This same procedure was used for the other variables obtained. I considered this approximation accurate enough.

Occasionally, an acreage or a cost would be listed without a corresponding price or acreage. This would be due to a delayed land payment, or acreage correction, or some other abnormal circumstance. If one were to use the totals of acres acquired and dollars paid to estimate average dollars paid per acre for a given year, the estimate would be slightly incorrect if this situation occurred in that year. This was considered insignificant due to the relative magnitude of the numbers concerned. The format of reporting permitted the separation of purchased and leased areas from gifts, donations, or free transferred areas. These free areas were excluded from the analysis.

Refuges. Both refuge acreage purchased and its cost were easily gathered. The procedure outlined above was used in the earlier years, and the national totals for each were simply transcribed in the later years. Data was only taken for the years 1950 through 1970 because of difficulties encountered with the previous years.

Cost per acre spent on refuge purchases was calculated by a simple division of costs by acres purchased.

Waterfowl Production Areas. This rather new program was first tabulated in the Migratory Bird Conservation Commission reports in

1961, and data collection for it was done in a manner identical to that for refuges in the later years.

Average cost per acre paid for land purchase each year was calculated as described for refuges.

Miscellaneous Variables. There were three of these variables.

Area of the United States. This variable (in acres) was only used in calculating the next variable. It was derived from Federal Aid sources.

Licensed hunters per acre of the United States. The number of licensed hunters each year was divided by the number of acres in the United States. This was used as a use index.

Year. This variable ranged from 47 to 70, corresponding to the years 1947 to 1970.

Regression Analysis

BMD02R, a statistical computer program from the University of California (Dixon 1971), was used for the regression analysis. The programs were run on an IBM Model 370 computer. The analysis provides for stepwise, multiple linear regression, progressively adding one variable so as to reduce the error sum of squares. Different options are available to control and supplement the regressions.

Prior to the regression analysis by computer, a number of variables were graphed against time. The purpose of this was two-fold: to gain an overview of the data for each variable and to detect possible correlations between variables. The use of time for the X-axis

enabled comparisons to be made of many pairs of variables with a relatively small number of graphs.

The two primary analyses were designated as AN70+1 and AN67+1. The reason for the use of two programs for this analysis was that data on Federal Aid net obligations by project categories were limited to prior to 1968. These constituted some of the variables in AN67+1. Each program will be described. Appendix Tables 5 and 6 list the variables included in each program, their means, and standard deviations. Lease and easement variables were not analyzed, due to the great variability of the variables, and the problems involved in collection of the variables. They are, however, presented in graphs in Appendix Figs. 13 and 14.

Program AN70+1 consisted of 23 variables and 7 subproblems. Fifteen of the variables were original data; eight were the result of transgenerations. For the analysis, all variables with six or more significant digits to the left of the decimal place were scaled five decimal places on the variable format card; that is, each of these data was multiplied by a factor of 10^{-5} by the computer as it read the data cards. This was done to reduce round-off error. This scaling must be remembered when evaluating the program output. On all tables, variables that were scaled before analysis are indicated.

A correlation matrix figured prominantly in setting the following options: F-level for inclusion, F-level for deletion, and tolerance level (Dixon 1971). The F-level for inclusion is the minimum individual F-value necessary for a variable entering the equation at any step. Computation ceases when no variable remains that would have an

F-value equal to or greater than the F-level for inclusion that was chosen. This level was set at 2.50, or less than the F-value for 1 and 20 degrees of freedom at the 0.90 probability level. The F-level for deletion was left at the minimum due to the effect of the other two options making it virtually unnecessary. The purpose of a tolerance level set at 0.50 was to avoid the inclusion of highly-intercorrelated independent variables in an equation.

The only additional restrictions on the entry of variables into the equations in AN70+1 were: variables from fiscal $year_{t+1}$ could not enter as independent variables in any subproblem, except for $year_{t+1}$ in the case of a fiscal $year_{t+1}$ dependent variable; and the area of the United States could not enter into any regression, since it was a constant. The designated dependent variables were: acres purchased, combined state and federal dollars paid for land purchase, and dollars paid per acre in fiscal $year_t$; acres purchased, combined state and federal dollars paid for land purchase, and dollars paid per acre in fiscal $year_{t+1}$; Federal Aid $appropriation_t$; and the working budget in fiscal $year_t$.

The purpose of the data analysis decisions was to accomplish these objectives: to analyze pertinent dependent variables in light of current decision-making; to analyze pertinent dependent variables in light of the previous fiscal year's decisions; and to avoid inclusion in an equation of highly intercorrelated independent variables, variables of low individual F-value on the dependent variable, or variables of low F-value considered in light of variables already in the equation.

Program AN67+1 was very similar to AN70+1 in execution and the restrictions specified above. Net obligations by project categories for both fiscal $year_{t+1}$ and fiscal $year_t$ were added, raising the total number of variables in the problem to 40. The additional dependent variables were: dollars and percent of total net obligations devoted to land acquisition in fiscal $year_t$ and fiscal $year_{t+1}$; and dollars of total net obligations for fiscal $year_{t+1}$. Federal Aid appropriation and working budget were excluded as dependent variables and were used as independent variables in all subproblems.

In addition to these two programs, three programs (MBCC-1, MBCC-2, and MBCC-3) were run to investigate the absence or presence of relations between Federal Aid land acquisition data and Duck Stamp land acquisition data. The original variables considered were: Federal Aid combined cost and acres of land purchased (fiscal years 1950 through 1970); Federal Aid combined cost and acres of waterfowl lands purchased (fiscal years 1957 through 1966); Migratory Bird Refuge System cost and acres of land purchased (fiscal years 1950 through 1970); and Waterfowl Production Area cost and acres of land purchased (1961 through 1970). Since data were lacking for all four variable groups over the time period 1947 through 1970, three programs were run. A listing of the variables used in the three programs, their means, and standard deviations are given in Appendix Tables 7 to 9. Their correlation matrices are found in Appendix Tables 12 to 14.

For each subproblem, a Federal Aid dependent variable was run against its counterparts (for example, Federal Aid waterfowl acres purchased was run as a dependent variable with Migratory Bird Refuge

acres purchased and all Federal Aid acres purchased as independent variables).

The BMD02R output included the following: variable means and standard deviations, and a variable correlation matrix for each program; a subproblem step-by-step multiple R, standard error of the estimate, and analysis of variance table; a subproblem step-by-step enumeration of constant, variable coefficient, standard error, and F-to remove for each variable entered in the equation as well as the partial correlation, tolerance, and F-to enter for each variable not in the equation; and a summary table for each subproblem, enumerating for each step the variable entered or removed, the multiple R and R^2, the increase in R^2, the F-value to enter or remove, and the number of independent variables included in the equation.

RESULTS

The following trends were observed from graphs. Increases over time were noted in a number of variables. From 1947 to 1970, Federal Aid appropriations increased from approximately $8.5 million to $31.5 million; working budget, from about $8.5 million to $43.5 million. Total net obligations increased from about $0.5 million in 1939 to $33.5 million in 1967; net obligations to land acquisition from $0.15 million to $3.55 million in the same time period; dollars spent on land purchase from approximately $0.15 million to $6.96 million in 1970. Dollars per acre spent on all Federal Aid land purchased has increased also, from about $5.00 in 1939 to $50.00 in 1970 (with a peak of $86.00 in 1968); for waterfowl-oriented land purchase, prices went from $30.00 in 1957 to $163.00 (the peak) in 1970. The reported number of hunting license holders has increased from 8.2 million in 1945 to 15.4 million in 1970; individual licenses sold increased from 18.2 million in 1959 to 22.2 million in 1970 (a reflection of increased hunter numbers and at the same time, a function of changes in state licensing policies). The cost of licenses and permits bought by hunters has risen from approximately $15.5 million in 1945 to $100.15 million in 1970, greater than a 500% increase. From 1947 through 1970, the average cumulative number of acres purchased under the Pittman-Robertson Act per licensed hunter rose from 0.064 to 0.207, an increase of over 200%. In the Migratory Bird Conservation Commission data, acres purchased, dollars spent, and cost per acre for refuge and Waterfowl Production Area land purchased have seen an increase

over time.

Decreases were also apparent for some variables over time. The percentage of total Federal Aid net obligations devoted to land acquisition decreased from 27.5% in 1939 (a peak of 48.5% was seen in 1944) to 16.5% in 1967. Acreage purchased under the Pittman-Robertson Act each year has been highly variable, but in recent years (1961 through 1970) has been below the mean for 1947 through 1970, 8 years out of 10. Acreage purchased for waterfowl has followed a gradual decline from 75,000 acres in 1957 to 20,000 in 1970. The sale of Duck Stamps has declined at least for the years 1957 through 1966, from approximately 2.3 million to 1.6 million. Data for the variables discussed herein is presented Appendix Figs. 1 through 12.

Land acquisition under the Pittman-Robertson program started slowly, reached its greatest importance as a proportion of Federal Aid net dollars obligated during the war years of 1942 through 1945, and has been relatively stabilized (0.15 to 0.20) since about 1953. In terms of dollars, the curve increased in the first few years, decreased during the war years with decreased appropriations, and gradually increased since about 1947.

The results from the regression analyses are summarized in Tables 1 through 5. There is one table for each variable category. Each subproblem with a form of that variable as the dependent variable is included in the one table. The same is true for the other variable categories. It is important to remember that the data for certain variables were multiplied by 10^{-5} before the analyses. Therefore, when entering data for these scaled variables into the equations, one

must remember to scale them by 10^{-5}. In addition, the results for scaled dependent variables obtained by using these equations are in units of 10^{5}. All scaled variables and their scaled values are indicated in the tables.

For each subproblem, the following are given: the dependent variable; multiple R; standard error of the estimate; F-ratio from the analysis of variance table; the independent variables entered into the equation, their coefficients, standard errors, and F-to remove; and the constant, or intercept.

The equations presented are not intended to be interpreted literally. For instance, a negative coefficient for an independent variable does not necessarily mean that a decrease in that variable in a year will result in an increase in the dependent variable in that year.

The interpretation of the results thus presented may be illustrated by the following example for the variable, acres purchased$_{t+1}$, in program AN70+1. The equation produced is:

(acres purchased$_{t+1}$) = 1.87511 - 0.29967 (license costs per hunter$_{t-2}$) + 0.00730 (balance$_{t}$)

This may be stated as: to estimate the acres likely to be purchased in a particular fiscal year, using data from previous years (prediction), first subtract 0.29967 times the average license costs per hunter three fiscal years previously, from 1.87511; next, add to this result, 0.00730 times the unobligated balance remaining at the end of the fiscal year just previous to the one in question.

When the dependent variable is normally distributed, the multiple

Table 1. Results of regression analyses with Federal Aid appropriations and total net obligations as the dependent variables.

	Dependent variable	Program and R	Std. error of est.	F-ratio		Independent variables and constant	Coefficient	Std. error	F-to remove
1'	Federal Aid appropriations$_t$	AN70+1 0.8573**	32.2301	58.225** (1,21 df)	20'	License costs$_{t-2}$	0.28225	0.03699	58.22
						Constant	10.09708		
4'	Total net obligations$_t$	AN70+1 0.9884**	9.1060	422.562** (2,20 df)	22'	Working budget$_t$	0.62873	0.03400	341.48
					18	Hunters per acre of U.S. area$_{t-2}$	10920.38672	3830.79248	8.13
						Constant	-42.82933		
32'	Total net obligations$_{t+1}$	AN67+1 0.9245**	14.2781	49.968** (2,17 df)	16'	Net obligations to surveys, etc.$_t$	2.60354	0.32369	64.70
					5'	Balance$_t$	0.45243	0.24314	3.46
						Constant	37.52402		

' Data in units of 10,000

Table 2. Results of regression analyses with net obligations to land acquisition and percent net obligations to land acquisition as the dependent variables.

	Dependent variable	Program and R	Std. error of est.	F-ratio		Independent variables and constant	Coefficient	Std. error	F-to remove
18'	Net obligations to land acq.$_t$	AN67+1 0.9594**	2.7150	43.399** (4,15 df)	4'	Total net obligations$_t$	0.22380	0.01982	127.51
					5'	Balance$_t$	-0.24273	0.05792	17.56
					6'	Acres purchased$_t$	4.37699	1.75799	6.20
					17	% net obligations to surveys, etc.$_t$	-0.33665	-.16449	4.19
						Constant	8.66728		
26'	Net obligations to land acq.$_{t+1}$	AN67+1 0.7849**	4.6881	28.892** (1,18 df)	1'	Federal Aid appropriation$_t$	0.14016	0.02608	28.89
						Constant	6.94492		
19	% net obligations to land acquisition$_t$	AN67+1 0.8884**	1.7952	14.037** (4,15 df)	6'	Acres purchased$_t$	5.72955	1.31486	18.99
					5'	Balance$_t$	-0.13376	0.03264	16.79
					33	Dollars per acre$_t$	0.11915	0.03952	9.09
					17	% net obligations to surveys, etc.$_t$	-0.31738	0.10915	8.46
						Constant	21.82071		
27	% net obligations to land acquisition$_{t+1}$	AN67+1 0.3998	2.9465	3.424 (1,18 df)	33	Dollars per acre$_t$	-0.10307	0.05570	3.42
						Constant	21.86250		

' Data in units of 10,000

Table 3. Results of regression analyses with acres purchased as the dependent variable.

	Dependent variable	Program and R	Std. error of est.	F-ratio		Independent variables and constant	Coefficient	Std. error	F-to remove
6'	Acres purchased$_t$	AN70+1 0.7540**	0.3090	8.347** (3,19 df)	16	Dollars per acre$_t$	-0.02166	0.00461	22.09
					10'	Hunters$_{t-2}$	0.01794	0.00525	11.65
					3'	Reversions to MBCC$_t$	-0.07938	0.04061	3.82
						Constant	-0.37302		
6'	Acres purchased$_t$	AN67+1 0.7136**	0.3215	8.819** (2,17 df)	17	% net obligations to surveys, etc.$_t$	-0.05410	0.01452	13.87
					3'	Reversions to MBCC$_t$	-0.10654	0.04189	6.47
						Constant	2.75619		
8'	Acres purchased$_{t+1}$	AN70+1 0.6006**	0.3646	5.643** (2,20 df)	20	License costs per hunter$_{t-2}$	-0.29967	0.08942	11.23
					5'	Balance$_t$	0.00730	0.00375	3.79
						Constant	1.87511		
8'	Acres purchased$_{t+1}$	AN67+1 0.6565**	0.3144	13.632** (1,18 df)	37	License costs per hunter$_{t-2}$	-0.28248	0.07651	13.63
						Constant	2.11276		
1'	Federal Aid acres purchased	MBCC-1 0.4912*	0.3929	6.043* (1,19 df)	3'	Migratory bird refuge acres purchased	-1.27920	0.52038	6.04
						Constant	1.44290		

Table 3. (Con't.)

1'	Federal Aid acres purchased	MBCC-2		F-value insufficient for computation					
1'	Federal Aid acres purchased	MBCC-3 0.7624*	0.2983	11.107* (1,8 df)	5'	Fed. Aid waterfowl acres purchased	1.28481	0.38551	11.11
						Constant	0.45998		
5'	Federal Aid waterfowl acres purchased	MBCC-3 0.9031**	0.1255	15.488** (2,7 df)	3'	Migratory bird refuge acres purchased	-0.73855	0.24756	8.90
					1'	Fed. Aid acres purchased	0.26662	0.11468	5.40
						Constant	0.44487		

' Data in units of 10,000

Table 4. Results of regression analyses with purchase dollars as the dependent variable.

	Dependent variable	Program and R	Std. error of est.	F-ratio		Independent variables and constant	Coefficient	Std. error	F-to remove
7'	Purchase dollars$_t$	AN70+1 0.8756**	6.1053	20.818** (3,19 df)	10'	Hunters$_{t-2}$	0.45219	0.09877	20.96
					6'	Acres purchased$_t$	7.91287	3.92567	6.84
					2'	Balance$_{t-1}$	0.13481	0.06790	3.94
						Constant	-41.55327		
7'	Purchase dollars$_t$	AN67+1 0.9598**	3.5289	62.408** (3,16 df)	4'	Total net obligations$_t$	0.28620	0.02555	125.44
					6'	Acres purchased$_t$	11.32012	1.94188	33.98
					5'	Balance$_t$	-0.27770	0.06895	16.22
						Constant	-6.20174		
9'	Purchase dollars$_{t+1}$	AN70+1 0.8333**	8.7641	47.725** (1,21 df)	4'	Total net obligations$_t$	0.22605	0.03272	47.72
						Constant	5.07420		
9'	Purchase dollars$_{t+1}$	AN67+1 0.7085**	6.8715	18.145** (1,18 df)	12'	Hunters$_t$	0.72126	0.16932	18.14
						Constant	-65.48138		
2'	Federal Aid purchase dollars	MBCC-1	F-value insufficient for computation						
2'	Federal Aid purchase dollars	MBCC-2 0.8286*	11.5542	7.665* (2,7 df)	6'	Waterfowl Prod. Area purchase dollars	1.35660	0.39197	11.98
					4'	Migratory bird refuge dollars	-0.42788	0.14449	8.77
						Constant	46.62965		

Table 4. (Con't.)

