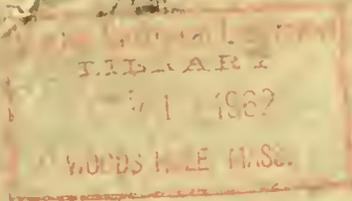


Wildlife Research Progress 1961



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Bureau of Sport Fisheries and Wildlife



CIRCULAR 146

The Department of the Interior, created in 1849, is our Nation's Department of Natural Resources, concerned with management, conservation, and development of water, wildlife, fish, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As America's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States, now and in the future.

Front cover photo by
Fred H. Dale, Staff Specialist

Back cover photos by
Lee E. Yeager, Leader,
Colorado Cooperative Wildlife Research Unit

UNITED STATES DEPARTMENT OF THE INTERIOR, Stewart L. Udall, *Secretary*
FISH AND WILDLIFE SERVICE, Clarence F. Pautzke, *Commissioner*
BUREAU OF SPORT FISHERIES AND WILDLIFE, Daniel H. Janzen, *Director*

WILDLIFE RESEARCH PROGRESS 1961

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FOREWORD

The population of the United States has doubled in the last 50 years; the gross national product has doubled in the last 20 years. These developments, accompanied by advances in transportation and increases in leisure time, have brought greater demands on natural resources and ever-increasing problems in wildlife conservation.

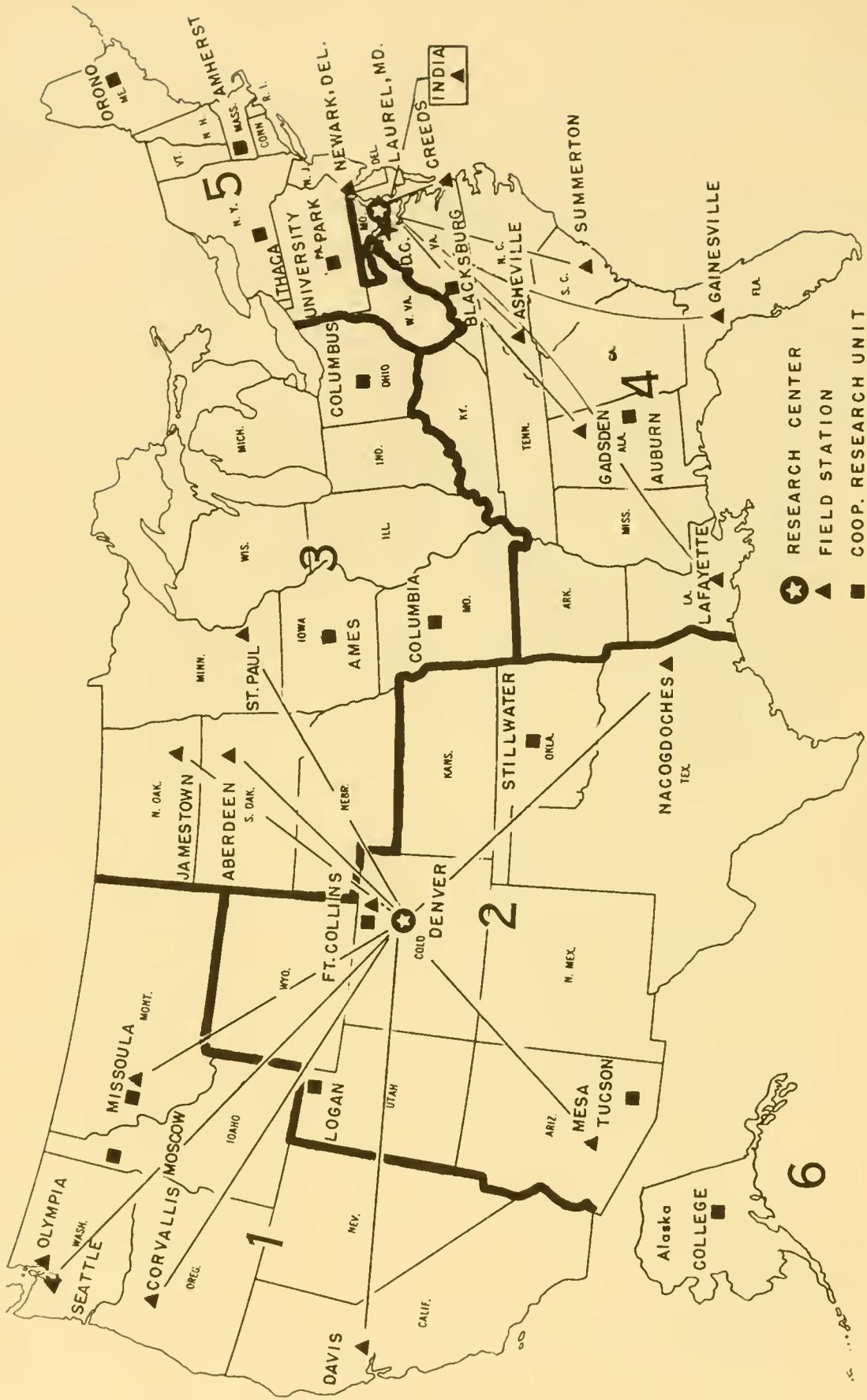
Wildlife problems are mostly manmade--complex yet challenging to conservationists, wildlife administrators, research scientists, and resource managers alike. And they are of concern to all of us. The interest of hunters and fishermen may be in more game and fish to catch; the tourist, camper, hiker, bird watcher, or suburban housewife may be pleased merely to see wildlife; the student may want to learn some technical detail about a given species; the conservationist may find satisfaction in knowing that a remnant of the whooping crane population still exists; and the farmer, the forester, or the jet plane passenger, while generally appreciative of wildlife, may with ample justification want to have methods devised for controlling animal depredations or eliminating bird aircraft hazards.

We are living in a changing world, a dynamic age. Changes in agricultural or forestry practices, changes in land use or transportation systems, or in almost any phase of our economy or mode of living, affect wildlife in some way. To keep pace with these changes and to ensure sound management of the Nation's wildlife resources, continued research is essential. The role of the Branch of Wildlife Research of the Bureau of Sport Fisheries and Wildlife in providing information and improved methodology for wildlife conservation, with particular reference to the period July 1960 to December 1961, is the subject of this report.

Daniel L. Leedy
Chief, Branch of
Wildlife Research

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- ★ RESEARCH CENTER
- ▲ FIELD STATION
- COOP. RESEARCH UNIT

BRANCH OF WILDLIFE RESEARCH, 1961

Wildlife Research Progress, 1961

The Bureau of Sport Fisheries and Wildlife has broad authority for research on an array of wildlife species, resident and migratory, game and nongame, harmful and beneficial. The Branch of Wildlife Research is the wildlife fact-finding arm of the Bureau. It performs research in the areas of waterfowl management, other migratory bird studies, upland wildlife, pesticide-wildlife relations, diseases and parasites, control methods, and classification, distribution, and life history studies.

The Cooperative Wildlife Research Unit Program is one of many cooperative programs participated in by the Branch. These Units are supported and administered under terms of memorandums of understanding signed by representatives of the Bureau, the Wildlife Management Institute, and the land grant colleges and the fish and game departments of 16 States. The Unit Program, in addition to conducting research, facilitates wildlife training and promotes conservation education through demonstrations, publications, lectures, and consultation. The assistance and support of the Wildlife Management Institute and of the cooperating States in the Unit activities mentioned in this report are gratefully acknowledged. Many of the findings recorded here are preliminary, and readers wishing more detailed information are requested to write to the Bureau or to the Units, listed in Appendix A.

The Branch also cooperates with other land-managing agencies of the Interior Department, and with the U.S. Forest Service, the Soil Conservation Service, the Department of Health, Education, and Welfare, and the Department of Defense in solving wildlife management problems. In cooperation with the Wildlife Management Institute, the Federal Aid in Wildlife Restoration Program, and the International Association of Game, Fish, and Conservation Commissioners, research is conducted in foreign

countries on potentially adaptable game species, and numbers of them are obtained for trial release in selected game-deficient areas of the United States.