2'	Federal Aid purchase dollars	MBCC-3 0.8296**	4.6331	17.657** (1,8 df)	6'	Fed. Aid waterfowl purchase dollars	1.11853	0.26619	17.66
						Constant	11.62642		
6'	Federal Aid waterfowl purchase dollars	MBCC-3 0.8296**	3.4362	17.657** (1,8 df)	2'	Fed. Aid purchase dollars	0.61527	0.14642	17.66
						Constant	0.46097		

' Data in units of 10,000

Table 5, Results of regression analyses with dollars per acre as the dependent variable.

	Dependent variable	Program and R	Std. error of est.	F-ratio		Independent variables and constant	Coefficient	Std. error	F-to remove
16	Dollars per $acre_t$	AN70+1 0.9236**	7.4752	36.735** (3,19 df)	10'	License $costs_{t-2}$	0.06213	0.01222	25.85
					6'	Acres $purchased_t$	-9.56801	4.09272	5.47
					2'	$Balance_{t-1}$	0.18512	0.08604	4.63
						Constant	5.92368		
33	Dollars per $acre_t$	AN67+1 0.9132**	5.2270	42.704** (2,17 df)	11'	License $costs_{t-2}$	0.06418	0.00787	66.41
					3'	Reversions to $MBCC_t$	1.35654	0.69830	3.77
						Constant	-2.99484		
17	Dollars per $acre_{t+1}$	AN70+1 0.8763**	8.6399	69.504** (1,21 df)	20	License costs per $hunter_{t-2}$	13.65871	1.63834	69.50
						Constant	-13.19514		
34	Dollars per $acre_{t+1}$	AN67+1 0.9240**	4.9726	49.648** (2,17 df)	11'	License $costs_{t-2}$	0.08172	0.00910	80.66
					18'	Net obligations to land acq.$_t$	-0.34668	0.16727	4.30
						Constant	2.95844		
5	Federal Aid dollars per acre	MBCC-1 0.7973**	10.3713	33.144** (1,19 df)	6	Migratory bird refuge dollars per acre	0.21905	0.03805	33.14
						Constant	17.47549		
7	Federal Aid dollars per acre	MBCC-2 0.5305	13.3128	3.134 (1,8 df)	9	Waterfowl Prod. Area dollars per acre	0.32312	0.18253	3.13
						Constant	32.29428		

Table 5. (Con't.)

7	Federal Aid dollars per acre	MBCC-3 0.6748*	7.8971	6.689* (1,8 df)	8	Migratory bird refuge dollars per acre	0.16236	0.0278	6.69
						Constant	20.82669		
9	Federal Aid waterfowl dollars per acre	MBCC-3 0.5477	29.0638	3.428 (1,8 df)	8	Migratory bird refuge dollars per acre	0.42778	0.23104	3.43
						Constant	14.96898		

' Data in units of 10,000

correlation correlation coefficient (R) indicates how closely the regression plane fits the observed points (Steel and Torrie 1960:286). Data in this analysis was not tested for normality. Therefore, the R value of 0.6006 computed in this example, can only be considered an approximation of regression fit. The standard error of the estimate is 0.3646, compared to a mean for the dependent variable of 1.14916, and a standard deviation of 0.43475 (means and standard deviations for all variables in each program are found in Appendix Tables 5 through 9). The first independent variable has an individual standard error of 0.08942, and the second, one of 0.00375. In the case of the second variable, the standard error times 2 is almost equal to the coefficient, indicating that the variable lends little accuracy to the equation by itself. This is also reflected in the comparatively low individual F-to remove (3.79) accompanying this variable. The F-ratio from the analysis of variance table is 5.643*, which is significant at the 0.95 level of confidence with 2 and 20 degrees of freedom. This means that the equation will produce values for the dependent variable, the confidence interval of which can be expected 95 out of 100 times, to fall so as to include the actual observed value of the variable.

It would have been beneficial to test the predictive abilities of the equations produced in the analyses. This could have been done by using 1970 as a test year for AN70+1, MBCC-1, and MBCC-2; using 1967 as a test year for AN67+1; and using 1966 as a test year for MBCC-3. These years would have been excluded from the respective regression analyses. Such testing was not done. Until testing is done (for in-

stance, with 1971 data), the results are not known to be valid for predictive purposes.

DISCUSSION

As mentioned in the previous section, the majority of subproblems studied resulted in regressions. Many of these were accompanied by multiple R's and F-ratios significant at the 0.99 probability level.

It was hoped that this study would yield some equations of predictive and managerial consequence. The purpose of a regression is not to "prove" cause and effect, but rather to indicate whether or not a relation exists. This may or may not be due to cause and effect. A linear relationship of X and Y are necessary for using regressions for prediction, while the other assumptions for linear regression (independence, normality of Y for a given X, and homogeneous variance) are necessary for testing hypotheses. If a relationship were truly linear for all X's and Y's, then prediction outside of the range of data observed is justified. However, in the case of a relationship that is known to be linear only over a given range of the variables, prediction outside of this range of variables is not likely to be correct.

My opinion is that the requirement of linearity was met adequately in the range of data used, and that it will be met outside the range of data, at lease for some period of time, probably at lease 5 years. Therefore, those subproblems which produced regressions of high significance probably also produced regressions of, at least, short-term predictability. This is not meant to imply that manipulation of any one independent variable would result in a desired change in a dependent variable.

It may be noted that if independent variables are entered into certain equations as equal to zero, the dependent variable will appear negative. This, of course, is not sensible. It is possible to request a zero intercept (constant) with BMD02R. To do so would have resulted in regression planes that fit the data less closely. This would eliminate the property that the sum of squares of the deviations is a minimum.

Another point to consider is that, for linear regression the assumption is made that the indpendent variables are measured without error (Steel and Torrie 1960). Most variables were considered error-free. It will be remembered that the collection of data for a few of the variables was admittedly prone to some error.

Federal Aid Appropriations

Federal Aid appropriations$_t$ was a dependent variable in AN70+1 only. Four independent variables were free to enter: license, etc., costs to hunters$_{t-2}$; licensed hunters$_{t-2}$; year$_t$; and average license, etc., costs per hunter$_{t-2}$. Just the first variable entered. The highly significant equation may be reflective of a logical positive relation between license sales and sporting arms and ammunition sales. The concept is that license revenues are a result of the number of people buying licenses that cost a certain average amount of money, and that Pittman-Robertson revenues are a result of the number of people buying an average amount of taxable equipment. Of course, non-quantified factors enter into these two relations: license costs vary within and among the states each year; and a large proportion of taxable equipment is purchased by hunters, but also some is purchased

for marksmanship competition, plinking, and self-defense, by non-hunters and hunters alike. The results for this variable are found in Table 1.

Total Net Obligations

Total net obligations occurred in two subproblems. It appeared in AN70+1 as obligations in fiscal $year_t$, where a very highly significant R was produced. The two variables entered were: working $budget_t$ (the "actual" Federal Aid money available for obligation in the year); and the average number of hunters per acre of total United States $area_{t-2}$, a general hunting pressure index. The coefficients were positive. Of course, obligations can be nore more than the money available to obligate in any one year, but this indicates (assuming a cause and effect relationship between income and expenditure) that a demand index, the hunting pressure, may also be a causative agent.

In program AN67+1, two variables entered into a relatively less, but still highly, significant equation. The first variable, net obligations to surveys, $etc._t$, appears to be affected by some factors not considered which also affect total net $obligations_t$. The second variable is $balance_t$, which may be considered a factor affecting the money available for obligation in fiscal $year_{t+1}$, and therefore (following the regression just discussed) a factor affecting the total net obligations in fiscal $year_{t+1}$. The next section contains a related discussion. The results for this variable are found in Table 1.

Net Obligations to Land Acquisition

Net obligations to land acquisition occurred for fiscal $year_t$ and fiscal $year_{t+1}$ in AN67+1. The results were quite different. Both regressions had highly significant R's, but quite different R's, 0.9594 and 0.7849, respectively.

The regression for net obligations to land $acquisition_t$ included total net $obligations_t$, $balance_t$, acres $purchased_t$, and percent net obligations to surveys, $etc._t$. The fourth variable was not a very important part of the regression, due to the relative size of its individual standard error (when compared to its coefficient). It stands to reason that, if total net obligations increase or decrease, net obligations to land acquisition would increase or decrease, respectively. It is also logical that there would be a positive relation between net obligations to land $acquisition_t$, and acres $purchased_t$, if other factors like price per $acre_t$ are not negatively correlated to acres $purchased_t$. However, $balance_t$ has a negative coefficient in the equation, as does percent net obligations to surveys, $etc._t$. The latter may be indicative of decision-making between obligating money to the one category or to the other. The former may be a result of the opportunistic nature of land acquisition under this program. There is always a number of states with unobligated balances remaining at the end of the fiscal year. The money left from fiscal $year_t$ remains as a "buffer" available for unexpected opportunities for land purchase and other projects in fiscal $year_{t+1}$. As a buffer, it increases the working $budget_{t+1}$, and is "protected" from reversion by

being obligated at the beginning of fiscal year$_{t+1}$. Using this assumption, one might deduce that a low balance may result from increased opportunity (or need) in the fiscal year to obligate money to land acquisition, and other project categories.

The equation for net obligations to land acquisition$_{t+1}$ was quite different from that for net obligations to land acquisition$_t$ just discussed. The one variable to enter this equation was Federal Aid appropriation$_t$. This relation may be due to the fact that all Pittman-Robertson expenditure is dependent on income (appropriation), and that there is a time lag between appropriation and obligation. The results for this variable are found in Table 2.

Percent Net Obligations to Land Acquisition

Percent net obligations to land acquisition was run for fiscal year$_t$ and fiscal year$_{t+1}$. The multiple R's that the regressions produced were lower than those produced for dollars obligated to land acquisition. They were 0.8884 and 0.3998, respectively.

The equation produced for percent net obligations to land acquisition$_t$ was very similar to the equation produced for net obligations to land acquisition$_t$. Similarly negative coefficients for the variables, balance$_t$ and percent net obligations to surveys, etc.$_t$ occurred. Acres purchased$_t$ was entered positively, also. The same arguments are proposed here as were proposed in the previous section for these variables and their coefficients. Total net obligations$_t$ was not included in the regression. Dollars per acre$_t$ entered with a positive coefficient, as might be expected if one assumes that the

proportion of dollars spent on land acquisition increases with the number of acres purchased and cost per acre.

The second regression, for fiscal $year_{t+1}$, included only one variable, dollars per $acre_t$. However, the equation produced was not significant, and this regression will not be discussed. The results for this variable are found in Table 2.

Acres Purchased

Acres purchased was involved in four subproblems in the first two programs. The results are in Table 3.

The acres $purchased_t$ subproblem in AN70+1 resulted in an equation with three independent variables, dollars per $acre_t$, $hunters_{t-2}$, and reversions to the Migratory Bird Conservation $Commission_t$. Dollars per acre paid for land purchase is felt to be the reflection of a variety of circumstances largely external to the Pittman-Robertson program, and is then an influence on the number of acres that can be purchased with Federal Aid money available. External factors largely determine the number of suitable acres for sale at an approvable price at any time. The coefficient is negative. This may be expected if one assumes that money to spend is relatively stable. Reversions to the Migratory Bird Conservation Commission also had a negative coefficient. This variable is considered to be an index of the states' ability or inclination to match Pittman-Robertson appropriations. Keeping a balance of money available for use each year over and above the year's appropriation is financially opportunistic and beneficial to the states. Not being able to obligate all Pittman-Robertson ap-

priations results in a higher proportion of a state's wildlife restoration either being paid 100% with state funds or else not being executed. Therefore, the state's money does not go as far as it would if its expenditure were accompanied by Federal Aid funds. The third variable, $hunters_{t-2}$, has a positive coefficient. There were three variables used in these analyses considered to be indices of states' income for wildlife-related programs: hunters, license costs (revenues), and license costs per hunter. The number of licensed hunters may be considered also as an index of demand for state-owned wildlife producing and public hunting areas. Therefore, hunters as an index for both of these concepts is logically positively related to acres purchased over time, as the states have attempted both to preserve and improve decreasing habitat types and to satisfy their hunting populations' demands.

Two variables entered into the regression equation for acres $purchased_{t+1}$ in AN70+1. They were: license, etc., costs per $hunter_{t-2}$, and $balance_t$. The equation was significant at the 0.95 probability level. The coefficients were negative and postive, respectively. In the case of the latter variable, it is discussed elsewhere that the positive relationship may be reflective of an increase in money available in $year_{t+1}$ when $balance_t$ is greater, and therefore as the working $budget_{t+1}$ is greater, total net $obligations_{t+1}$ tend to be greater. The reason for the negative coefficient may be that, although revenues and demand have been increasing, land cost and "non-availability" of land to purchase have been increasing at a relatively faster rate. This increase has been accompanied by increases in the costs of devel-

opment and maintenance of publicly-owned properties, and an admitted decrease in emphasis on land acquisition for wildlife management and restoration of the type being studied, due in part to such expenses. Therefore, while increased revenues would tend to increase land purchase (other factors constant), factors constraining land purchase make the reverse seem superficially to be the case.

The two forms of the variable were also run in program AN67+1. Acres purchased$_t$ was related to percent net obligations to surveys, etc.$_t$ and reversions to the Migratory Bird Conservation Commission$_t$. Both of these independent variables have been discussed previously. In brief, the expenditures in the surveys and investigations category have a negative effect on potential expenditures (and therefore, acreage purchased) in the land acquisition category, since funds are limited each year. Secondly, if reversions to the Migratory Bird Conservation Commission are considered an index of the states' inability or disinclination to match Pittman-Robertson funds, and one considers land acquisition to be significantly opportunistic (and therefore benefited or increased through flexibility in access to funds), the negative relation seems logical.

The regression produced for acres purchased$_{t+1}$ involved the independent variable, license costs per hunter$_{t-2}$, with a negative coefficient. This independent variable was discussed for acres purchased$_{t+1}$ in AN70+1.

Federal Aid Acres Purchased

Federal Aid variables were run for 1950 through 1970 in MBCC-1

(with migratory bird refuge data); for 1960 through 1970 in MBCC-2 (with migratory bird refuge and Waterfowl Production Area data); and for 1957 through 1966 in MBCC-3 (with migratory bird refuge and Federal Aid waterfowl-oriented land acquisition data). The results for Federal Aid acres purchased are found in Table 3.

Federal Aid acres purchased was the dependent variable for one subproblem in each program. In MBCC-1, a regression resulted with migratory bird refuge acres purchased as the independent variable, in an equation significant at the 0.95 probability level. The coefficient was negative. Graphical work indicates that, generally, average yearly land purchase under the refuge system was greater between 1961 and 1970 than between 1950 and 1960; the opposite has been true for land purchase under the Pittman-Robertson program. A plausible reason for these diverging trends might be the combination of a decreased emphasis on land acquisition under the Pittman-Robertson program as a restoration and managerial tool (supplanted in part by better game management on previously-purchased lands and private property) and the rather narrow constraints of the Migratory Bird Refuge System which spends money from Duck Stamps only for land acquisition. Although sales of Duck Stamps have not followed the trend of increasing license licensed hunters in general, increases in the cost of Duck Stamps from the original $1.00 to the present $5.00 have kept revenues increasing relative to general land cost increases.

In MBCC-2, no regression was produced at all. The F-levels to enter were not sufficient to result in a regression.

In MBCC-3, a regression significant at the 0.95 probability level

was produced for Federal Aid-supported acres purchased by entering Federal Aid waterfowl-oriented acres purchased with a positive coefficient. Appendix Fig. 4 appears to bear this out. If it is generally accepted that land purchase is the result of money available to spend and suitable land available to buy at an approvable price, then it would appear that (due to the factor of fund availability alone) all types of land purchase tend to increase at roughly the same time and decrease at roughly the same time. This equation indicates that, for the time span involved, the trend of total acres purchased under the Federal Aid program is more closely matched by waterfowl acres purchased under the Federal Aid program than by waterfowl land acquisition under the migratory bird refuge acquisition program.

Federal Aid Waterfowl Acres Purchased

The equation for Federal Aid waterfowl acres purchased in MBCC-3 involved two independent variables, migratory bird refuge acres purchased and Federal Aid acres purchased. The coefficients were negative and positive, respectively. The equation was significant at the 0.99 probability level. A decrease in Federal Aid waterfowl purchased has generally paralleled the trend of all Federal Aid acreage purchased over 1957 through 1966, while refuge acreage purchased has generally increased. Therefore, the positive coefficient for the Federal Aid variable appears logical under the argument just previously discussed. At the same time, the reverse relation between refuge and Federal Aid land purchase also previously discussed appears

to support the negative coefficient for the migratory bird refuge variable.

It appears to me that, while general land prices have increased over the past 20 years, prices paid under both systems under discussion for waterfowl-oriented land have increased at a rate greater than that for Federal Aid lands in general (and therefore, even greater than for wildlife lands exclusing waterfowl lands). Increasing funds for land purchase under the refuge system have just been discussed as an agent for maintaining or even increasing the amount of acreage bought each year under the system. Comparatively decreasing funds (relative to increasing land prices) available under the Pittman-Robertson program for land acquisition would tend to limit acquisition to less expensive acreages, or smaller acreages. Appendix Fig. 6 shows that per acre costs for waterfowl lands purchased under the Pittman-Robertson program have generally been greater than those for all Pittman-Robertson acreages. The logical conclusion is that the ability to purchase waterfowl acreages has been decreasing relative to all other acreages. Therefore, a negative coefficient for migratory bird refuge acres purchased occurs in the regression. The results for this variable are found in Table 3.

Purchase Dollars

The results for all purchase dollars variables are listed in Table 4. Purchase dollars$_t$ was run in both AN70+1 and AN67+1. In AN70+1, three variables entered: hunters$_{t-2}$, acres purchased$_t$, and balance$_{t-1}$. All coefficients were positive. Considered most impor-

tant of these three was the positive effect of $hunters_{t-2}$ as a demand index. $Balance_{t-1}$ constitutes part of the money available for obligation in fiscal $year_t$. Therefore (if one assumes that more funds will be spent on land purchase in years where more funds are available) it seems logical that they are positively related. It has been suggested previously that acres $purchased_t$ is a complex variable determined partly by chance, or opportunity. Opportunity involves suitable land being for sale at an approvable price and the state having the money to spend.

In AN67+1, purchase $dollars_t$ was regressed with total net $obligations_t$, acres $purchased_t$, and $balance_t$. $Balance_t$ is the dollars remaining unobligated at the end of fiscal $year_t$. It is suggested that perhaps a large balance may be intentionally provided for by decreased opportunistic spending during the year. This may be in anticipation of a need for that money in the succeeding year (perhaps predicted lower revenues from the Pittman-Robertson Act or from license fees). Or, it may result from a decrease in opportunity to spend money above and beyond basic yearly expenses. The positive coefficients for the other two variables follow arguments suggested in previous sections.

Purchase $dollars_{t+1}$ was also run in both programs. In AN70+1, only one variable entered, total net $obligations_t$, with a positive coefficient. It will be remembered that this variable is highly related to the working $budget_t$, or the actual amount of money available to spend in the $year_t$. The $balance_t$ is often larger when the Federal Aid $appropriation_t$ is greater. Therefore, the money available to spend in the succeeding year is that amount greater than just

the appropriation in fiscal year$_{t+1}$. Therefore, expenditures tend to increase. In addition, a large balance may indicate a less pressing demand on Federal Aid moneys for obligation to other project categories, and therefore an ability to obligate money to land acquisition.

In AN67+1, hunters$_t$ entered. The coefficient was positive. Hunters$_t$ has been considered a demand index, and the positive relation appears logical.

Federal Aid Purchase Dollars

Table 4 shows that no equation was produced for Federal Aid purchase dollars in MBCC-1. An equation significant at the 0.95 level was produced in MBCC-2. The variables entered were Waterfowl Production Area purchase dollars and migratory bird refuge purchase dollars, with a positive and a negative coefficient, respectively. The negative relation of spending in the Federal Aid and migratory bird refuge programs may be reflective of increased refuge spending during a period of decreased Federal Aid spending in the 1960's (Appendix Figs. 5 and 8).

In MBCC-3, the variable to enter the highly significant equation for Federal Aid purchase dollars was Federal Aid waterfowl purchase dollars, with a positive coefficient. Just as Federal Aid acres purchased and Federal Aid waterfowl acres purchased were roughly parallel when graphed, so too were the purchase dollars variables. They were highly related for this time period, more so than the migratory bird refuge purchase refuge dollars variable and Federal Aid purchase dollars. Results for this variable are listed in Table 4.

Federal Aid Waterfowl Purchase Dollars

Federal Aid waterfowl purchase dollars was regressed in MBCC-3 with Federal Aid purchase dollars, with a positive coefficient. The equation was highly significant. It was previously discussed with Federal Aid purchase dollars as the dependent variable. Table 4 includes these results.

Dollars per Acre

This variable occurred in both forms ($_t$ and $_{t+1}$) in both AN70+1 and AN67+1. The results are listed in Table 5. Dollars per acre$_t$ in AN70+1 resulted in a regression with three independent variables: license costs$_{t-2}$, acres purchased$_t$, and balance$_{t-1}$. The positive coefficients of the first and the last may be attributed to arguments presented previously. This may be summarized briefly as their being positively related to money available to spend in fiscal year$_t$. An abundance of money to spend might logically be reflected in either purchase of acreages of land more expensive than "normal" or of more acres of "normally-priced" land. Additionally, when funds are limited, it follows that either more acres would be purchased at a lower price per acre, or fewer acres at a higher price. This might be suggested as an explanation for the negative coefficient of acres purchased$_t$.

Dollars per acre$_t$ in AN67+1 was regressed to license costs$_{t-2}$ and reversions to the Migratory Bird Conservation Commission$_t$, both with positive coefficients. A suggestion for the first variable was just discussed. While dollars per acre has generally increased over time, reversions to the Migratory Bird Conservation Commission have

rather stable.

The subproblem for dollars per $acre_{t+1}$ in AN70+1 entered only one variable, license costs per $hunter_{t-2}$. The coefficient was predictably positive, considering arguments given previously. In AN67+1, license $costs_{t-2}$ and net obligations to land $acquisition_t$ entered. The former coefficient was positive, the latter negative. The former has been discussed previously as an index to state game agency funds, and therefore, ability to purchase more valuable land. Net obligations to land $acquisition_t$ has somewhat increased over the time span involved, while cost per acre has increased greatly.

Federal Aid Dollars per Acre

In MBCC-1, a highly significant equation was produced for Federal Aid dollars per acre. Migratory bird refuge dollars per acre entered as the independent variable, with a positive coefficient. As explanation, the general price of land has been on the increase in the United States over the time period involved, and values for all per acre cost variables considered in this study have increased.

In MBCC-2, Waterfowl Production Area dollars per acre entered into the equation, but the equation was not significant. My contention is that, although the previous equation discussed was highly significant (0.99 probability level), no significant equation was produced here because the variability of the data was great, and the time period of 1957 through 1966 was too short a segment (too few cases) to produce a significant equation.

In MBCC-3, migratory bird refuge dollars per acre was the only

variable in the significant equation (0.95 probability level). The coefficient was positive, which was logical considering previous arguments. The results are given in Table 5.

Federal Aid Waterfowl Dollars per Acre

Federal Aid waterfowl dollars per acre was a dependent variable in MBCC-3. The independent variable entered was migratory bird refuge dollars per acre, with a positive coefficient. The equation was not significant. Again, extreme variability and the small number of cases may have been a reason for no significant results. Table 5 includes the results for this variable.

CONCLUSIONS

The literature review, data graphing, and regression of variables analyzed supported the following concepts. Land acquisition under the Federal Aid in Wildlife Restoration Act appears to be influenced by many of the same factors that influence other wildlife land acquisition. Briefly, these are availability of funds, demand for public wildlife lands, and opportunity to buy suitable lands.

Numbers of hunters and other wildlife-oriented recreationists, license, etc., revenues and Federal Aid excise tax revenues, and private hunting areas posted to the public have been increasing over the time span of this study. Suitable wildlife and hunting areas have decreased. This combination has increased the need for publicly-owned (especially state) land for wildlife-related recreation and restoration. The monetary base for wildlife-oriented projects has been increasing. Also accompanying these trends have been the increasing costs for land, including some types of wildlife habitat formerly considered of low value by many (for example, fresh water estuaries), and now of increasing desirability. This price increase trend has appeared to offset the increases in revenue and resulted in generally decreased acreage purchase in recent years in the Pittman-Robertson program.

There has been emphasis in many states in recent years toward decreased land acquisition due to rising costs of land, rising maintenance and development costs, and increased reliance on more intensive forms of wildlife management on lands already in public possession.

Many studies are pointed in this direction. Roughly 75% of all Federal Aid net obligations between 1947 and 1967 have been devoted to development (including maintenance and management) and surveys and investigations (including research, game counts, and game management assessment).

The usefulness of the regressions produced is limited by certain statistical drawbacks of the data used. Testing of the regressions is also needed. Yet they still have possible applicability. Their implications as a support of basic concepts has just been mentioned. The analysis does not show cause and effect. The regressions may be regarded in two ways. First, they show historical correlations between certain variables of interest. These relations are over a certain time period. Some are concerned with decisions made concurrently in a single year, and some are concerned with decisions concerning the dependent variable made one year subsequent to those of the independent variables. Second, they may have short-term predictive significance. It must be reiterated that it would not be valid to use them to try to predict changes in the dependent variables with manipulated changes in one or more independent variables.

As MacMullen (1968) pointed out, with succeeding years, the opportunity to buy suitable lands will decrease with increases in demand for all uses of land accompanying population increases and economic expansion. There is a definite need for each state to set scientifically-based planning horizons for wildlife land acquisition and a way to measure progress toward such a goal, if land acquisition is to be used effectively as a wildlife restoration tool and as a means towards

satisfying public demand for wildlife-based or -enhanced outdoor recreation. In addition, creative use should be made of a variety of acquisition tools to meet future needs - purchase, lease, easement, and combinations of the three to suit particular needs, and provide flexibility and adaptability in the land acquisition programs of the states.

Public wildlife agencies on all levels need the support of an informed citizenry for their programs. For this reason, it is suggested that such agencies keep and disseminate basic information on such programs, in forms meaningful to the public. It is very important at this time to have available, in particular I believe, land acquisition information for the hunting segment of the population, whose dollars support state game agencies and the Federal Aid program, and who generally support land acquisition. Many sportsmen rely heavily on state-owned game management and public hunting areas for their recreational opportunities.

In the future, I feel, data similar to that analyzed in this study should be kept available. This should be on both the state and the national level, and both in visual form (graphs) and as data for ongoing scientific analysis. The format reported in the last (1961 through 1970) Federal Aid annual reports was excellent. It contained state-by-state and national figures for all non-calculated Federal Aid and hunter variables concerned in this study. The one exception was the lack of net obligations by project categories since last published in 1967. I feel that these figures are important in any general program analysis, and suggest their publication be resumed.

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APPENDIX

Appendix Table 1. Federal Aid acres purchased or approved for purchase data and sources.

Fiscal year	Acres purchased or approved for purchase *		Source of value: Annual report	Source of value: Context (table or text)	Source of value: Page number	Datum disposition
1970	184,775.		1970	both	4,26	value used
1969	66,057.		1969	both	2,22	value used
1968	60,247.		1968	both	2,28	value used
1967	71,985.		1967	both	2,22	value used
1966	78,223.		1966	both	2,14	value used
1965	65,107.		1965	both	2,10	value used
1964	93,719.		1964	both	3,8	value used
1963	85,700.		1963	both	3,6	value used
1962	60,002.		1962	both	3,6	value used
1961	117,205.		1961	both	2,40	value used
1960	145,967.		1960	both	3,25	value used
1959	176,285.		1959	both	3,69	value used
1958	173,355.		1958	both	3,61	value used
1957	141,682.		1957	both	3,93	value used
1956	146,110.		1956	text	15	
	135,667.		1956	table	105	value used
1955	81,378.	A/	1955	text	16	
	72,554.		1955	table	101	value used
1954	88,389.		1954	both	16,107	value used
1953	116,433.		1953	both	10,95	value used
1952	100,915.		1953	calc.	10	
	100,880.		1952	both	9,72	value used
1951	115,242.		1952	calc.	9	
	114,703.		1951	both	12,17	value used
1950	196,436.		1951	calc.	12	
	196,376.		1950	text	4	value used
1949	163,000.	B/	1949	text	4	value used
1948	134,761.		1948	text	6	value used
1947	35,418.		1948	table	8	
	35,418.		1947	text	5	value used

* Includes purchase in fee title only
A/ This figure includes acreage of combined projects
B/ This figure was presented as "almost 163,000 acres"

Appendix Table 2. Federal Aid dollars spent on or obligated to land purchase data and sources.

Fiscal year	Dollars spent on or obligated to land purchase	Source of value: Annual report	Source of value: Context (table or text)	Source of value: Page number	Datum disposition
1970	9,245,435. *	1970	both	4,26	value used
1969	4,241,381. *	1969	both	2,22	value used
1968	5,186,169. *	1968	both	2,28	value used
1967	3,855,321. *	1967	both	2,22	value used
	4,723,379. A/	1967	calc.	17	
1966	3,378,924. *	1966	both	2,14	value used
	3,367,686. A/	1967	calc.	17	
1965	3,213,557. *	1965	both	2,10	value used
	4,671,737. A/	1967	calc.	17	
1964	3,769,490. *B/	1964	calc.	3	
	3,354,751. *	1964	table	8	value used
	3,542,392. A/	1967	calc.	17	
1963	3,902,340. *B/	1963	calc.	3	
	3,707,196. *	1963	table	6	value used
	3,549,674. A/	1967	calc.	17	
1962	3,229,621. *	1962	both	3,6	value used
	3,174,064. A/	1967	calc.	17	
1961	3,414,176. *	1961	both	2,40	value used
	3,344,922. A/	1967	calc.	17	
1960	3,589,670. B/	1960	calc.	3	
	3,589,119. B/	1960	calc.	94	value used
	3,243,633. A/	1967	calc.	17	
1959	5,759,299. B/	1959	calc.	3	value used
	5,759,247. A/	1967	calc.	17	
1958	3,998,645. B/	1958	calc.	3	value used
	3,998,604. A/	1967	calc.	17	
	11,466,914. C/	1963	calc.	5	
1957	4,397,113. B/	1957	calc.	3	value used
	4,397,166. A/	1967	calc.	17	
	10,132,928. C/	1963	calc.	5	
1956	3,325,464. C/	1956	calc.	15	
	3,987,780. D/	1956	calc.	15,105	value used
	3,171,999. B/	1956	calc.	15	
	3,080,824. A/	1967	calc.	17	
1955	2,470,464. D/	1956	calc.	15	
	2,849,009. B/	1956	calc.	15	
	2,470,464. D/	1955	calc.	16,101	value used
	2,770,921.	1955	calc.	16	
	2,748,162. A/	1967	calc.	17	

Appendix Table 2. (Con't.)

1954	2,636,644.	D/	1955	calc.	15	
	2,659,625.	D/	1954	calc.	16	value used
	2,572,612.	A/	1967	calc.	17	
1953	3,061,024.	D/	1955	calc.	15	
	3,052,873.	D/	1954	calc.	16	value used
	3,315,141.	A/	1967	calc.	17	
1952	1,994,299.	A/	1967	calc.	17	value used
1951	2,475,069.	A/	1967	calc.	17	value used
1950	3,470,409.	A/	1967	calc.	17	value used
	2,380,113.	D/	1950	calc.	4	
1949	2,510,200.	D/	1950	calc.	4	value used
	2,708,678.	A/	1967	calc.	17	
1948	1,540,428.		1948	table	8	value used
	1,541,666.	D/	1949	calc.	4	
	1,585,754.	A/	1967	calc.	17	
1947	329,922.		1948	table	8	
	305,977.	A/	1967	calc.	17	
	327,853.		1947	table	6	value used

* Federal Aid and state combined cost exclusive of overhead

A/ Calculated by multiplying the Federal Aid net obligations by 1.33 to approximate Federal Aid plus state land acquisition obligations (from net obligations table, 1967 report)

B/ Calculated by multiplying the Federal Aid obligation furnished by 1.33 to approximate Federal Aid plus state cost

C/ Calculated as in footnote A, but with value for net obligations given in pre-1967 table (differing from value given in 1967 table)

D/ Calculated by multiplying acreage chosen by price per acre given in text

Appendix Table 3. Federal Aid acres held by or approved for lease, etc., data and sources.

Fiscal year	Acres held by or approved for lease, etc. *		Source of value: Annual report	Source of value: Context (table or text)	Source of value: Page number	Datum disposition
1970	9,811,286.		1970	table	28	
	716,862.	A/	1970	calc.	28	value used
1969	19,687,385.		1969	table	24	
	4,806,707.	B/	1969	calc.	24	value used
	10,597,013.	A/	1969	calc.	24	
1968	9,840,110.		1968	table	30	
	735,285.	A/	1968	calc.	30	value used
1967	9,560,372.		1967	table	24	
	470,498.	A/	1967	calc.	24	value used
1966	9,589,574.		1966	table	16	
	499,202.	A/	1966	calc.	16	value used
1965	207,946.		1965	table	12	value used
1964	11,071,518.		1964	table	10	
	247,776.	A/	1964	calc.	10	value used
1963	65,934.		1963	table	8	value used
1962	11,124,102.		1962	table	8	
	299,212.	A/	1962	calc.	8	value used
1961	12,410,508.		1961	both	2,43	
	1,692,212.		1961	calc.	43	value used
1960	203,011.		1960	table	28	value used
1956	125,361.		1956	text	15	value used
1955	144,697.		1955	text	16	value used
1954	139,172.		1954	text	16	value used
1953	200,898.		1953	text	10	value used
1952	102,741.		1953	text	10	
	102,741.		1952	text	9	value used
1950	123,109.		1950	text	4	value used
1949	115,000.		1949	text	9	value used
1948	183,320.		1948	text	6	value used
1947	125,873.		1947	text	5	value used

* Includes lease, easement, gift, water rights, grazing rights, other rights

A/ Calculated by subtracting all acreage in New Mexico from national total (see text for discussion)

B/ Calculated by subtracting all acreage in New Mexico, Mississippi, Florida, and Virginia (see thesis text)

No values were given for 1951 and 1957 through 1959

Appendix Table 4. Federal Aid dollars spent on or obligated to lease, etc., data and sources.