Other projects made possible through the cooperation of conservation agencies, scientific institutions, or individuals include the international bird-banding record center at the Patuxent Wildlife Research Center, Laurel, Maryland. Here banding data on more than 11 million birds and recovery records on more than 1 million migratory birds are kept in addition to a file of more than 3 million cards on the distribution and migration of North American birds. The world's largest collections of North American birds and mammals are maintained at the U.S. National Museum in cooperation with employees of the Smithsonian Institution. These records, together with the professional taxonomic services rendered by Branch employees, are available to investigators both within and without the Bureau. The assistance of the thousands of banders, observers, and collectors who have cooperated in collecting the specimens or in providing the data makes this comprehensive service possible.

Details on Branch organization, administrative and supervisory channels, locations of research installations, and financing are given in the appendixes. Briefly, the Branch is organized on a staff-and-line basis with the Directors of the four research centers, the Leaders of the 16 Cooperative Wildlife Research Units, and the foreign game introduction project leader reporting directly to the Branch's Washington Office, which is responsible for program planning, coordination, and administration. Fiscal, personnel, and property management are handled through the Bureau's six Regional Offices. In the fiscal year 1962 the Branch had more than 150 professional and over 100 nonprofessional employees and a budget of more than \$2½ million.

RECENT DEVELOPMENTS OF INTEREST

Migratory Bird Populations Station

A new unit of the Branch was established through reorganization of the Patuxent Wildlife Research Center, October 19, 1961. This unit, the Migratory Bird Populations Station, concentrates under the Station Director those phases of research dealing with

national and international studies of migratory bird population dynamics, including bird banding and data processing. It serves as a clearing house and a planning center for developing various migratory bird surveys and investigations involving cooperation of operational personnel of the Bureau and assistance from State, Canadian, and other conservation agencies. Analyses of data already available in the bird banding files, in addition to information from current surveys, are an important part of the Station's initial work.



Colorado Unit Leader demonstrating the technique of live-trapping beaver to summer-camp forestry and wildlife students, Pingree Park, northcentral Colorado. (Photo by Lee E. Yeager.)



Many Unit students have found it necessary to set up basecamps on their summer study areas. In this instance Bill Rutherford, of the Colorado Unit, is working out of such a camp on the Williams Fork, North Park, Colorado.

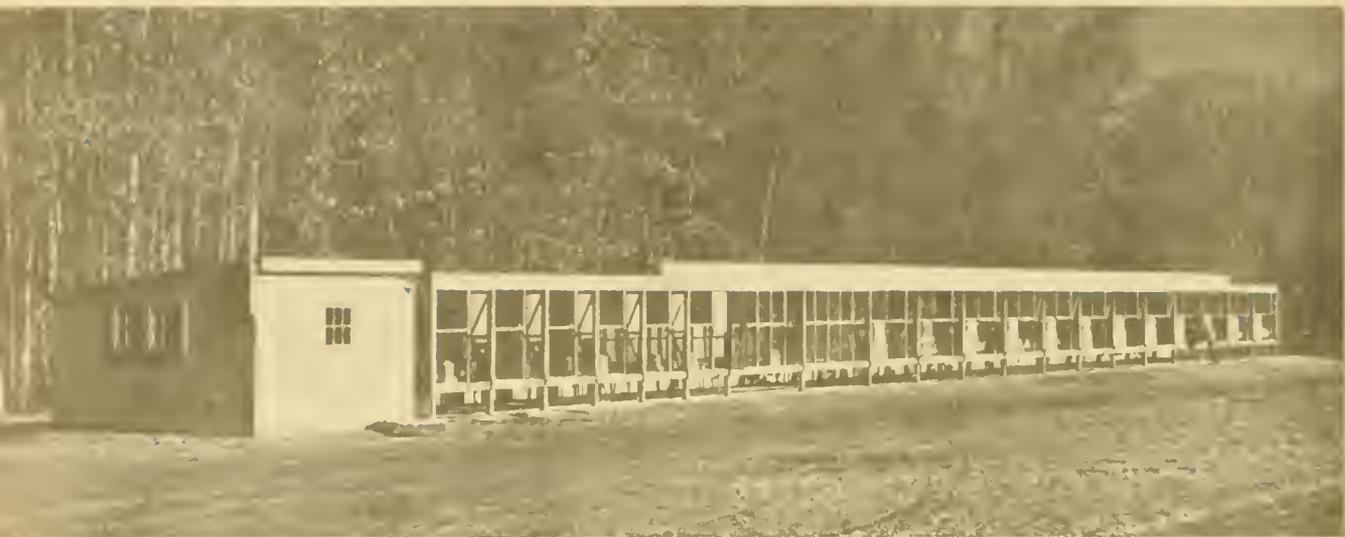
(Photo by Lee E. Yeager, Colorado Cooperative Wildlife Research Unit.)

New laboratory and research facilities

To improve the quality and output of research, every effort is being made to recruit topnotch personnel and to provide adequate facilities. Increased attention to pesticide-wildlife relations, control methods, and other problems requiring laboratory facilities has resulted in acquiring modern laboratory and other equipment. Excellent progress was made in 1961 on the construction of a 25,000-square-foot biochemical-pathology laboratory at the Patuxent Wildlife Research Center. Pens for research on pesticides and control

methods were constructed at the Denver Wildlife Research Center and its Olympia, Washington, substation.

Planning money was included in the budget for the fiscal year 1962 to locate a site and prepare plans for a wildlife research center in the Northern Great Plains Area, where greatly expanded research on waterfowl production problems is needed. In restoring the bird banding files which were damaged by fire in June 1959, a modern automatic data processing system has been substituted for the time-consuming manual procedure previously used. With the



Gull pens at the Patuxent Wildlife Research Center. Gulls have become a problem to jet aircraft at many U.S. airports. Mass capture methods are being explored through development of anesthetic or hypnotic baits, which are tested on captive gulls. Distances gulls regularly travel to airport trouble sites are being determined by observations of color-dyed gulls; various dyes are tried on captive gulls to help select an assortment of durable dyes that can be spotted easily at a distance. (Photo by F.C. Schmid.)



◀ The new Forestry Research Center at Olympia, Washington, which houses the Denver Center's Olympia Field Station. (Photo by Denver Wildlife Research Center.)



◀ New outdoor holding pens at the Olympia field station for testing the effect of systemic chemicals and foliar repellents on a variety of forest animals. (Photo by Denver Wildlife Research Center.)

support of State legislatures and grants from the National Science Foundation, the Atomic Energy Commission, and other agencies, research facilities are better at the Cooperative Unit schools than at any time in the history of this 27-year-old program.

New Cooperative Wildlife Research Units

Arrangements were made in 1961 to transfer one of the original Units from Oregon State University to Cornell University, Ithaca, New York. Authorization and funds were received to establish a Unit at Louisiana State University at Baton Rouge in the fiscal year 1962, bringing the total of such Units to 17.

Major works published and planned

Publications appearing during the period July 1, 1960, to December 31, 1961, are listed in Appendix C. Special mention is made here of a few major works either published or currently in preparation.

The Mammals of Wisconsin by H. H. T. Jackson, retired employee of the Branch, was published in February 1961 by the University of Wisconsin Press. This 518-page book is far more than the usual State mammal guide and represents a lifetime of painstaking work.

Muskrats and Marsh Management, by Paul L. Errington of Iowa State University and associated with the Iowa Cooperative Wildlife Research Unit since its inception, was published by the Wildlife Management Institute and Stackpole Company, Harrisburg, Pennsylvania.

The popular and long out-of-print book, American Wildlife and Plants, by A.C. Martin, H. S. Zim, and A. L. Nelson, was reprinted in a paper-back edition by Dover Publications, Inc., 180 Varick Street, New York 74, New York. This valuable book is now available at \$2 a copy.

Publication by the University of California Press of the 221-page Seed Identification Manual by Alexander C. Martin, retired employee of the Branch, and William D. Barkley in December 1961 was an important contribution to wildlife management and botanical literature. It is exceptionally well illustrated and contains important clues for identifying seeds of plants valuable to wildlife.

Important works in press or in preparation include The Black Brant, Sea Goose of the Pacific, by former Oregon Unit Leader A.S. Einarsen; Birds of Texas, by Harry C. Oberholzer, based on his work as an employee of the Bureau from 1895 to 1914; a book on the marshes of the United States by Neil Hotchkiss; and a book on the white-winged dove by George B. Saunders and others. Other works in initial stages of preparation include a book on the birds of Idaho by Thomas Burleigh, a book on the history and philosophy of predator control by Stanley P. Young, Collaborator, and a book on waterfowl and waterfowl habitat patterned after the Yearbook of Agriculture. This is to be edited by Joseph P. Linduska, former employee and now Collaborator of the Bureau.

RESEARCH HIGHLIGHTS

Waterfowl management research

The conservation and management of the waterfowl resource are two of the primary responsibilities of the Bureau of Sport Fisheries and Wildlife. In carrying out these responsibilities, continuing research is needed to improve techniques for managing existing waterfowl habitat, both in breeding areas and in migration and wintering areas; to develop means of creating new habitat; to draw up guidelines for habitat acquisition to best fill the yearlong requirements of the birds; to evaluate the effects on the birds of regulations and other management measures; and to improve inventory techniques.



Field studies by graduate students and Branch personnel are conducted in widely varying types of terrain from seashore to mountain top, from desert to tundra and rain forest, and from Arizona to Alaska and India. Transportation varies from jeep to dogsled and from boat to airplane. Here at Trappers Lake, Colorado, at 10,000-foot elevation, researchers are resorting to boat to get to their summer study area. (Photo by Lee E. Yeager.)

Population studies.--One means of evaluating the status and productivity of annual waterfowl populations is the examination of wings submitted to Bureau and cooperating State biologists. By noting color, growth, wear, and replacement of feathers, much can be learned about the sex and age ratios of various populations, the species composition of ducks in the hunters' bags, and whether production of young birds was good or poor.

The duck wing collection-productivity survey was expanded for the 1960-61 hunting season to include the Atlantic and Mississippi Flyways and, because of its uniquely valuable contribution to an understanding of waterfowl population dynamics, was further expanded in the 1961-62 season to all four flyways. Analysis of wings received from hunters in the Mississippi Flyway indicated an increase in the importance of mallards and a decrease in percentage of lesser scaups in the hunters' bags in the 1960-61 season as compared with the previous season. In the 1960-61 season the percentage of young birds was relatively high in the populations of mallards, American widgeons, green-winged teals, blue-winged teals, pintails, wood ducks, ring-necked ducks, and lesser scaups. Preliminary results from the 1961-62 wing collections indicated that both the number and the proportion of young ducks in the bag were substantially below those for the 1960-61 season, suggesting reduced kill and poorer production.

The mail questionnaire survey of waterfowl hunters was intensified so as to achieve reliable kill data in States or groups of States within a flyway; previously the results of these surveys were reliable only for the flyway as a whole. Special studies were made of bias that exists when hunters report their kill and hunting activity in mail questionnaires, and of the relations of season length and bag limits to duck stamp sales and the waterfowl bag. There appears to have been a significant positive correlation between season length and the sales of duck stamps during the decade 1950-51 through 1959-60.

Accomplishments of pre-hunting-season banding of mallards and black ducks and of the overall wood duck banding program during 1959 and 1960 were summarized in progress reports (see Appendix C).

During the summer of 1961 a study of aerial inventory techniques applicable to the Far North, or bush country, was initiated. Simultaneously, ground studies were begun in the Northwest Territories to learn the factors affecting brood production and its chronology under the conditions found there. Information on the role of the bush country in the production of species important in the hunting kill is needed, particularly during years of drought on the prairies and as some indication of what might result if further drainage occurs in the pothole country.

Through these and other studies the Bureau is able to refine its procedures for forecasting fall populations of waterfowl and measuring the effects of various hunting regulations on the level of the kill.

Waterfowl ecology.--Investigators from the Denver Wildlife Research Center documented the effects on waterfowl habitat of severe drought on study areas near Redvers, Saskatchewan, Louisiana, Alberta, and Jamestown, North Dakota. On the Redvers area the number of water areas on May 1, 1961, was 78 percent below the previous 9-year average and the number of breeding pairs of ducks had decreased 86 percent. Brood production dropped from a mean of 30 broods per square mile during the period 1952-60 and from a mean of 50 broods per square mile in 1952 and 1953 to 3 broods per square mile in 1961. A good start was made in the Jamestown area in determining basic water level-plant association relationships in and around potholes and the use of various types of potholes by waterfowl. The lack of suitable cover along the receding shorelines was especially unfavorable for diving ducks and late-nesting dabblers, including the gadwall, blue-winged teal, and shoveler.



Trapping, banding, color-marking, sexing, and aging Canada geese at Flathead Lake, Montana.

(Photo by John J. Craighead.)

A 2-year investigation of the breeding ecology of the common goldeneye was completed at the Maine Cooperative Wildlife Research Unit. It was estimated that total mortality from the start of incubation to attainment of flight was about 80 percent of potential production.

A Utah Unit study of the food habits of juvenile mallards revealed that newly hatched mallards feed primarily on terrestrial insects and take more plant food, primarily seeds, as the birds grow older. Although a great variety of food items may exist on a marsh during the duck rearing season, few occur in significant numbers and fewer still occur abundantly in the diet of the birds. Abundance of food is important, but it is the combination of quantity, accessibility, and palatability of a specific item of animal or plant material that appears to determine what food items will be consumed by a duckling of a particular age.

From 1955 through 1958, 548 goslings were color-marked by members of the Montana Cooperative Unit to determine the breeding age of Canada geese in the Flathead Valley of Montana. Eighty-three color-marked 1-year-old birds were observed, and none were known to nest. Thirty-six 2-year-olds were closely observed, and 29 percent of these nested. Twelve 3-year-olds were observed, and 100 percent of these nested. The one 4-year-old observed nested. Similar data were obtained from marked known-age geese in captive flocks except that none of the six 4- and 5-year-olds nested.

On the Back Bay-Currituck Sound waterfowl wintering ground, facts concerning food production are being correlated with water salinity and waterfowl use. Preliminary analyses of data collected over a 4-year period have established production calendars for several important food species

and have shown a relation between fungus infection and water salinity in the production of sago pondweed. In growth studies in sandy soils, sago pondweed, widgeongrass, and claspingleaf pondweed produced the greatest volume of vegetation at the highest salinity level (17 percent of sea strength) and wild celery and southern naiad at the lowest salinity level (2 percent). The greatest production of nitella was at an intermediate level.

Studies were begun in the coastal marshes of Louisiana to develop more rapid and reliable methods for measuring waterfowl utilization of wintering habitats. The most promising results have been obtained from a sampling system based on aerial counts along randomly selected transects within the different ecological and management units.

Management of aquatic plants.--One phase of waterfowl habitat management is the control of noxious aquatic weeds, methods for which are being studied by biologists of the Patuxent Wildlife Research Center.

A 1961 survey of Eurasian watermilfoil in the Chesapeake Bay area showed that 100,000 acres were infested, an increase of more than 50,000 acres from 1960. History of the increase is shown in the records of sampling stations on the Susquehanna Flats. None of the stations was infested in 1957, 1 percent in 1958, 47 percent in 1959, 84 percent in 1960, and 88 percent in 1961. Eurasian watermilfoil rapidly chokes out waterfowl food plants and interferes with boating, swimming, and fishing. Infestations have been found in fresh and brackish waters from New York State to North Carolina and Tennessee. The ability of floating fragments to root and the capability of plants to survive in 14 to 16 feet of water help explain the rapid spread of this species. It generally does not grow along shorelines exposed to constant wave and tidal action.

Cooperative studies with the State of Maryland have shown that 2,4-D can provide effective control in tidal areas. Best



Studying waterfowl foods in the San Luis Valley, south-central Colorado--R.A. Ryder photographed as a graduate student of Colorado State University where he was associated with the Colorado Unit.

(Photo by Lee E. Yeager.)

methods and seasons of application are now being developed for a variety of site conditions.

Alligatorweed, another plant of concern in waterfowl habitat management, is ecologically versatile. It grows in upland fields as well as in ponds and waterways throughout the Southeast. Sources of reinfestation, therefore, are always at hand.

Experiments in water-level manipulation showed that growth of rooted plants was set back by drops in water level and stimulated by rises. Tests of methods for chemical control of alligatorweed showed that rooted growth can be controlled by a single application of silvex granules during the active growth period of the plants. Single

applications of a mixture of the sodium salt of fenac with 2,4-D or other phenoxy compounds also were effective. Floating mat growth was not controlled by these methods.