Fiscal year	Dollars spent on or obligated to lease, etc. *		Source of value: Annual report	Source of value: Context (table or text)	Source of value: Page number	Datum disposition
1970	109,498.		1970	table	28	
	46,702.	A/	1970	calc.	28	value used
1969	155,089.		1969	table	22	
	91,032.	B/	1969	calc.	22	value used
	109,637.	A/	1969	calc.	22	
1968	79,768.		1968	table	30	
	32,708.	A/	1968	calc.	30	value used
1967	177,575.		1967	table	24	
	125,421.	A/	1967	calc.	24	value used
1966	172,101.		1966	table	16	
	81,197.	A/	1966	calc.	16	value used
1965	92,599.		1965	table	12	value used
1964	93,631.		1964	table	10	
	38,976.	A/	1964	calc.	10	value used
1963	8,129.		1963	table	8	value used
1962	88,987.		1962	table	8	
	34,863.	A/	1962	calc.	8	value used
1961	154,292.		1961	both	2,43	
	100,701.	A/	1961	calc.	43	value used
1960	42,074.		1960	table	28	value used

* Includes lease, easement, gift, water rights, grazing rights, other rights

A/ Calculated by subtracting all cost in New Mexico from national total (see thesis text for discussion)

B/ Calculated by subtracting all cost in New Mexico, Mississippi, Florida, and Virginia (see thesis text)

No values given before 1960

Appendix Table 5. Means and standard deviations of variables in regression analysis AN70+1.

	Variable	Mean	Standard deviation
1'	Federal Aid appropriation	149.72484	61.16180
2'	Unobligated balance$_{t-1}$	44.08385	24.14520
3'	Reversions to Migratory Bird Conservation Comm.$_t$	2.41613	1.70355
4'	Total net obligations$_t$	142.25163	57.10292
5'	Unobligated balance$_t$	49.06293	26.80923
6'	Acres purchased$_t$	1.08422	0.43720
7'	Land purchase dollars$_t$	33.35350	11.74759
8'	Acres purchased$_{t+1}$	1.14916	0.43475
9'	Land purchase dollars$_{t+1}$	37.23071	15.49013
10'	Licensed hunters$_{t-2}$	133.53824	16.48445
11'	License, etc., costs to hunters$_{t-2}$	494.68872	185.76494
12'	Licensed hunters$_t$	138.82178	9.68882
13'	License, etc., costs to hunters$_t$	559.50269	193.86517
14'	United States area (in acres)	23038.68750	0.01692
15	Year$_t$	58.00000	6.78233
16	Dollars per acre spent on land purchase$_t$	34.44778	18.11562
17	Dollars per acre spent on land purchase$_{t+1}$	36.22079	17.52397
18	Licensed hunters per acre of total U.S. area$_{t-2}$	0.00580	0.00072
19	Licensed hunters per acre of total U.S. area$_t$	0.00603	0.00042
20	License, etc., costs per licensed hunter$_{t-2}$	3.61791	1.12433
21	License, etc., costs per licensed hunter$_t$	3.97897	1.19967
22'	Working budget$_t$	193.80876	80.60715
23	Year$_{t+1}$		

' Data in units of 10,000

Appendix Table 6. Means and standard deviations of variables in regression analysis AN67+1.

	Variable	Mean	Standard deviation
1'	Federal Aid appropriation$_t$	132.09708	41.24554
2'	Unobligated balance$_{t-1}$	37.86758	16.61913
3'	Reversions to Migratory Bird Conservation Comm.$_t$	2.51674	1.78648
4'	Total net obligations$_t$	126.61823	39.46802
5'	Unobligated balance$_t$	40.73999	14.95115
6'	Acres purchased$_t$	1.14771	0.43409
7'	Land purchase dollars$_t$	31.71512	11.54115
8'	Acres purchased$_{t+1}$	1.16599	0.40568
9'	Land purchase dollars$_{t+1}$	33.47884	9.47757
10'	Licensed hunters$_{t-2}$	131.88832	17.09598
11'	License, etc., costs to hunters$_{t-2}$	451.93066	158.41333
12'	Licensed hunters$_t$	137.20518	9.31023
13'	License, etc., costs to hunters$_t$	510.49756	153.63525
14'	United States area (in acres)	23038.68750	0.01667
15	Year$_t$	56.50000	5.91608
16'	Dollars obligated to surveys, etc.$_t$	30.84901	11.23082
17	Percent of net obligations to surveys, etc.$_t$	24.77495	5.15240
18'	Dollars obligated to land acquisition$_t$	23.79921	8.61671
19	Percent of net obligations to land acquisition$_t$	18.58995	3.47394
20'	Dollars obligated to development, etc.$_t$	65.32971	20.55240
21	Percent of net obligations to development, etc.$_t$	51.24492	4.48838
22'	Dollars obligated to coordination$_t$	6.58984	1.70597
23	Percent of net obligations to coordination$_t$	5.40499	0.70671
24'	Dollars obligated to surveys, etc.$_{t+1}$	33.51494	11.74745
25	Percent of net obligations to surveys, etc.$_{t+1}$	24.24994	4.02826
26'	Dollars obligated to land acquisition$_{t+1}$	25.45988	7.36491
27	Percent of net obligations to land acquisition$_{t+1}$	18.82994	3.12882
28'	Dollars obligated to development, etc.$_{t+1}$	70.23543	17.68468
29	Percent of net obligations to development, etc.$_{t+1}$	51.65491	3.88537

Appendix Table 6. (Con't.)

30'	Dollars obligated to coordination$_{t+1}$	7.06221	1.52029
31	Percent of net obligations to coordination$_{t+1}$	5.27999	0.48406
32'	Total net obligations$_{t+1}$	136.27260	35.42155
33	Dollars per acre spent on land purchase$_t$	29.42262	12.13505
34	Dollars per acre spent on land purchase$_{t+1}$	31.63763	12.30236
35	Licensed hunters per acre of total U.S. area$_{t-2}$	0.00572	0.00074
36	Licensed hunters per acre of total U.S. area$_t$	0.00596	0.00040
37	License, etc., costs per licensed hunter$_{t-2}$	3.35157	0.94277
38	License, etc., costs per licensed hunter$_t$	3.68794	0.98455
39'	Working budget$_t$	169.96475	50.19887
40	Year$_{t+1}$	57.50000	5.91608

' Data in units of 10,000

Appendix Table 7. Means and standard deviations of variables in regression analysis MBCC-1.

	Variable	Mean	Standard deviation
1'	Federal Aid acres purchased	1.11681	0.43964
2'	Federal Aid purchase dollars	38.84763	15.16634
3'	Migratory bird refuge acres purchased	0.25491	0.16882
4'	Migratory bird refuge purchase dollars	30.03014	32.48071
5	Federal Aid dollars per acre of land purchased	38.39275	16.74641
6	Migratory bird refuge dollars per acre of land purchased	95.49214	60.95161

' Data in units of 10,000

Appendix Table 8. Means and standard deviations of variables in regression analysis MBCC-2.

	Variable	Mean	Standard deviation
1'	Federal Aid acres purchased	0.88302	0.38249
2'	Federal Aid purchase dollars	43.72548	18.19974
3'	Migratory bird refuge acres purchased	0.38018	0.15645
4'	Migratory bird refuge purchase dollars	56.79059	28.60312
5'	Waterfowl Production Area acres purchased	0.23469	0.10763
6'	Waterfowl Production Area purchase dollars	15.77153	10.54371
7	Federal Aid dollars per acre of land purchased	51.61157	14.80702
8	Migratory bird refuge dollars per acre of land purchased	149.42279	39.40961
9	Waterfowl Production area dollars per acre of land purchased	59.78326	24.31123

' Data in units of 10,000

Appendix Table 9. Means and standard deviations of variables in regression analysis MBCC-3.

	Variable	Mean	Standard deviation
1'	Federal Aid acres purchased	1.13724	0.43460
2'	Federal Aid purchase dollars	38.94133	7.82265
3'	Migratory bird refuge acres purchased	0.29918	0.20133
4'	Migratory bird refuge purchase dollars	35.03534	32.23949
5'	Federal Aid waterfowl acres purchased	0.52713	0.25790
6'	Federal Aid waterfowl purchase dollars	24.42032	5.80178
7	Federal Aid dollars per acre of land purchased	37.35930	10.08893
8	Migratory bird refuge dollars per acre of land purchased	101.82509	41.93224
9	Federal Aid waterfowl dollars per acre of land purchased	58.52789	32.75078

' Data in units of 10,000

Appendix Table 10. Correlation matrix of variables in regression analysis AN70+1.

Variable number	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'
1'	1.000	0.736	-0.134	0.962	0.904	-0.199	0.680	-0.106	0.802	0.697
2'		1.000	0.190	0.847	0.765	-0.121	0.617	-0.038	0.714	0.591
3'			1.000	-0.012	-0.174	-0.235	0.045	-0.287	-0.091	0.301
4'				1.000	0.828	-0.167	0.756	-0.100	0.833	0.763
					1.000	-0.190	0.494	-0.041	0.705	0.477
						1.000	0.282	0.462	-0.075	0.033
							1.000	-0.090	0.503	0.808
								1.000	0.332	-0.210
									1.000	0.574
										1.000

Appendix Table 10. (Con't.)

Variable number	11'	12'	13'	14'	15	16	17	18	19	20
1'	0.857	0.779	0.873	0.750	0.845	0.801	0.746	0.697	0.779	0.892
2'	0.623	0.706	0.628	0.610	0.589	0.672	0.498	0.591	0.706	0.585
3'	0.110	0.326	0.003	0.292	0.109	0.144	0.077	0.301	0.326	0.076
4'	0.895	0.828	0.888	0.820	0.868	0.807	0.721	0.763	0.828	0.835
5'	0.644	0.628	0.664	0.491	0.602	0.700	0.610	0.477	0.628	0.634
6'	-0.418	-0.159	-0.411	-0.258	-0.405	-0.527	-0.436	0.033	-0.159	-0.484
7'	0.633	0.745	0.633	0.752	0.661	0.598	0.488	0.808	0.745	0.551
8'	-0.445	-0.149	-0.373	-0.452	-0.413	-0.408	-0.603	-0.210	-0.149	-0.489
9'	0.621	0.680	0.659	0.551	0.626	0.537	0.470	0.574	0.680	0.570
10'	0.751	0.876	0.679	0.867	0.754	0.613	0.589	1.000	0.876	0.652
11'	1.000	0.762	0.984	0.913	0.990	0.887	0.871	0.751	0.762	0.989
12'		1.000	0.722	0.865	0.783	0.686	0.624	0.876	1.000	0.686
13'			1.000	0.870	0.984	0.887	0.849	0.679	0.722	0.980
14'				1.000	0.929	0.781	0.763	0.869	0.865	0.865
15					1.000	0.877	0.856	0.754	0.783	0.973
16						1.000	0.788	0.613	0.686	0.886
17							1.000	0.589	0.624	0.876
18								1.000	0.876	0.652
19									1.000	0.686
20										1.000

Appendix Table 10. (Con't.)

Variable number	21	22'	23
1'	0.831	0.979	0.845
2'	0.566	0.858	0.589
3'	-0.034	-0.045	0.109
4'	0.842	0.984	0.869
5'	0.612	0.915	0.602
6'	-0.422	-0.187	-0.405
7'	0.589	0.700	0.661
8'	-0.414	-0.091	-0.413
9'	0.601	0.823	0.626
10'	0.629	0.706	0.754
11'	0.974	0.837	0.990
12'	0.642	0.802	0.783
13'	0.993	0.850	0.984
14'	0.841	0.751	0.929
15	0.972	0.818	1.000
16	0.869	0.809	0.877
17	0.845	0.715	0.856
18	0.629	0.706	0.754
19	0.642	0.802	0.783
20	0.981	0.804	0.973
21	1.000	0.800	0.972
22'		1.000	0.818
23			1.000

' Data in units of 10,000

Appendix Table 11. Correlation matrix of variables in regression analysis AN67+1.

Variable number	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'
1'	1.000	0.396	0.018	0.923	0.759	0.165	0.689	-0.191	0.685	0.812
2'		1.000	0.567	0.648	0.424	0.244	0.616	-0.244	0.325	0.648
3'			1.000	0.226	-0.035	-0.330	0.117	-0.268	0.151	0.370
4'				1.000	0.596	0.189	0.845	-0.270	0.669	0.909
5'					1.000	0.277	0.341	-0.050	0.463	0.511
6'						1.000	0.511	0.529	0.318	0.152
7'							1.000	-0.045	0.586	0.809
8'								1.000	0.308	-0.240
9'									1.000	0.706
10'										1.000

Appendix Table 11. (Con't.)

Variable number	11'	12'	13'	14'	15	16'	17	18'	19	20'
1'	0.778	0.765	0.751	0.767	0.775	0.894	-0.194	0.701	0.018	0.915
2'	0.377	0.654	0.287	0.559	0.341	0.363	-0.669	0.670	0.358	0.715
3'	0.276	0.470	0.173	0.402	0.263	0.173	-0.169	0.189	0.027	0.244
4'	0.831	0.851	0.803	0.889	0.836	0.914	-0.287	0.874	0.199	0.975
5'	0.332	0.536	0.244	0.335	0.271	0.434	-0.502	0.352	-0.078	0.712
6'	-0.253	0.014	-0.224	-0.124	-0.241	-0.042	-0.568	0.411	0.653	0.200
7'	0.565	0.711	0.567	0.724	0.600	0.697	-0.380	0.915	0.505	0.790
8'	-0.592	-0.187	-0.551	-0.536	-0.529	-0.369	-0.117	-0.055	0.289	-0.261
9'	0.463	0.709	0.450	0.537	0.511	0.641	-0.145	0.538	0.080	0.657
10'	0.770	0.879	0.703	0.864	0.765	0.812	-0.372	0.773	0.180	0.900
11'	1.000	0.692	0.981	0.920	0.985	0.931	0.067	0.611	-0.052	0.760
12'		1.000	0.635	0.839	0.720	0.764	-0.226	0.708	0.031	0.852
13'			1.000	0.890	0.988	0.937	0.182	0.617	-0.037	0.705
14'				1.000	0.934	0.912	-0.041	0.713	0.013	0.835
15					1.000	0.958	0.159	0.639	-0.051	0.745
16'						1.000	0.087	0.710	-0.014	0.837
17							1.000	-0.410	-0.573	-0.402
18'								1.000	0.608	0.805
19									1.000	0.122
20'										1.000

Appendix Table 11. (Con't.)

Variable number	21	22'	23	24'	25	26'	27	28'	29	30'
1'	0.334	0.906	-0.783	0.756	0.103	0.785	-0.053	0.864	0.023	0.829
2'	0.597	0.607	-0.671	0.304	-0.022	0.181	-0.382	0.454	0.345	0.473
3'	0.221	0.217	-0.279	0.268	0.276	-0.027	-0.378	0.182	0.002	0.308
4'	0.316	0.956	-0.878	0.797	0.233	0.681	-0.235	0.847	0.022	0.868
5'	0.724	0.619	-0.554	0.283	-0.395	0.573	0.095	0.631	0.395	0.485
6'	0.196	0.177	-0.299	-0.254	-0.646	0.206	0.343	0.071	0.399	-0.009
7'	0.165	0.807	-0.754	0.554	0.105	0.517	-0.153	0.620	0.068	0.656
8'	-0.098	-0.373	0.058	-0.399	-0.458	0.116	0.584	-0.226	0.001	-0.306
9'	0.209	0.615	-0.647	0.552	0.032	0.859	0.301	0.641	-0.200	0.622
10'	0.413	0.926	-0.780	0.713	0.181	0.615	-0.268	0.804	0.105	0.791
11'	0.066	0.839	-0.633	0.920	0.550	0.573	-0.352	0.770	-0.222	0.861
12'	0.345	0.826	-0.688	0.722	0.300	0.667	-0.182	0.754	-0.086	0.735
13'	-0.086	0.792	-0.587	0.929	0.615	0.572	-0.313	0.728	-0.323	0.838
14'	0.148	0.891	-0.686	0.874	0.528	0.563	-0.398	0.765	-0.158	0.830
15	-0.043	0.827	-0.621	0.948	0.616	0.609	-0.313	0.759	-0.318	0.858
16'	0.027	0.892	-0.720	0.924	0.459	0.733	-0.185	0.823	-0.251	0.899
17	-0.776	-0.308	0.466	0.206	0.661	-0.012	0.091	-0.217	-0.770	-0.066
18'	0.132	0.786	-0.841	0.595	0.131	0.485	-0.217	0.652	0.096	0.663
19	-0.059	0.155	-0.376	-0.107	-0.360	-0.021	0.028	0.045	0.351	0.009
20'	0.507	0.935	-0.878	0.717	0.127	0.651	-0.244	0.841	0.137	0.834
21	1.000	0.356	-0.401	-0.054	-0.477	0.123	-0.159	0.339	0.646	0.193
22'		1.000	-0.758	0.737	0.168	0.653	-0.202	0.800	0.063	0.810
23			1.000	-0.626	-0.005	-0.591	0.202	-0.786	-0.217	-0.778
24'				1.000	0.635	0.651	-0.344	0.839	-0.310	0.922
25					1.000	0.044	-0.429	0.162	-0.683	0.371
26'						1.000	0.385	0.726	-0.265	0.684
27							1.000	-0.312	-0.357	-0.310
28'								1.000	0.174	0.908

Appendix Table 11. (Con't.)