Management implications of alligatorweed control were investigated through study of plant invaders of areas from which alligatorweed had been removed. Weatherwax (*Hydrochloa carolinensis*), which is a common invader in many areas, proved to be attractive to ducks and geese on areas reflooded in early winter.

Studies in management of waterfowl food plants showed that the germination of wild rice can be extended over a 2-year period by planting mixed lots of seeds subjected to different conditioning treatments. One portion, held in water at normal refrigerator temperatures near 42° F., germinates the year of planting. The other portion, kept in water at normal room temperatures of about 72° F., does not germinate until the second year. At room temperatures, water must be changed frequently during the first 30 days to prevent undue putrefaction. Other plant management studies showed that attractive orchard grass and clover meadows can be established on droughty and infertile sites by use of a moderate layer of ripe seed mulch harvested in early July and spread in late August.

Mosquito control--wildlife relations.-- Although drainage of marshes and certain applications of chemical insecticides for mosquito control may be harmful to waterfowl and other forms of fish and wildlife, the controlled flooding of marshes for the same purpose may enhance these resources.

Studies of the effects of mosquito control impoundments on wildlife were begun under contract by the Florida State Board of Health. Three study areas, each in a different marsh type, were selected along the eastern coast of Florida. Replicated natural and impounded marshes have been included in the experiment. Natural and

managed water level fluctuations will be compared on certain areas. Nine times as many water and marsh birds were observed in the impounded marshes as in the unimpounded ones. Coots, ducks, herons, and shorebirds benefited most from the impoundments.

Other Migratory Bird Studies

In this budget subactivity of the Branch of Wildlife Research are included studies of doves, woodcock, and cranes, and bird-banding services for all North American migratory birds, game and nongame.

Doves.--Steps were taken to implement the mourning dove management and research program, developed jointly with the International Association of Game, Fish, and Conservation Commissioners last year, by employing two additional dove biologists. One is engaged in summarizing accumulated banding data, and the other is studying methods of improving population inventory techniques. Several dove research projects are being conducted by Cooperative Units.

Results of a study of penned mourning doves at the Missouri Unit indicate that mating is the major influence on cooing frequency of a male dove. Tenfold increases in frequency of coos resulted when penned females were removed from their mates. When the females were returned, cooing dropped to the previous levels, if pair bonds were restored. If these results can be extended to the field, then any precise interpretation of mourning dove call-count data for inventory purposes requires information on the ratio of mated to unmated birds.

In Pennsylvania, the Cooperative Unit initiated a study to determine the importance of conifer groves to mourning doves. Preliminary data indicate that the conifer groves are utilized heavily as roost sites and for nesting. Gunning pressure also is heavy at well-established dove roosts.

Woodcock.--Analyses of wings of woodcock sent to the Patuxent Wildlife Research Center by hunters have provided data of practical value in the management program. Approximately 11,000 wings were returned in the 1961 survey. The perfection of a new technique based upon differences in the pattern and color of certain secondary wing feathers permits age determination throughout the hunting season and until the first annual molt. This technique replaces the slower, previously used technique which involved microscopic examination of primary feathers and was not reliable for late-shot woodcock from the southern States where the birds winter. The improved technique will increase the speed and accuracy of age ratio measurements, and provide a means of determining the age of woodcock at the time of banding.

Cranes.--Denver Center biologists continued surveillance of the whooping crane remnant population and studied the effects of hunting on sandhill cranes in the Texas-New Mexico area. Experimentation in the techniques for capturing, color-marking, and artificial propagation of sandhill cranes was initiated. If successful on these relatively abundant cranes, the techniques may be of use in bolstering populations of the related, but rare, whooping crane.

Bird banding.--Following a fire in the Bird Banding Laboratory of the Patuxent Wildlife Research Center in June 1959, restoration of game bird bandings and recoveries was essentially completed by December 1961, banding and recovery data having been placed on punchcards and magnetic tape. A preliminary summary from the tape has revealed that since banding was first initiated, over 3 million ducks and geese have been banded and over 400,000 of these have been recovered and reported to the Banding Laboratory. Mallards account for over one-third of the total bandings and nearly one-half of the total recoveries. Over 600,000 pintails have been banded and 64,000 recovered. Other species with large representation are the black duck with 284,000 banded and 41,000 recovered; blue-winged teal with 233,000

banded and 11,000 recovered; and Canada geese with 172,000 banded and 37,000 recovered. Bands recovered and reported in 1961 totaled 39,104, or about 5 percent above the number reported in 1960.

A communication from the USSR Academy of Sciences reported that 766 young and 434 adult snow geese had been banded during 1961 at Wrangel Island, USSR. Seventy of these were subsequently shot in Alaska, Oregon, California, and Nevada. One sandhill crane banded at Bitter Lake National Wildlife Refuge in New Mexico, one Laysan albatross and one black-footed albatross banded at Midway Island in the Pacific, and 16 snow geese banded at Tule Lake and Sacramento National Wildlife Refuges in California were reported as having been recovered in Russia. Some of the geese were retained for "maintenance of Zoological Parks" in Russia.

In April 1961, two communications from the USSR transmitted information on the recovery of 95 Fish and Wildlife Service bands. Most of these recoveries were of snow geese and pintails. A regular movement of these two species between Siberia and the North American Continent is indicated.

Upland Wildlife Ecology

Much of the resident upland wildlife, including game birds and mammals, is produced on private land, and the management responsibilities are primarily those of the State Fish and Game Departments. However, the Bureau of Sport Fisheries and Wildlife assists in research on upland wildlife problems and, through cooperative agreement and legislation, conducts wildlife studies needed to provide wildlife information to Federal land-managing agencies.

During the past year, an evaluation of the effects of forestry practices on wildlife production in the Southeast was undertaken



In a pesticides-wildlife study by the Massachusetts Cooperative Wildlife Research Unit, much is being learned about the biology and life history of the towhee. Here are (above) a female towhee caught in a mist net, (upper right) a clutch of four eggs, (right center) two fledglings, and (lower right) a nestling being banded.

(Photos by Massachusetts Cooperative Wildlife Research Unit.)

at the request of the U.S. Study Commission, Southeast River Basins. This indicated that the wildlife productivity potential of the area, although not as yet fully attained, can be expected to meet recreational needs of the hunting public for many years in the future. The review demonstrated the need for more accurate inventory techniques of game species.

Biologists of the Denver Center studied the relation of small mammal populations to forest regeneration and range conditions, the influence of showshoe hare and white-tailed deer upon timber stand development, and the effects on wildlife habitat of silvi-



cultural practices and phytocide applications to forest and range lands. Most of this work was done in close cooperation

with forest and range experiment station personnel of the U.S. Forest Service in the Pacific Northwest, Intermountain, Rocky Mountain, Lake States, and Southern Regions.

Small mammal studies.--A 5-year study of pocket gopher populations in relation to grazing intensity on the Black Mesa Experimental Area of western Colorado was inconclusive. Plant species composition and ground cover conditions, which change slowly on this type of range, will require extension of the study to define the relationship. In 1957 and 1958, when pocket gopher populations were high on Black Mesa, 61 and 56 percent, respectively, of the animals were young of the current season; when a population low occurred in 1959, only 13 percent of the animals were recorded as young-of-the-year. The percentage of young increased to 40 and 57 percent, respectively, in 1960 and 1961.



Foliage, stem, and branches of advanced subalpine fir reproduction were clipped and barked by voles as high as 66 inches above ground level during winter with the aid of heavy snow cover on cut strips, Fool Creek watershed, Oregon.

(Photo by Jay Gashwiler.)

On the Fool Creek Watershed, Fraser Experimental Forest, Colorado, population studies have been made of small mammals over a 5-year period following experimental strip-cutting of lodgepole pine and spruce-fir timber by the Forest Service. As measured by seed traps, seed production has been negligible. Deer mice, chipmunks, and other small mammals frequently considered important in causing loss of tree seeds were present, but not abundant. On the other hand, red-backed and montane vole populations were high in 1957, 1 year after the strip-cutting, when green slash provided an abundance of food and cover for these animals. Evidence of extensive feeding on the inner bark of the slash and on advanced conifer reproduction was prevalent during the winter of 1956-57. As the logging debris dried and deteriorated, this abundant food supply was lost and the vole population declined.

In the H. J. Andrews Experimental Forest of Oregon, seedling loss from time of germination until winter was estimated at 77 percent for Douglas fir, 98 percent for hemlock, and 97 percent for western red cedar. Most of the hemlock and western red cedar seedlings succumbed to drought. Douglas fir losses were attributed to heat, drought, mice, and cutworms. Live-trap sampling indicated that deer mice, Oregon voles, Cooper's chipmunks, and wandering and Trowbridge shrews were present on both virgin timber and logged areas, red-backed voles were present in timbered habitat, and Douglas ground squirrels in the



Litter of 5 deer mice about 24 hours old. In 1961 the average litter size was 4.9 young per female.

(Photo by Jay Gashwiler.)

cutover areas. Deer mice commonly associated with loss of Douglas fir seed were found to have a breeding season extending from March to October on the experimental area. Juveniles were found in the population from July through November with a peak in October when about 57 percent of the deer mice were young-of-the-year. The maximum number of embryos per female was 9 and the average was 5.

The role of red squirrels in forest regeneration was investigated on Cedar Island in Flathead Lake, Montana. A mark-and-release study showed that approximately 50 percent of the fall population of red squirrels on the Island was composed of animals 2 years old or older. There appeared to be a poor survival of young, for 7 out of 10 juveniles marked in midsummer disappeared by November. The squirrels began clipping green Douglas fir cones in July and continued through the fall. Clipping seemed to be concentrated on thrifty, heavy seed-bearing trees, and by November few cones remained on the trees frequented by red squirrels.

Other mammals.--A 12-year study of a Lower Michigan jack pine plantation revealed that 22 out of 25 trees within deer and hare exclosures were of crop quality, whereas on unprotected plots only 1 of 7 made a crop tree, most of the remainder being multistemmed or badly deformed. The average height of the protected trees was 13.5 feet, compared with 7.5 feet for unprotected trees. Tree survival as recorded in 1961 was 96 percent in the exclosures and only 44 percent in the unprotected plots. Similar results were obtained in a red pine plantation in the Tamarack National Wildlife Refuge in northwestern Minnesota and in a planted jack pine stand in the Superior National Forest of Minnesota.

Among the mammals studied by the Cooperative Wildlife Research Units were



Severe deer browsing produced multiple-stemmed and badly deformed jack pine in Lower Michigan.

(Photo by Laurits Krefting.)

antelope; black, grizzly, and polar bears; bison; mule and white-tailed deer; elk; javelina; moose; bighorn and Dall sheep; such fur animals as beaver, fisher, arctic fox, marten, mink, muskrat, river otter, and ringed seal; small game mammals including the snowshoe hare, cottontail, and swamp rabbits, and the gray squirrel; and others, including bats, the bobcat, coatimundi, porcupine, cotton rat, and ground squirrels. Mention is made here of only a few of these studies.

Over a 3-year period, Montana Unit personnel have made a total of 1,809 different observations of marked, and unmarked but recognizable, grizzly bears. Data from field observations and recaptures indicate a high cub mortality during their first winter. The cub-yearling ratio has been 91 to 53. Animals remaining with their mothers as yearlings and 2-year-olds grow and develop more rapidly than those that are cast off as yearlings. A number of marked bears have exhibited airline movements exceeding 50 miles, and at least 7 bears marked within Yellowstone National Park have been killed by hunters outside the Park.



In an Alaska Cooperative Wildlife Research Unit mink study, John Burns, graduate student, also learned about Eskimo life in the Yukon-Kuskokwim Delta area. Above left is a typical trapper's camp. The dwelling consists of a willow log frame, grass and square-cut sods from the surrounding tundra. To the right a "taluyak" (wire mink trap) is being set in a stream covered by ice. The "taluyak" and rifle are the major means of taking mink in this area. (Photos by John Burns.)

Examination of black bear droppings collected in the Whitefish Range in north-western Montana revealed that plant material occurred in essentially all of the scats, insects in 45.3 percent, mammals in 5.0 percent, and birds in 0.4 percent. In terms of volume, animal material formed a very minor part of the fecal remains.

In Colorado, continued measurement of the effects of weather on mule deer behavior by Unit personnel has begun to reveal certain patterns and the reasons for these patterns. It is increasingly evident that deer are creatures of habit and, in the absence of hunting or other violent disturbance, can be depended upon to respond in a given way to given stimuli. Thus, mule deer use the upper and lower edges of heavily timbered areas more than the interior; they tend to travel along wooded draws in going up and down mountain slopes; they feed during periods of comparatively low wind turbulence, whether day or night; and they bed down on clear days in winter, in coniferous timber or behind rock outcrops, nearly always on a southerly exposure.

The mule deer on Wildhorse Island, Montana, probably represent a typical example of an un hunted population on a restricted range. This population, estimated at between 400 and 500 animals in 1954, dropped to an estimated 150-200 in 1961. Poaching and movement from the Island are both considered to be insignificant. Natural mortality appears to be exceeding the number of young animals brought into the population. This is an old-age population with a sex ratio of about 113 bucks to 100 does.

Typical classification of 100 mule deer on the Island in October would be something like 36 bucks, 32 does, and 32 fawns; while in May it normally would have changed to 47 bucks, 41 does, and 12 fawns. These sex and age ratios are a summary of classified counts made over a 3-year period.

Iowa Unit studies indicate that the State's white-tailed deer are favored with an adequate supply of good food, and reproductive success is high. This is verified by the fact that 20 fawns available for examination after



Grizzlies in Yellowstone National Park were trapped and immobilized. Weights and measurements were taken and the bears were tagged and color-marked before being released. This bear weighed 565 pounds. (Photo by Frank C. Craighead.)

the close of the rutting season had an average of 1.25 fetuses each. Older does showed 1.94 fetuses each. Three-fourths of Iowa's doe fawns breed their first fall.

For the past 6 years the Arizona Unit has carried on a program of research to gather needed information on the collared peccary. These studies have included work on reproduction, methods of aging animals, productivity, food and water requirements, home range and movement studies, and an analysis of age structures of wild populations. During 1961, four Arizona Unit publications on this important game animal appeared.

As a result of studies on how to determine the age of peccaries, it is now possible to classify the animals into known-age categories up to the age of $21\frac{1}{2}$ months. It was found that, in 1957, 2 percent of the animals were in the 2-to-10-month age class compared with 6, 4, and 3 percent, respectively, in this category in 1958, 1959, and 1960. It is believed that the low percentage in the 2-to-10-month age class in 1957 and the low percentage in the

10-to- $21\frac{1}{2}$ -month age class in 1958 (9 percent in 1958, compared with 20 and 13 percent, respectively, in 1959 and 1960) were results of the severe drought of 1956. There are strong indications that severe drought years have adverse effects on the peccary populations, and that their numbers, like those of so many animals, are closely related to the annual rainfall.

In studies of beaver production by the Maine Unit, no significant differences were noted in current reproductive rates as compared with an earlier period (1947 to 1950); beavers in central Maine, however, produced significantly more young than did those of northern Maine. Also, as compared with northern beavers, Alabama beavers use relatively little woody vegetation for food, and this use occurs primarily in winter. Summer feeding is more of the browsing and grazing type, with much herbaceous vegetation being eaten. In summer, dams are abandoned to a large extent, and the beavers use natural waterways and manmade impoundments.

A study of muskrats on a large marsh in northern Ohio revealed a higher juvenile age ratio in muskrats taken from controlled water level units than in those from areas not under management. Data from slightly over 9,000 specimens suggest that age ratios vary because of higher juvenile survival, rather than in the inherent reproductive capacity of the two populations studied. Immature muskrats from the managed marsh units weighed significantly more than those trapped in undiked units of the marsh. The presence of 21 placental scars in each of 3 reproductive tracts showed that some of the female muskrats in western Lake Erie marshes produce 3 litters per breeding season. Three cases of probable transuterine migration and one case of twinning were noted in the specimens examined. Ovaries collected from January through August contained corpora lutea.

Adult female cottontails in southeastern Ohio are known to produce fewer young per litter than they do in other parts of the State. An attempt is being made by Unit personnel to ascertain why this is so.