Variable number	21	22'	23	24'	25	26'	27	28'	29	30'
29									1.000	-0.076
30'										1.000

Appendix Table 11. (Con't.)

Variable number	31	32'	33	34	35	36	37	38	39'	40
1'	-0.673	0.881	0.598	0.666	0.812	0.765	0.710	0.688	0.953	0.775
2'	-0.080	0.386	0.401	0.324	0.648	0.654	0.291	0.203	0.656	0.341
3'	0.117	0.187	0.431	0.216	0.370	0.470	0.238	0.107	0.203	0.263
4'	-0.553	0.866	0.712	0.692	0.909	0.851	0.745	0.732	0.973	0.836
5'	-0.497	0.549	0.153	0.339	0.511	0.536	0.280	0.171	0.764	0.271
6'	0.004	-0.006	-0.410	-0.297	0.152	0.014	-0.338	-0.248	0.217	-0.241
7'	-0.361	0.629	0.493	0.429	0.809	0.711	0.449	0.500	0.770	0.600
8'	0.046	-0.234	-0.597	-0.719	-0.240	-0.187	-0.656	-0.585	-0.238	-0.529
9'	-0.597	0.708	0.342	0.373	0.706	0.709	0.346	0.363	0.670	0.511
10'	-0.585	0.800	0.701	0.661	1.000	0.879	0.646	0.622	0.881	0.765
11'	-0.517	0.845	0.893	0.904	0.770	0.692	0.983	0.961	0.764	0.985
12'	-0.605	0.786	0.643	0.598	0.879	1.000	0.585	0.516	0.845	0.720
13'	-0.492	0.826	0.846	0.880	0.703	0.635	0.972	0.989	0.712	0.988
14'	-0.527	0.825	0.858	0.825	0.864	0.839	0.860	0.833	0.815	0.934
15	-0.537	0.857	0.882	0.883	0.765	0.720	0.960	0.960	0.749	1.000
16'	-0.597	0.908	0.781	0.820	0.812	0.764	0.880	0.894	0.855	0.958
17	0.075	-0.045	0.036	0.115	-0.372	-0.226	0.145	0.230	-0.381	0.159
18'	-0.391	0.652	0.566	0.400	0.773	0.708	0.520	0.552	0.798	0.639
19	0.047	-0.017	0.017	-0.214	0.180	0.031	-0.098	-0.042	0.133	-0.051
20'	-0.535	0.829	0.639	0.649	0.900	0.852	0.668	0.625	0.988	0.745
21	-0.189	0.185	0.034	0.105	0.413	0.345	-0.002	-0.147	0.472	-0.043
22'	-0.568	0.814	0.705	0.763	0.926	0.826	0.754	0.729	0.945	0.827
23	0.430	-0.756	-0.576	-0.445	-0.780	-0.688	-0.553	-0.524	-0.866	-0.621
24'	-0.556	0.926	0.806	0.787	0.713	0.722	0.890	0.889	0.722	0.948
25	-0.045	0.316	0.589	0.475	0.181	0.300	0.577	0.619	0.078	0.616
26'	-0.731	0.815	0.384	0.523	0.615	0.667	0.512	0.503	0.705	0.609
27	-0.049	-0.203	-0.400	-0.248	-0.268	-0.182	-0.347	-0.317	-0.170	-0.313
28'	-0.718	0.967	0.598	0.640	0.804	0.754	0.702	0.663	0.860	0.759

Appendix Table 11. (Con't.)

Variable number	31	32'	33	34	35	36	37	38	39'	40
29	-0.036	-0.074	-0.236	-0.239	0.105	-0.086	-0.262	-0.331	0.133	-0.318
30'	-0.454	0.944	0.702	0.728	0.791	0.735	0.807	0.788	0.838	0.858
31	1.000	-0.714	-0.417	-0.455	-0.585	-0.605	-0.460	-0.430	-0.580	-0.537
32'		1.000	0.676	0.721	0.800	0.786	0.787	0.764	0.851	0.857
33			1.000	0.789	0.701	0.643	0.876	0.823	0.624	0.882
34				1.000	0.661	0.598	0.899	0.867	0.654	0.883
35					1.000	0.879	0.646	0.622	0.881	0.765
36						1.000	0.585	0.516	0.845	0.720
37							1.000	0.970	0.680	0.960
38								1.000	0.632	0.960
39'									1.000	0.749
40										1.000

' Data in units of 10,000

Appendix Table 12. Correlation matrix of variables in regression analysis MBCC-1.

Variable number	1'	2'	3'	4'	5	6
1'	1.000	0.454	-0.491	-0.550	-0.575	-0.471
2'		1.000	-0.017	0.084	0.382	0.366
3'			1.000	0.878	0.454	0.580
4'				1.000	0.626	0.797
5					1.000	0.865
6						1.000

' Data in units of 10,000

Appendix Table 13. Correlation matrix of variables in regression analysis MBCC-2.

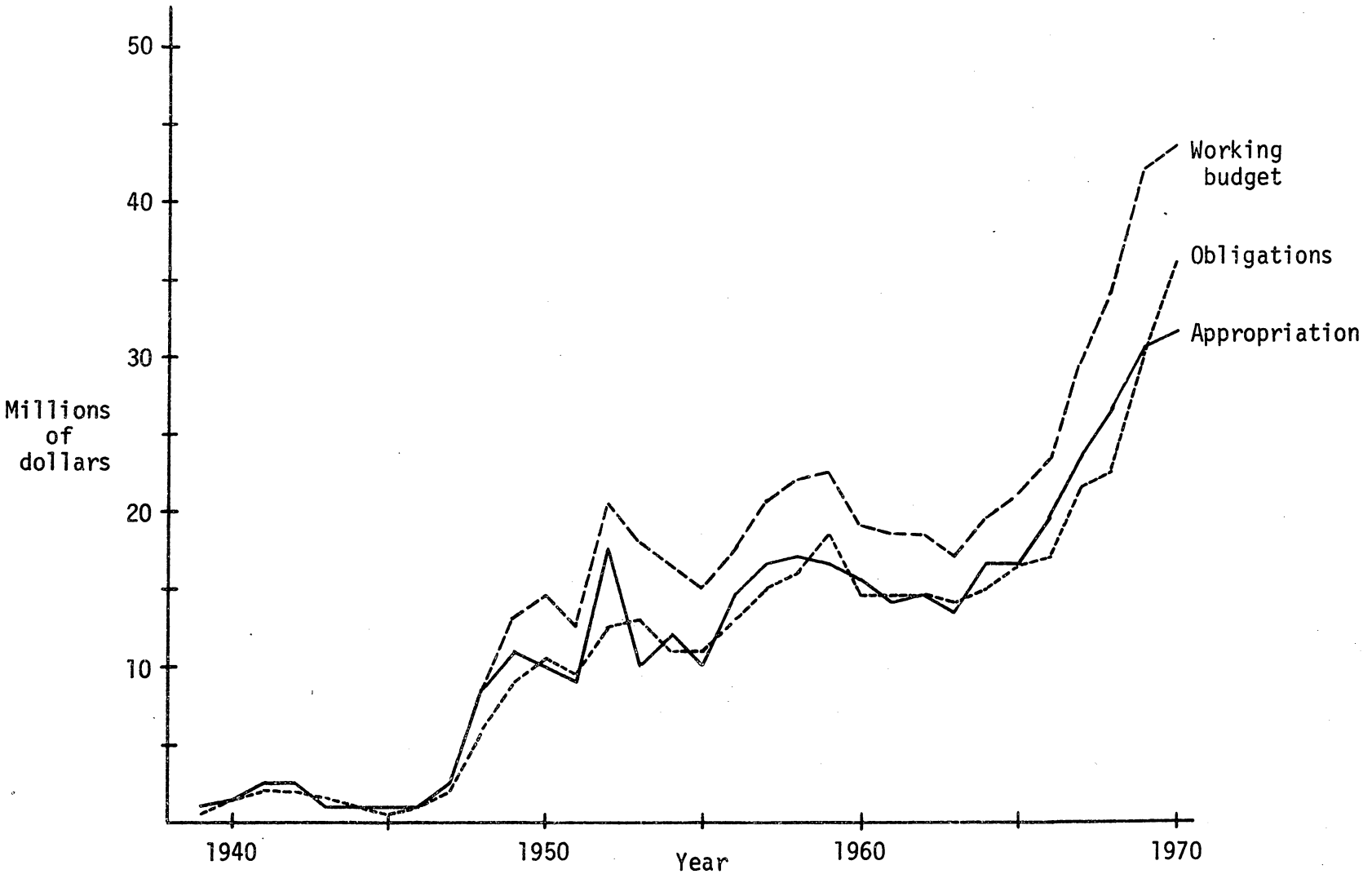
Variable number	1'	2'	3'	4'	5'	6'	7	8	9
1'	1.000	0.834	-0.281	-0.398	-0.004	0.179	-0.363	-0.177	0.124
2'		1.000	-0.523	-0.387	0.356	0.542	0.201	0.173	0.481
3'			1.000	0.784	-0.194	-0.062	-0.363	-0.003	0.077
4'				1.000	0.308	0.363	-0.000	0.603	0.421
5'					1.000	0.916	0.494	0.727	0.739
6'						1.000	0.516	0.725	0.924
7							1.000	0.510	0.531
8								1.000	0.670
9									1.000

' Data in units of 10,000

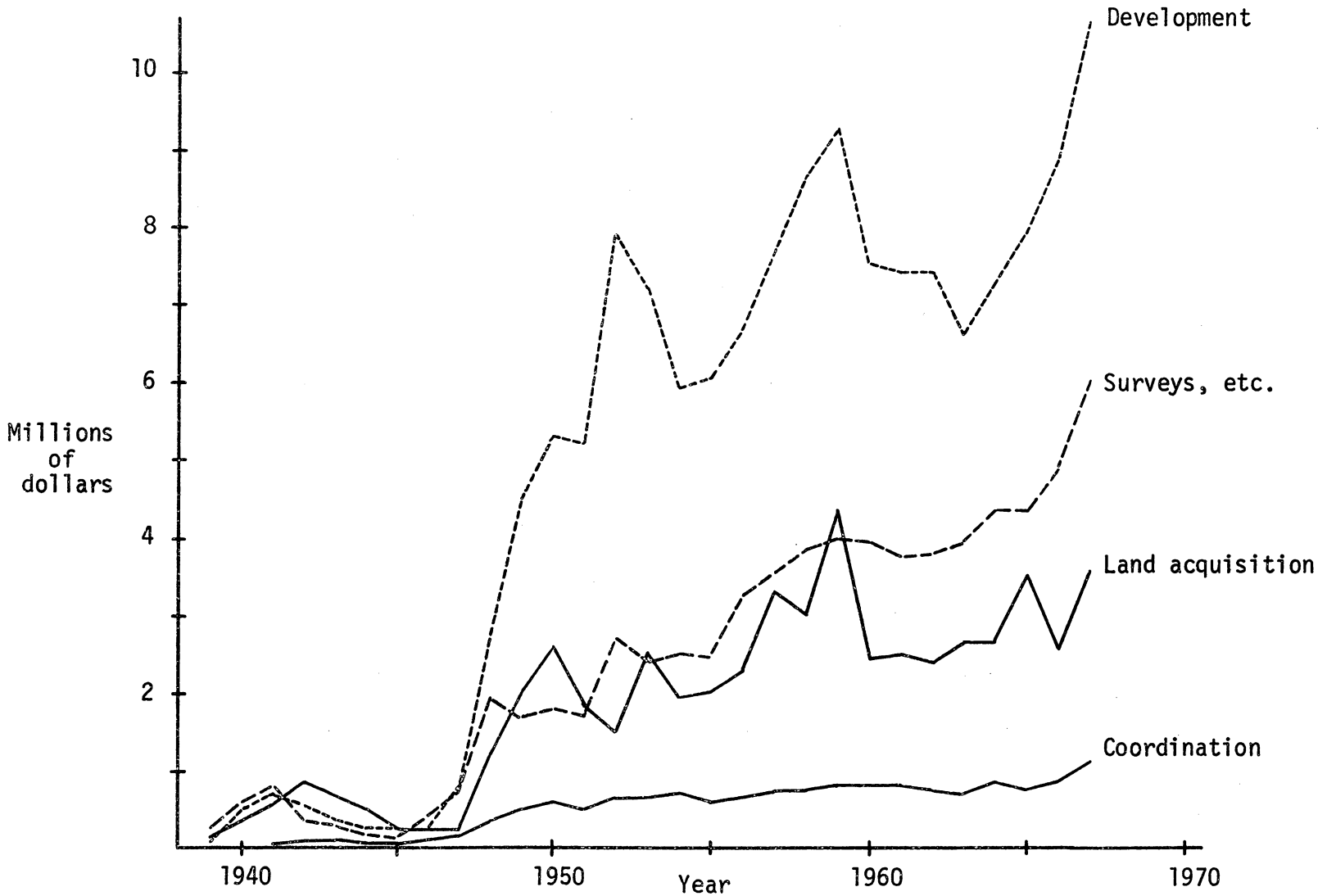
Appendix Table 14. Correlation matrix of variables in regression analysis MBCC-3.

Variable number	1'	2'	3'	4'	5'	6'	7	8	9
1'	1.000	0.757	-0.543	-0.660	0.762	0.537	-0.898	-0.846	-0.478
2'		1.000	-0.248	-0.460	0.634	0.830	-0.452	-0.696	-0.268
3'			1.000	0.908	-0.821	-0.140	0.460	0.602	0.890
4'				1.000	-0.838	-0.419	0.512	0.837	0.857
5'					1.000	0.591	-0.560	-0.742	-0.846
6'						1.000	-0.175	-0.636	-0.289
7							1.000	0.675	0.383
8								1.000	0.548
9									1.000

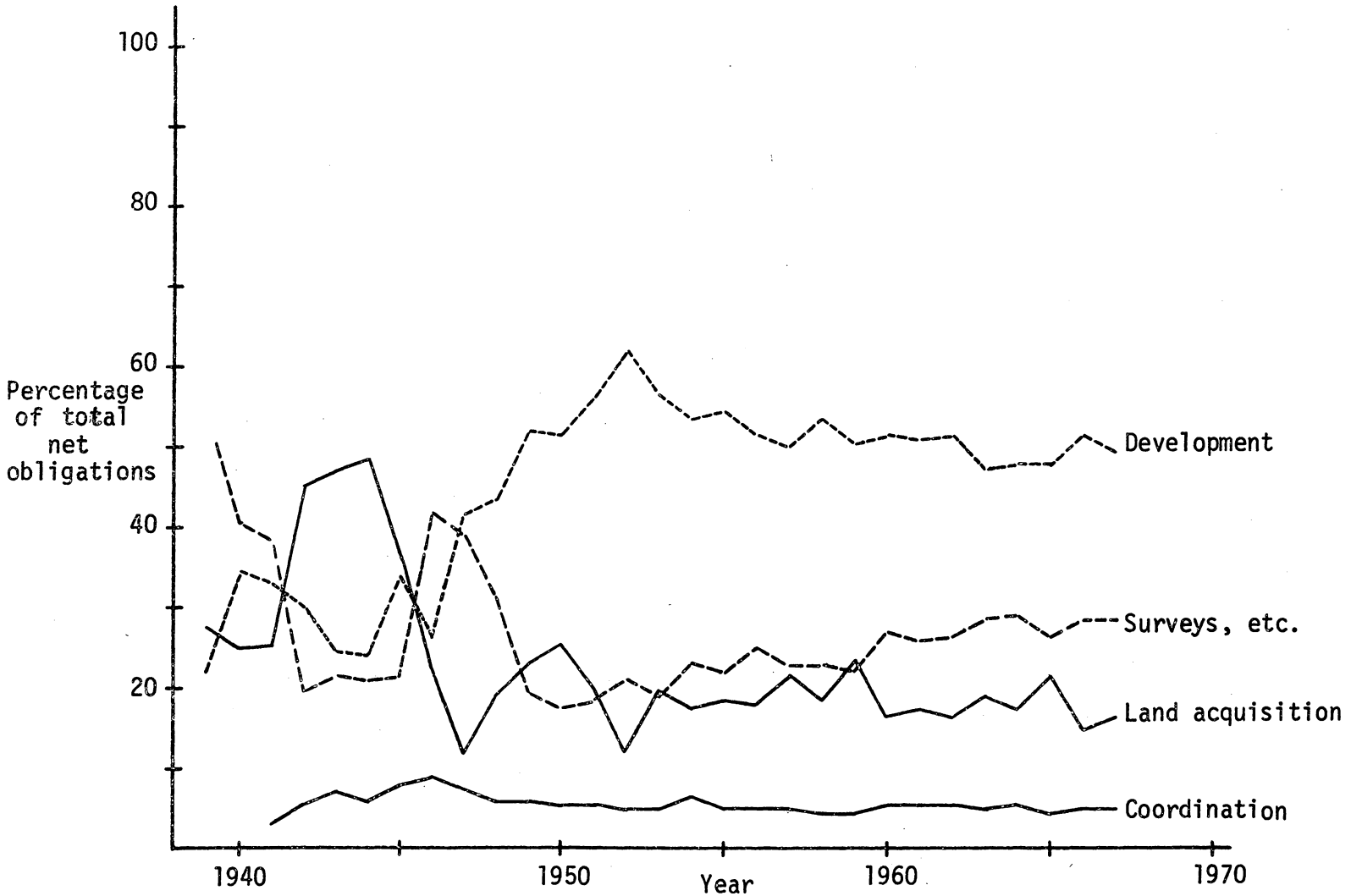
' Data in units of 10,000



Appendix Fig. 1. Millions of dollars of Federal Aid appropriation, working budget, and total net obligations by year, 1939-1970.