Juvenile cottontails from southeastern Ohio show consistently lower values for phosphorous, hemoglobin, and calcium blood levels than do juveniles from other regions of Ohio. General summations of data suggest that differences in the secretion of pituitary gonadotrophins and/or adrenocortical steroids may be influencing the basic productivity of these animals. This may be a reflection of soil differences in various parts of the State.

A study of the characteristics of a swamp rabbit population in Missouri provided an estimate of 1.6 years average longevity for these rabbits. Apparently there is little or no breeding by juvenile females; in this respect the swamp rabbit differs markedly from the cottontail.

Resident game birds.--Observations by Pennsylvania Unit personnel revealed that, after 7 years, openings created for grouse in pole-size timber had lost much of their value for broods owing to natural plant succession. Brood habitat disappears long before the areas become unsuitable for adult grouse.

In Utah, a study was made of the effects of environmental and biological factors on rally calling in the chukar partridge as an aid to the interpretation of census methods. Frequency of calling was high in the morning and evening, and negligible during midday. The daily pattern of calling before and after postbreeding covey formation showed definite differences. High calling periods normally occurred at lowered light intensities and mild temperatures. High winds and precipitation diminished calling at most times. However, it appeared that internal motivation to call was high enough at times to stimulate calling under adverse conditions. The presence of other chukars normally stimulated calling; the presence of predators normally inhibited calling. Sex and social rank influenced calling by penned birds. Dominant males called more frequently than subordinate birds. Calling by females was more frequent than by males.

As a result of a 2-year study of chukar partridges and their range in western

Colorado by the Unit, the following general management recommendation can be made: Provide green food to chukars during the prebreeding season (February to about mid-March) to induce the physiological condition necessary to high productivity. This can best be done by establishing chukars on range with natural water sources, preferably streams through small farmed valleys flanked by steep, rocky, canyonlike slopes. The feeding of green-cured alfalfa can be resorted to during very dry winters and springs when the growth of green food is short or nonexistent. Manmade watering devices commonly known as "guzzlers" induce wider distribution of chukars during dry years and help maintain populations on marginal range, but it is doubtful whether they contribute to significant increases in the population.

Gambel's quail research by personnel of the Arizona Unit has pointed to ways of increasing production of young birds. Earlier research indicated that the substance found in green foods which is necessary for successful breeding is either vitamin A or an associated substance. Artificial stimulation of breeding in wild quail was attempted using high concentrations of vitamin A in a supplementary feed during both 1960 and 1961. To give experimental accuracy, paired study areas were used with the vitamin available to the quail on only one area but added feed given on both areas. Breeding success was measured by determining the fall young-adult ratios. This was done by trapping and banding, and, in 1961, wing collection boxes and hunter cooperation were also tried to find this ratio.

In 1960, added vitamin A was available during most of the breeding season, and was therefore given both to the breeding pairs and to the young-of-the-year. Coveys were larger and there were more young where the birds had received extra vitamin A. In 1961, the feeding period was shortened to ascertain whether management economies could be effected. Less positive results were attained with a shorter feeding period. Continued research is planned to find the

correct time to feed, the method of supplementation, and the minimum investment to produce favorable results.

Blood of pheasants in Iowa was investigated with more than 5,700 agglutination tests on samples of wild birds from various parts of Iowa and on pen-reared stock from Iowa, Wisconsin, and Illinois. Individual differences provided a sound basis for continuing investigations.

An investigation by the Ohio Unit revealed that free amino acid concentrations in the blood of pheasants varied quantitatively among genera, species, and hybrids examined. These quantitative differences could be determined by chromatographic analysis, but no qualitative variations could be detected. Two amino acids, histidine and homocysteine, showed consistent deviations between species of *Phasianus*. Quantities of several amino acids appear to be related to sex.

Studies of these types may prove useful in taxonomic work and in selection of birds for stocking.

The year ending December 31, 1961, was one of the most successful in the Foreign Game Introduction Program. In the 1960-61 shipping season, 6,033 foreign game birds from India were obtained and shipped to 12 cooperating States. These birds included the Indian common sand grouse, the black francolin, the gray francolin, the red junglefowl, and the Kalij pheasant. A cooperating biologist from the Nevada Fish and Game Commission completed 2 years with the program in India and returned to Nevada in April 1961. The project leader returned to the States in May for a summer of field inspection and consultation with State game officials and visits to State game farms. He returned to India in November to direct the study and collecting of game birds for trial release in this country.

Although it is too early to predict results for any species, early reports are en-



Studies of predation on resident wildlife were conducted by the Montana Cooperative Wildlife Research Unit. Among the species studied were the magpie and the great-horned owl. To the left, magpies are being banded and color-marked prior to releasing into the wild for further observation. Right, a young great-horned owl is tethered near the nest site to determine the kinds and amount of food provided by the parents.

(Photos by John J. Craighead)

couraging in several States for the black and gray francolins, and the black-necked pheasant from Iran. The red junglefowl and the Kalij pheasant have not as yet been available in sufficient numbers to make adequate tests.

Pesticide-wildlife relations

Toxicological studies and pen tests.-- Toxicological studies of the effects of pesticides on wildlife were given special attention in 1961 as the quickest dependable method of detecting potential hazard in the use of new pesticidal chemicals. Tests of herbicidal chemicals were incorporated in the toxicological program for the first time. Five hundred and sixteen tests involving more than 3,700 birds and mammals were made with 18 insecticides and 14 herbicides. All of the herbicides tested were relatively nontoxic to quail, pheasant, and ducks. The birds survived for long periods when fed diets containing as much as 5,000 p.p.m. However, certain herbicides (amitrole, dalapon, and derivatives of 2,4-D and 2,4,5-TP) appeared to depress reproduction of ducks when fed at levels less than 25 percent of those producing mortality.

Some of the newer organophosphorus insecticides are highly toxic to birds, and appear to be cumulative in action. Phosphamidon, which has been suggested for gypsy moth control, is much more toxic than parathion, and quail will not survive on diets containing 1 p.p.m. Co-Ral, dexton, dimethoate, Bayer 25141, and Bayer 29493 also are more toxic than parathion, and levels of these compounds producing death of quail range from 1 to 50 p.p.m. Dibrom, thimet, and thiodan have relatively low orders of toxicity, and do not appear to produce cumulative effects.

Toxicity of heptachlor to woodcock was measured in a special series of tests with birds captured on the Louisiana wintering grounds. Woodcock feed largely on earthworms and apparently will accept only living food, so it was necessary to develop suitable methods and time periods for exposure of earthworms to the toxicant. The earthworms stored toxicant in their

tissues without obvious harm to themselves, and the woodcock showed no aversion to eating poisoned worms.

Fifty percent of the birds (6 of 12) which fed on worms containing an average of 3 p.p.m. of toxicant died within 34 days. Four more birds had died by the 51st day, and the remaining two were then killed for chemical analysis. Worms collected in areas treated with heptachlor often contain more toxicant than the worms fed to the experimental birds.

Collections and chemical analyses of woodcock were continued in an effort to determine the extent of heptachlor contamination in the wild population. Heptachlor epoxide was found in a high proportion of birds collected in the South and in a high proportion of adults collected in the spring in the North.

Two new chemicals (kepone and its analog GC-1283) which are being tested for use in fire ant control were found to be considerably less toxic to birds than is heptachlor. Tests showed, however, that kepone had a marked depressive effect upon reproduction of quail and pheasants. Prolonged exposure to this compound resulted in loss of characteristic coloration of male quail, pheasants, and mallards, and in marked tissue changes in the livers and gonads of pheasants.

At the Denver Wildlife Research Center one deer and nine cottontail rabbits were fed diets containing varying amounts of pure DDT (p,p'-isomer). This was done in part to test a hypothesis explaining the presence of DDD (Rothane or TDE) residues found in analyzing many field samples. The subsequent presence and prevalence of DDD in the tissues of the rabbits and deer experimentally exposed to pure pp'-DDT must be explained by changes taking place within the bodies of the exposed animals. Since the identity of DDD was established by the infrared spectrophotometer and by an alternate paper chromatographic technique, it remains only to determine where within the animal, and how, this conversion is accomplished. Generally, DDT has been considered to

degrade only to DDE and DDA, the latter being readily excreted.

With expanded pen and laboratory facilities at both the Denver and Patuxent Centers and with improved techniques, it is now possible to screen commonly used pesticides for acute and chronic toxicity levels at a more rapid rate and on a greater variety of wildlife. Among the techniques developed was a "clean-up" method for treating biological samples being analyzed for the pesticide Sevin.



Y-shaped rotary blender used for mixing diets containing pesticide.

(Photo by Denver Wildlife Research Center.)



Mule deer fawns in enclosures at Denver Federal Center are kept for pesticide studies. They are fed known amounts of pesticides to determine toxicity and retention of the material within body tissues.

(Photos by Denver Wildlife Research Center.)

Field and laboratory studies.--Chemical analyses of birds and mammals found dead in areas treated for control of Japanese beetles or white-fringed beetles contained up to 50 p.p.m. of dieldrin in their tissues. Concentrations in many of the approximately 250 specimens equaled or exceeded those found in quail or pheasants that died after exposure to dieldrin or aldrin in pen feeding tests.

The 1961 counts of quail numbers in a Georgia area treated for the control of the imported fire ant with 2 pounds per acre of heptachlor in 1958 showed that populations had increased to a level that was very nearly normal.

A field study of survival of birds and small mammals in a forest area treated with DDT was made in cooperation with the U.S. Forest Service at its Coweeta Hydrologic Laboratory in North Carolina. Comparisons on two areas treated with 1 pound of chemical per acre and on two untreated areas showed no significant differences attributable to treatment.

Field studies also included a series of tests to determine possible effects on wildlife of chemical control of Eurasian water-milfoil with 2,4-D. Field application of granular formulations of 2,4-D as high as 120 pounds acid equivalent per acre did not kill caged oysters, crabs, clams, or fish. Animals now are being analyzed for herbicidal residues. In one trial, however, decay of treated vegetation reduced oxygen in the water to the extent that both caged and uncaged animals died.

Tissues from several deer and one antelope collected in Montana and Wyoming following treatment of forest and range areas with DDT and aldrin, respectively, were found to contain varying amounts of pesticide residues, the greatest amounts being present in the fat.

A long-term field investigation of the effects on wildlife of Sevin was begun in July 1961 at Lostwood National Wildlife

Refuge in North Dakota. Prespray censusing of sharp-tailed grouse, deer, and waterfowl was accomplished, and prespray samples were taken of soil, vegetation, aquatic invertebrates, suspended matter in pond water, and tissues from game animals for chemical analysis and comparison with postspray samples.

Experimental testing of Compound 1080 baits for use in harvester ant control in New Mexico was evaluated from the standpoint of wildlife hazards. The preliminary results indicated that the bait used was attractive to wildlife and that some of the few birds and rodents present in the sparsely vegetated test area consumed lethal amounts of the poison.

Of considerable interest was the finding of up to 0.9 p.p.m. of DDT and its metabolites in the tissues of 4 ducklings collected near Yellowknife, Northwest Territories, Canada, more than 500 miles from any known pesticide-treated area. Tissues from 13 adult ducks collected in the Yellowknife area contained an average of 0.3 p.p.m. of DDT and metabolites, and 24 eggs an average of 2.2 p.p.m. It is therefore postulated that the adults picked up the pesticides on their wintering grounds and passed them along to their ducklings through the eggs.

The effect of sublethal amounts of endrin on a small mammal population when applied under field conditions is being studied by the Ohio Unit. An application of 0.6 pounds per acre of endrin had no apparent effect on populations of meadow voles. Satisfactory bioassay techniques have been developed for determining minute quantities of endrin in meadow vole tissue. Mascarated voles are steam-distilled, and the resultant distillate is assayed in tanks of live guppies held at constant temperatures.

Ohio Unit researchers also are attempting to develop a method of ascertaining the eventual dispersal of an insecticide in an ecosystem by using an insecticide marked with a radioactive isotope (S^{35}). Quantities of S^{35} were detected in insects, minnows, worms, mice, and turtles taken from plots sprayed with labeled malathion. Dusky-

winged fungus gnats showed the highest quantity of radioactivity in comparison with other insect groups. More basic studies of this general nature are needed in order to assess the effects of pesticides on the ecologic complex.

Wildlife diseases and parasites

The problem whether birds are important in transmission of encephalitis to man and horses was investigated in a series of field surveys. A temporary field laboratory was set up in the Chincoteague-Assateague area of the Atlantic coast under the auspices of the Patuxent Wildlife Research Center, the Walter Reed Army Institute of Research, and the University of Maryland. The area was especially suitable for study because of its isolation and the presence both of wild ponies and of large numbers of birds. The presence of eastern encephalitis virus had been demonstrated previously. Blood samples were taken from approximately 1,500 birds. Mosquitoes also were collected and processed for virus isolation. Antibodies were demonstrated in 18 birds, including 5 clapper rails, 2 snowy egrets, 2 brown thrashers, 5 catbirds, 2 yellow-breasted chats, 1 towhee, and 1 robin.

A species of *Plasmodium*, the organism involved in mosquito-borne malaria, was isolated from a Canada goose at the Seney National Wildlife Refuge by blood inoculation into a 3-week-old domestic goose. Although blood smears have shown *Plasmodium* infection in geese, this was the first isolation of a natural infection. Tests of the isolate have shown that mallard ducks are susceptible and that chickens cannot be infected.

A strain of *Trypanosoma cruzi*, the causative agent of Chagas disease in humans in Central and South America, has been found in about 2 percent of the raccoons trapped at the Patuxent Center. This represents the most northern known occurrence of this parasite. Experimental study of isolates showed that the raccoon strain was much less virulent than the one occurring in man. Other species of animals besides



Improvised temporary laboratory for study of encephalitis at Chincoteague Wildlife Refuge. The isolated refuge area was ideal for the virus transmission study because of the presence of wild ponies, a large bird population, and the known occurrence of the virus in the area. (Photo by Patuxent Wildlife Research Center.)

raccoons have been shown to be carriers in other areas, but no other hosts have been detected in studies at Patuxent.

Continued observations were made at the Bear River Migratory Bird Refuge, Utah, on the relationship of botulism outbreaks and populations of bottom-dwelling macro-invertebrates. The first sick and dead birds were observed in mid-July, following a gradual decline in numbers of tendipedid larvae. A peak in bird losses was reached at the end of August and another peak during

the latter part of September following localized die-offs of aquatic invertebrates. In the course of an attempt to induce experimentally a small-scale botulism outbreak by the use of insecticide on the invertebrates assumed to produce the toxins, the potentially useful observation was made that malathion inhibits the growth of Clostridium botulinum type C in the test tube. Further controlled studies are anticipated to determine the concentration of malathion required to inhibit bacterial growth in naturally occurring media.



Here, Richard Andrews, graduate student of Iowa State University, and research assistant of the Iowa Unit, conducts tests to determine the presence or absence of Pullorum and Newcastle disease in pheasants. (Photo by Iowa Cooperative Wildlife Research Unit.)

Some of the waterfowl of various species examined for internal and external parasites were found to be heavily parasitized. For example, a 4-week-old trumpeter swan cygnet taken at the Red Rock Lakes National Wildlife Refuge, Montana, contained 9 species of parasites (4,077 individuals) and a 6-week-old cygnet carried 15 species (1,008 individuals) while a 2-week-old canvasback had acquired 100 parasites of 8 species in its short period of existence.

Animal damage control

Animal damage problems are becoming more acute as the competition between man and wild animals stiffens. The need

for more selective and effective control measures is apparent whether the animal be bird or mammal or whether the damage be to forest or range vegetation, to agricultural or horticultural crops, to packaged or stored goods, or to aircraft. To develop such control measures many approaches are being investigated: environmental or habitat manipulation; cultural practices including the development of damage resistant strains of crops; scaring devices; chemical repellents; electronic, sonic, and supersonic devices; traps; lethal substances; radiation; reproductive inhibitors; drugs; and disease organisms, to name some of them.

Habitat manipulation.--Laysan Albatross populations at Midway Atoll included a relatively low 21,000 nesting pairs on Sand Island and 30,000 nesting pairs on Eastern Island in the winter of 1960-61. The aircraft strike rate remained well below that of the previous year, reflecting the beneficial effect of the habitat management that was completed in March 1960. This habitat management consisted in leveling the dunes that had provided rising air currents, which in turn had attracted soaring albatrosses to the vicinity of the principal runway.