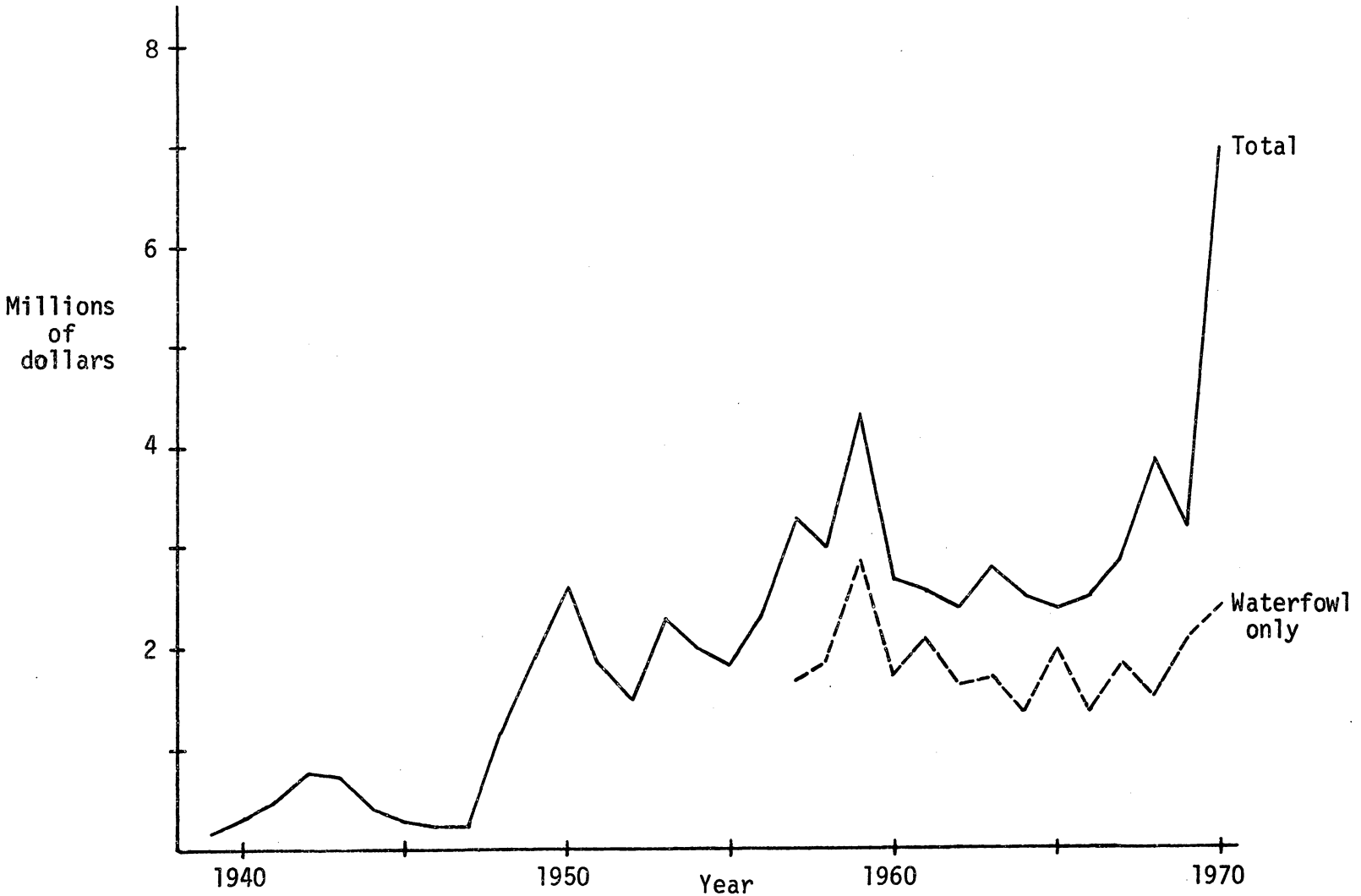


Appendix Fig. 2. Millions of net Federal Aid dollars obligated in the four major project categories by year, 1939-1967.



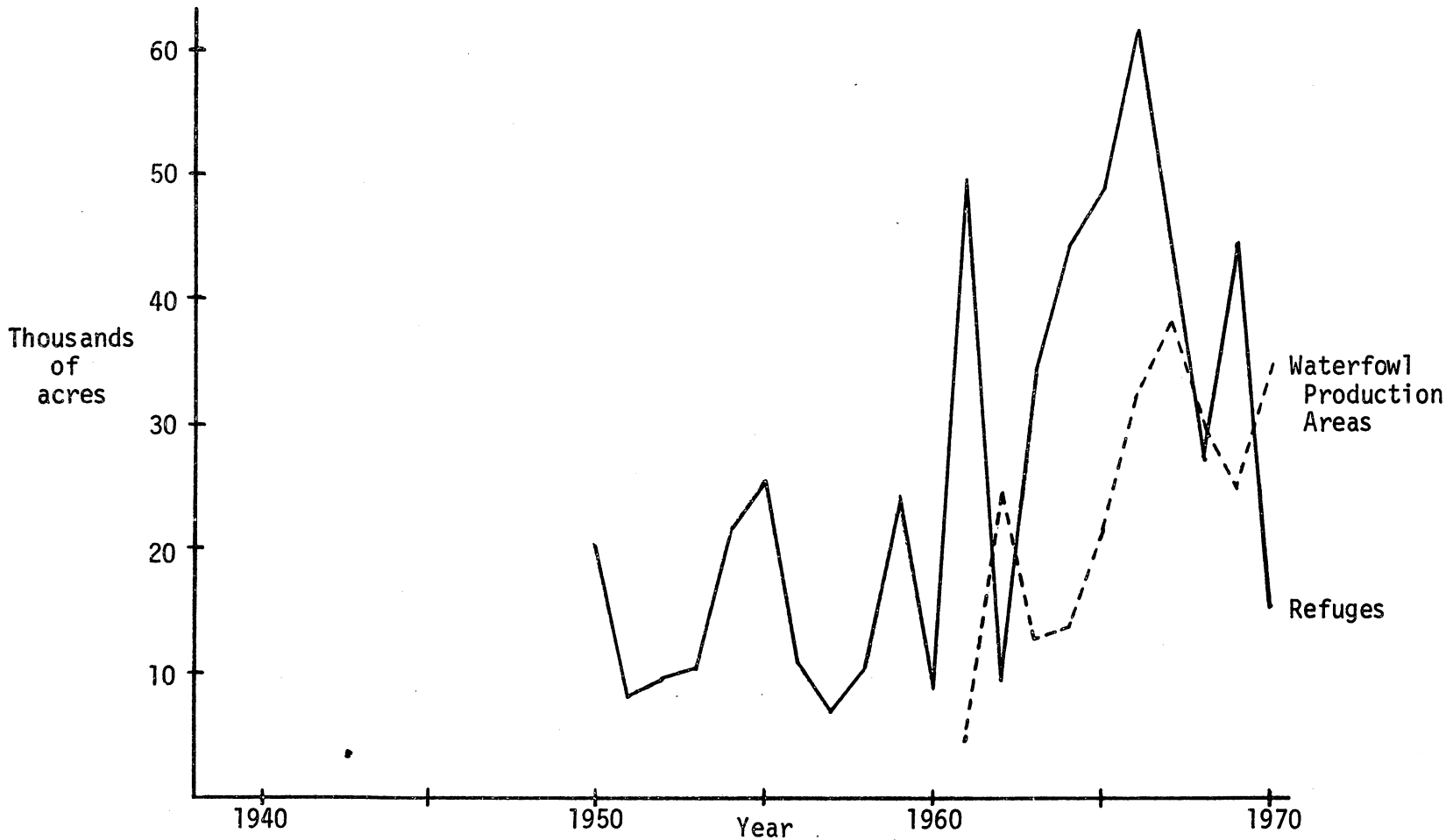
Appendix Fig. 3. Percentage of total net Federal Aid obligations in the four major project categories by year, 1939-1967.

Appendix Fig. 4. Thousands of acres acquired or approved for purchase under the Pittman-Robertson Act by year, 1939-1970.

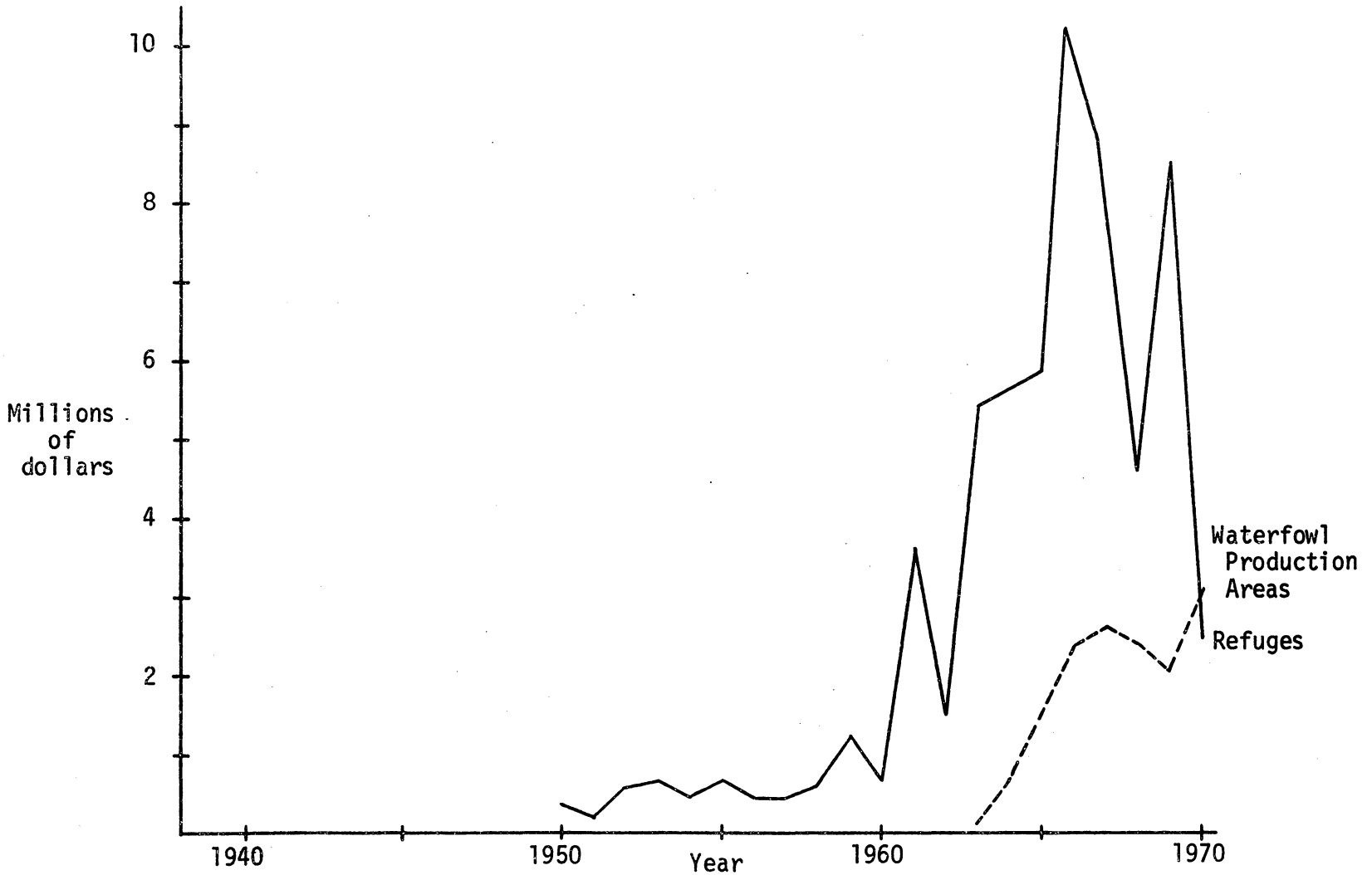


Appendix Fig. 5. Millions of Federal Aid dollars spent on or obligated to land purchase by year, 1939-1970.

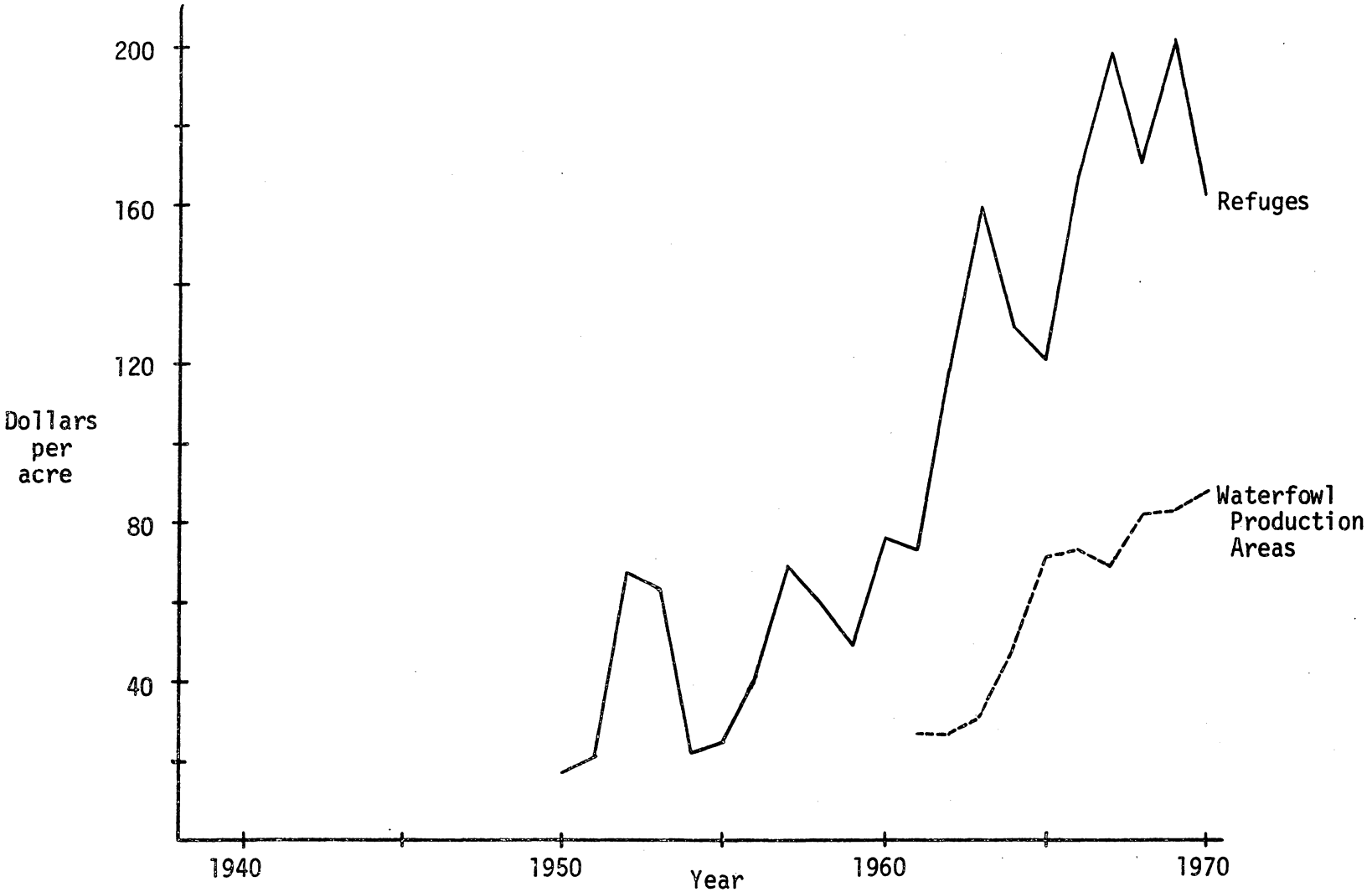
Appendix Fig. 6. Combined state and federal cost per acre for Federal Aid land purchase in dollars by year, 1939-1970.



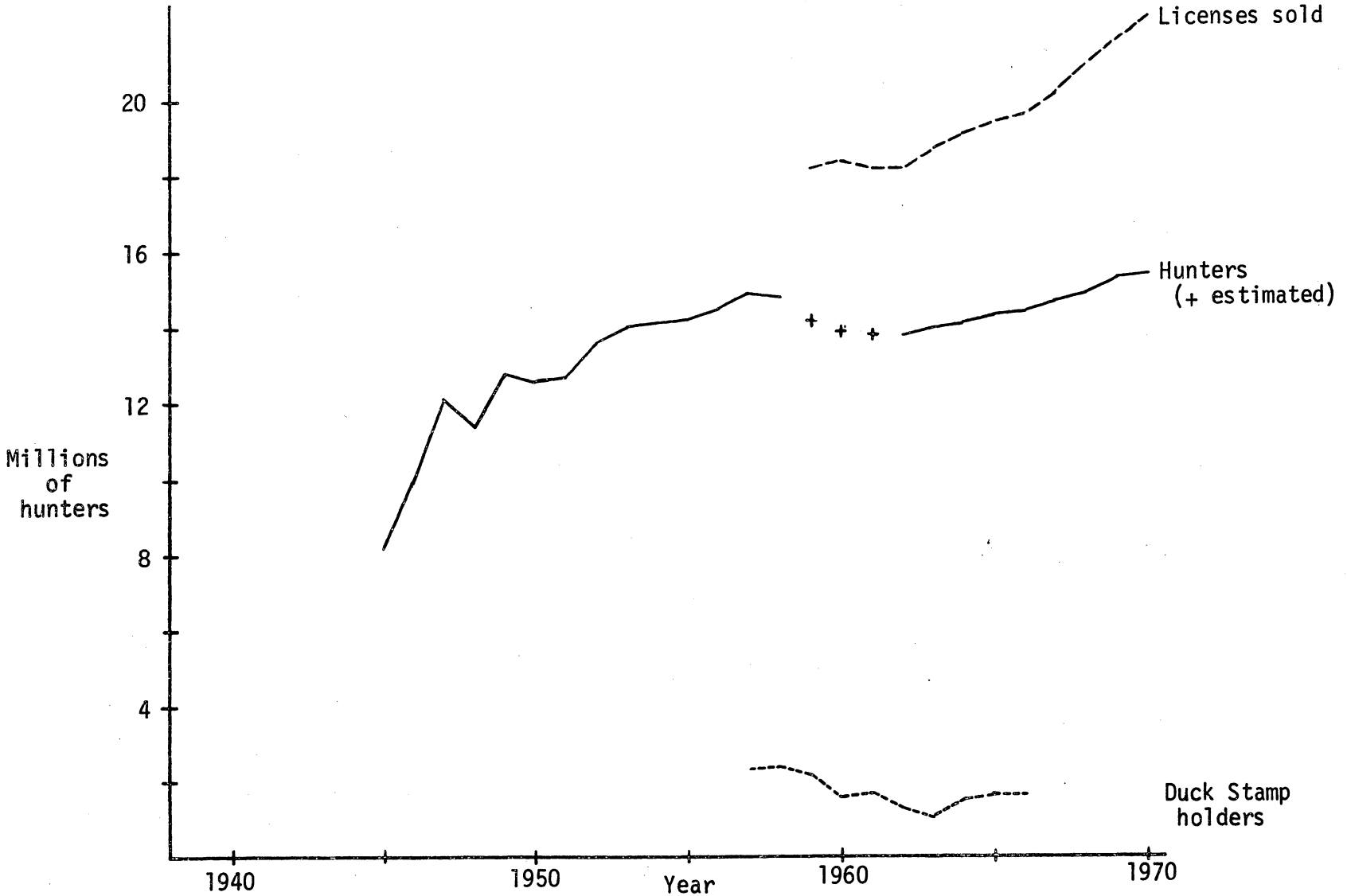
Appendix Fig. 7. Thousands of acres purchased by the Migratory Bird Conservation Commission by year, 1950-1970.



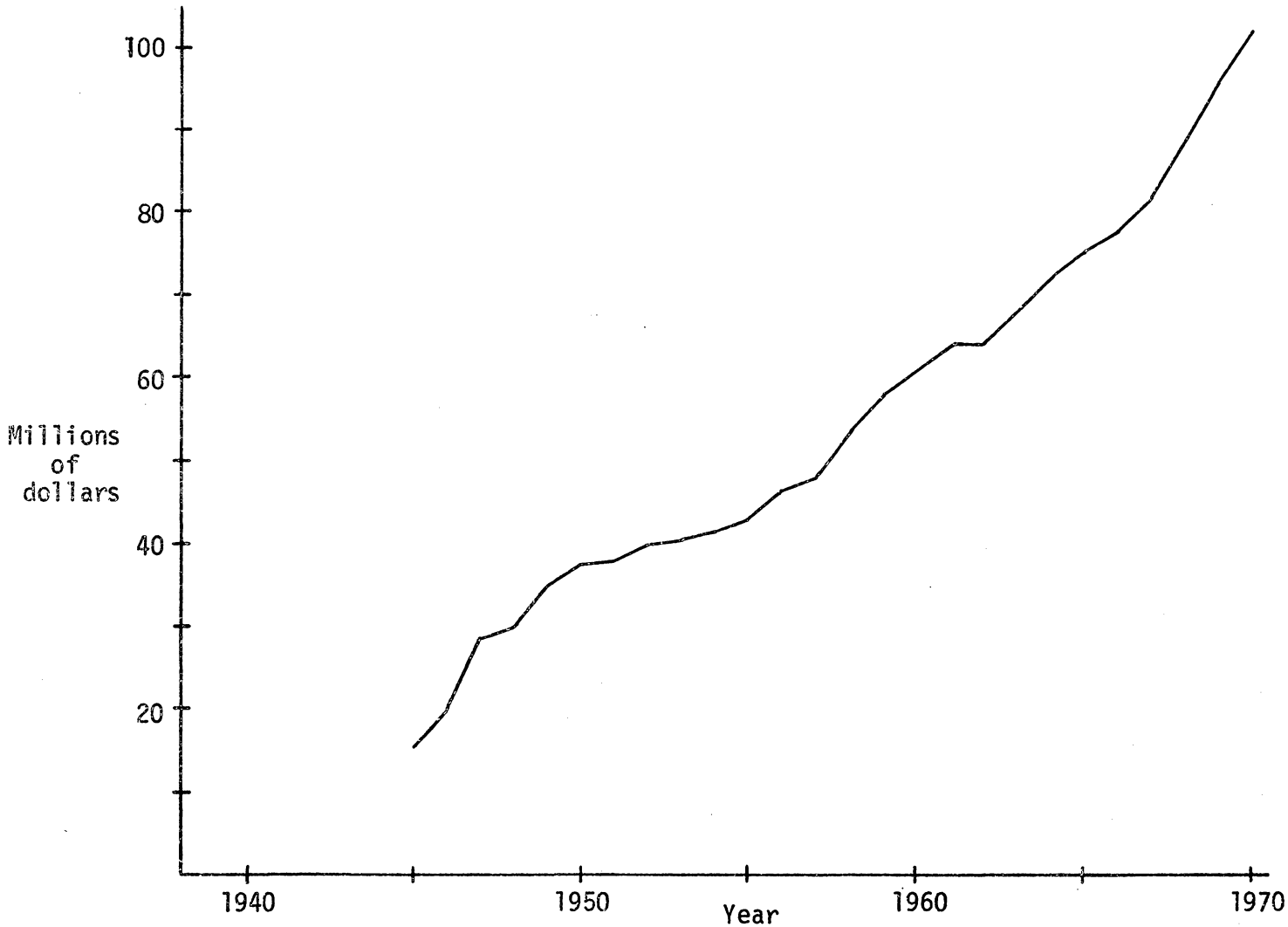
Appendix Fig. 8. Millions of dollars spent on land purchase by the Migratory Bird Conservation Commission by year, 1950-1970.



Appendix Fig. 9. Cost per acre for Migratory Bird Conservation Commission land purchase in dollars by year, 1950-1970.

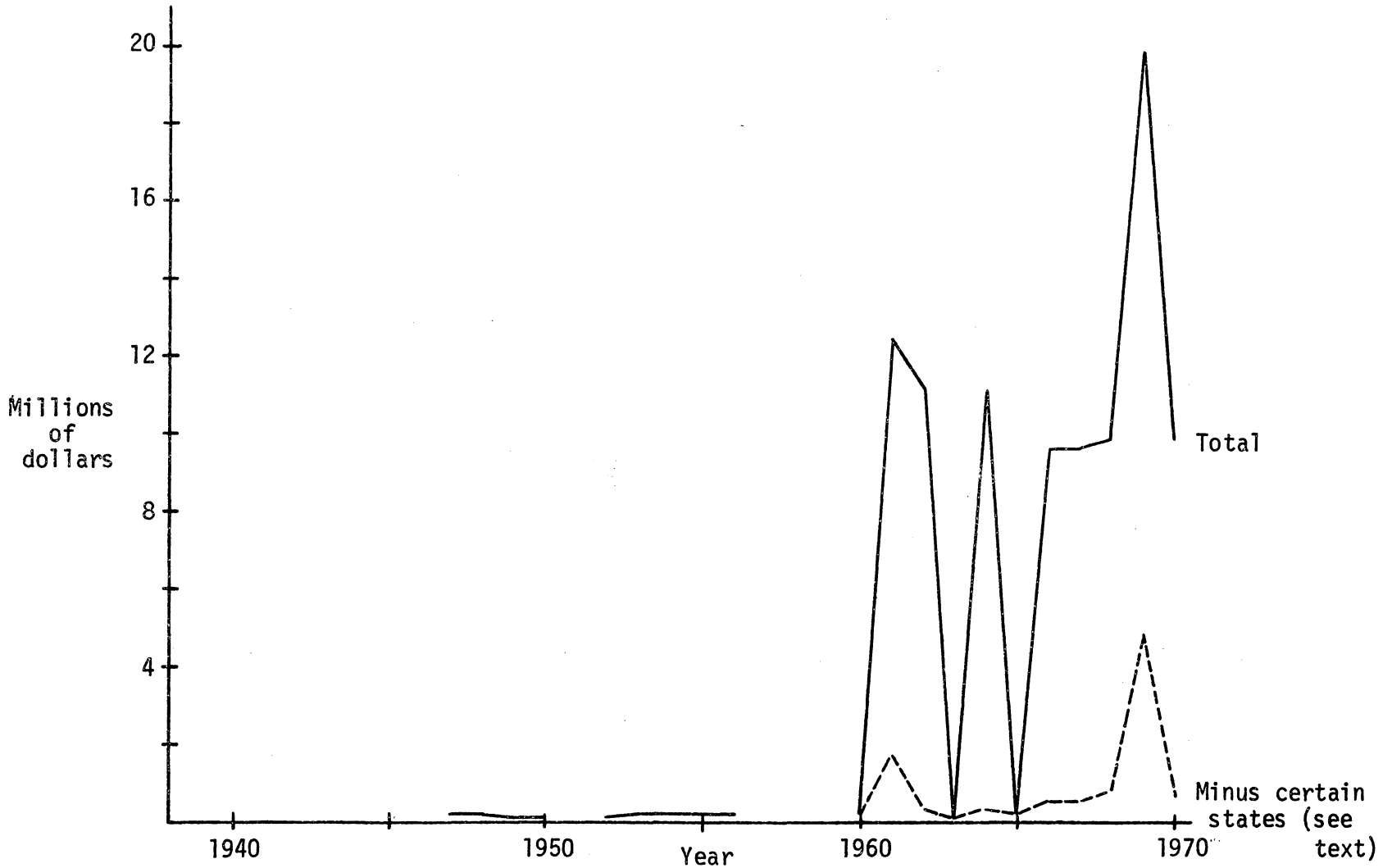


Appendix Fig. 10. Millions of licensed hunters by year, 1945-1970.

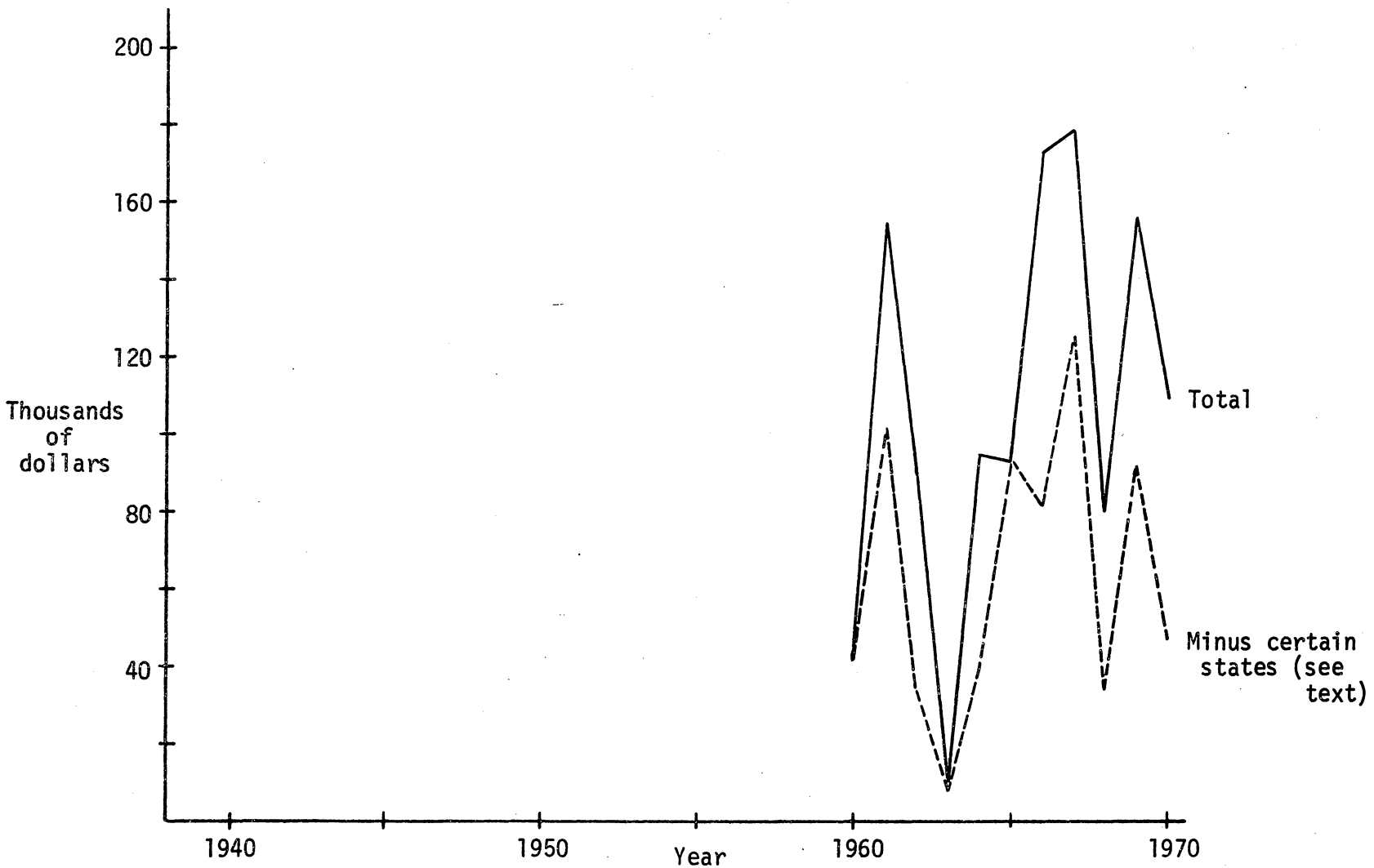


Appendix Fig. 11. Millions of dollars spent by hunters on licenses, permits, etc. by year, 1945-1970.

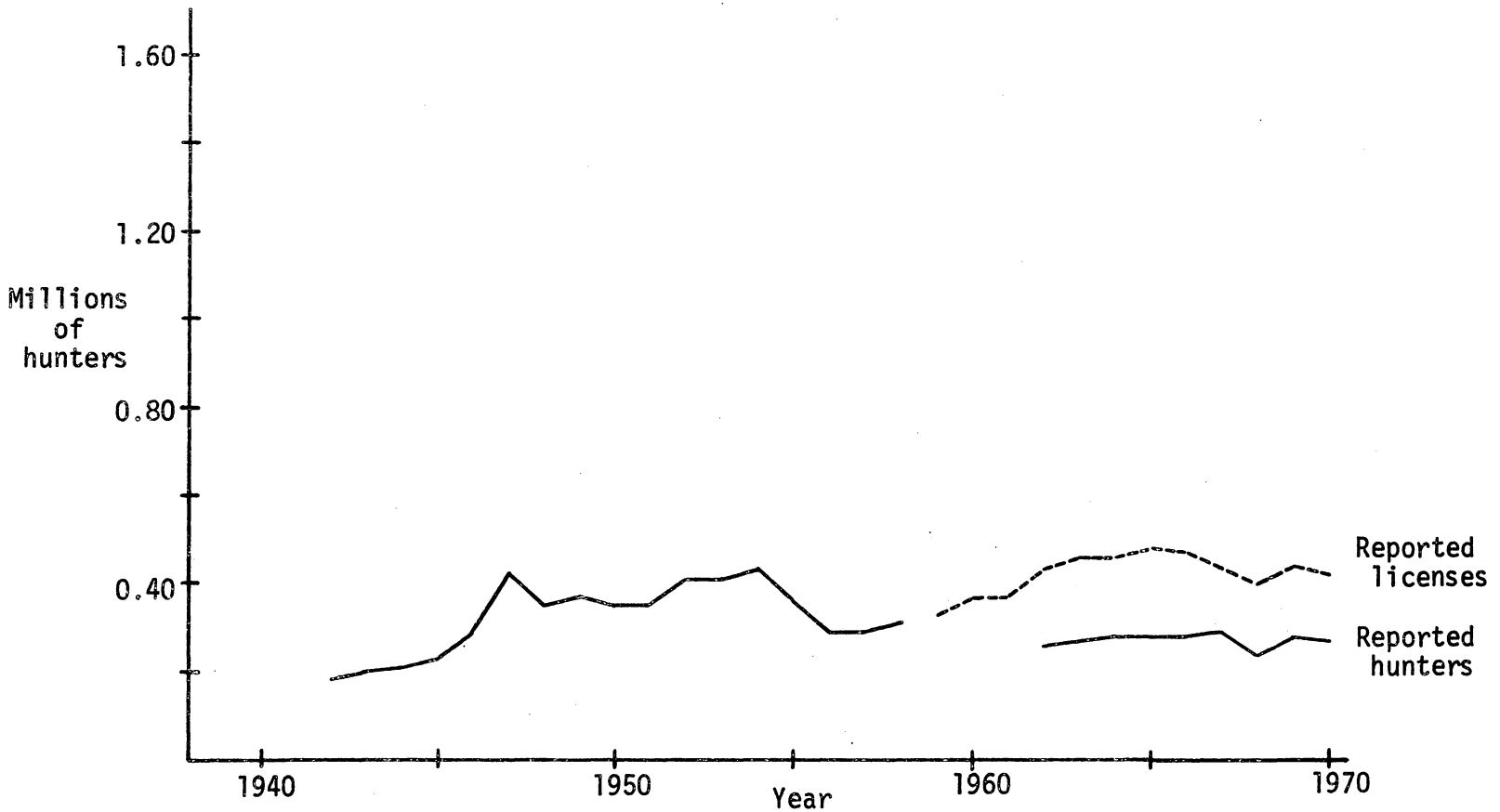
Appendix Fig. 12. Average accumulated Federal Aid acres purchased or approved for purchase in year$_t$ per licensed hunter in year$_{t+1}$, by year$_{t+1}$, 1947-1969.



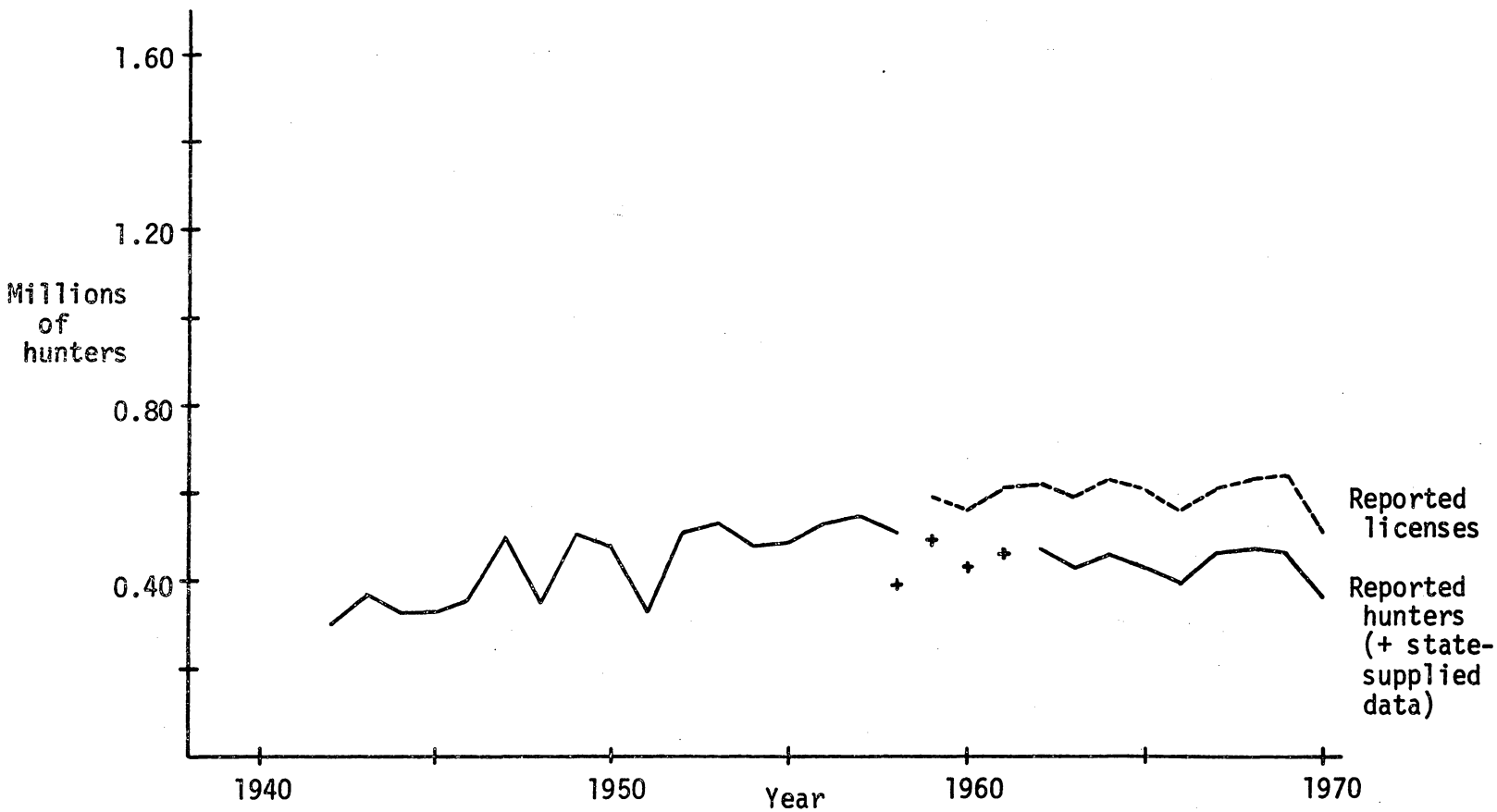
Appendix Fig. 13. Millions of acres leased or approved for lease under the Pittman-Robertson Act by year, 1947-1970.



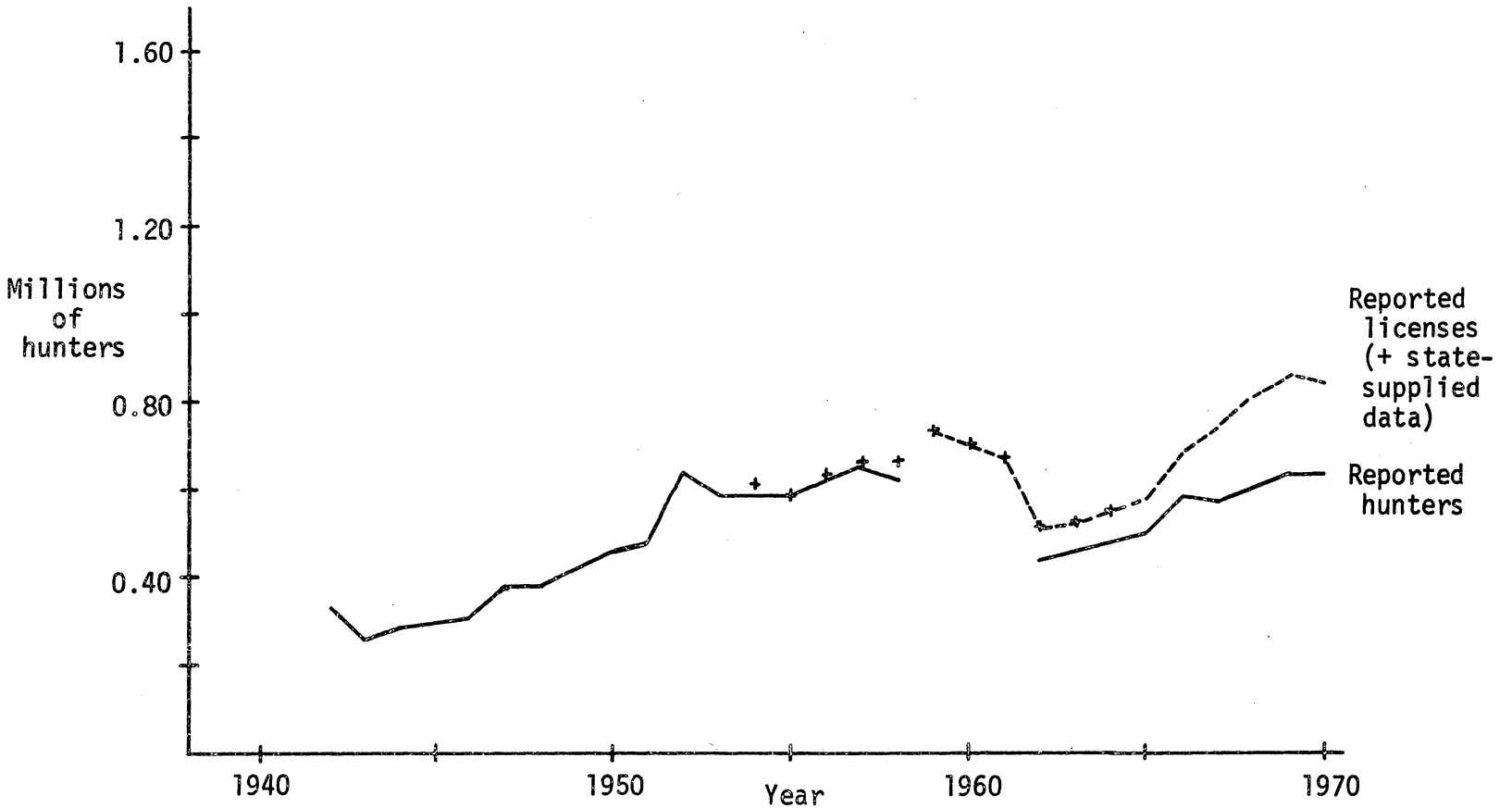
Appendix Fig. 14. Thousands of Federal Aid dollars spent on or obligated to lease and easement by year, 1960-1970.



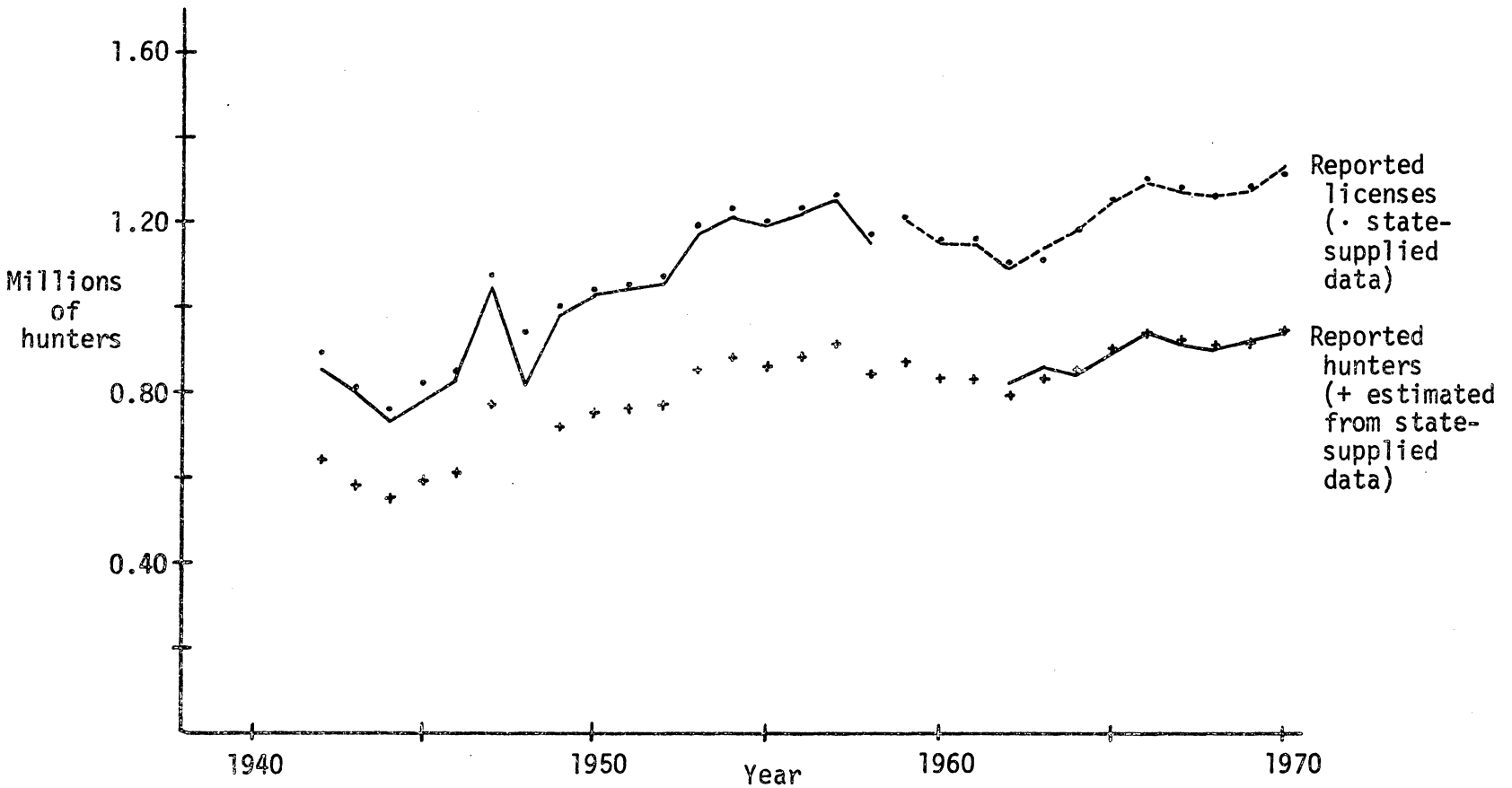
Appendix Fig. 15. Licensed hunters and licenses sold in Colorado as reported in the Pittman-Robertson annual reports by year, 1942-1970.



Appendix Fig. 16. Licensed hunters and licenses sold in Minnesota as reported in the Pittman-Robertson annual reports and as supplied by the state in reply to a request for data, by year, 1942-1970.



Appendix Fig. 17. Licensed hunters and licenses sold in Wisconsin as reported in the Pittman-Robertson annual reports and as supplied by the state in reply to a request for data, by year, 1942-1970.



Appendix Fig. 18. Licensed hunters and licenses sold in Michigan as reported in the Pittman-Robertson annual reports and as supplied by the state in reply to a request for data, by year, 1942-1970.

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Analysis of Factors Influencing Decisions to Acquire Public Land for Wildlife

Susan Brand Rayburn

ABSTRACT

Public land acquisition for wildlife-related purposes was studied, using land acquisition under the Federal Aid in Wildlife Restoration Act between 1947 and 1970 for the analysis. On the basis of a literature review, variables were selected for graphing and for regression analysis. Data was compiled from Federal Aid and other sources. Stepwise multiple linear regressions were run for selected land acquisition and other pertinent variables. Of 31 subproblems, 21 produced equations significant at the 0.99 probability level; 5 produced equations significant at the 0.95 probability level; 3 did not produce significant equations; and 2 produced no equations.

Land acquisition under the Federal Aid in Wildlife Restoration Act appeared to be strongly related to fund availability, competing uses for funds, increasing land prices, decreasing opportunity to buy suitable land, and increasing hunter demand for public hunting areas.