A gradual increase in strikes during the spring of 1961 was believed to be largely a result of a rapid increase in the albatross population in a 30-acre area adjacent to the principal runway. Because the increase in this critical tract is expected to continue for several years, it was recommended to the Navy that it be blacktopped or otherwise made unattractive to albatrosses.

At the Logan Airport in Boston, site of the disastrous airplane crash of October 1960, destruction, through the use of herbicides, of phragmites cover serving as a roost for starlings has reduced the hazards from these birds, but gulls and shore birds still remain a problem.

Scaring devices.--A shotgun patrol to frighten gulls away from the Logan Airport



Birds damage many types of crops. Here are some samples: First column, from top, corn, grapes, grapefruit; second column, grain sorghum, rice in shock. (Photos by Denver Wildlife Research Center.)

was reported to be partially successful. Investigations of herring gull populations and movements by the Massachusetts Audubon Society under contract with the Bureau of Sport Fisheries and Wildlife indicated that a majority of the gulls creating the problem live year-round within 10 miles of the airport. Recorded distress cries of herring gulls are being tested as a method of frightening gulls from airfields. Pre-

liminary tests were sufficiently promising that the technique is being explored further with the aid of mobile electronic equipment.

An ultrasonic siren, tested as a possible albatross scaring device at Midway, proved ineffective. Such devices would seem to be of possible use in some situations, however, and an electrical sound laboratory has been established at the Denver Wildlife Research Center. Much of the equipment necessary for further field studies has been obtained. Recordings have been made of the distress calls of the starling, redwinged blackbird, yellow-headed blackbird, cowbird, common grackle, ring-billed gull, magpie, and sparrowhawk. Recordings have been made of many of the common noise-making devices and of sounds made by jet



Anthracnose damage to milo is sometimes incorrectly diagnosed as blackbird damage. Note how closely the blasting due to anthracnose on the upper part of this head of milo resembles bird damage.

(Photo by J.W. Hardy, Virginia Cooperative Wildlife Research Unit.)

planes, trains, and sirens. A carryall truck has been equipped with recording and amplifying devices for use in studying the effects of sounds on birds in the field. Also, a contract was entered into with the Stanford Research Institute to explore the effects of different frequencies and intensities of sounds on birds. Previous research has shown that carbide exploders, the sound of .22 caliber rifle fire, and other noisemakers and scare devices are effective under some conditions.

Repellents and toxicants.--At the Denver Wildlife Research Center 421 coded chemicals were received from 10 cooperating chemical companies in a program to select and test compounds of potential use in preventing animal damage to forest and range plants. The chemicals were used in bioassay studies to determine their toxic and repellent characteristics, and the 132



Some varieties of grain crops are more resistant to bird damage than others. Here the two heads on the left are blackbird resistant; those on the right are badly damaged.

(Photo by J.W. Hardy, Virginia Cooperative Wildlife Research Unit.)

compounds which exhibited desirable characteristics were given phytotolerance tests to determine their effects on seed germination and seedlings. They were also subjected to more advanced tests to determine plant translocation or systemic characteristics. Nearly 11,000 small mammals were used as test animals. Of five promising chemicals which emerged from the screening program in 1961 and which were sent to the Olympia, Washington, substation for field-testing, two are highly repellent to small mammals while exhibiting low toxicity, one is a cumulative toxic agent, and the other two are systemic compounds having both repellent and toxic characteristics.

Limited tests of several lethal chemicals were made at cattle feed lots and at blackbird or starling roosts in holly groves and other sites, but none can be recommended for operational use at this time.



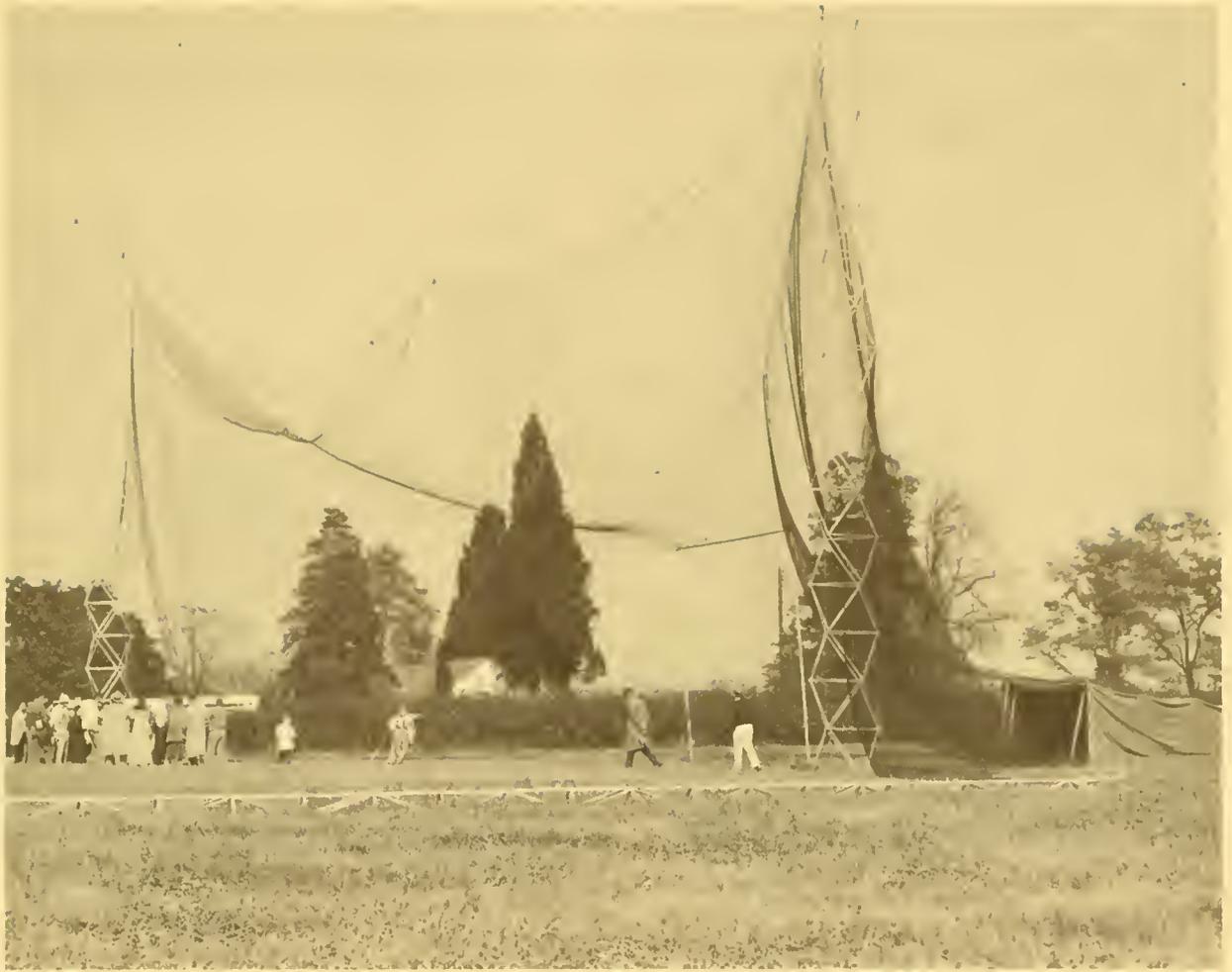
Neither sounds of gun fire, distress calls, nor ultrasonic tests (illustrated here) have caused albatrosses to leave their nests on Sand Island, Midway. (Photo by Chandler S. Robbins.)

A new technique involving the micro-encapsulation of toxicants is being investigated. This technique may have utility in improving the acceptance of certain chemicals by the target animals and in regulating the reaction time of the animals to the chemicals.

The "coyote-getter," long used operationally in predator control programs, was improved by the development of an injection-molded plastic capsule in which the toxicant can be hermetically sealed. Safety improvements included a crossed-wire guard and deflector on the top of the getter assembly.

Capturing devices for birds.--Traps, although not considered practical for the alleviation of many bird depredation problems, are useful in bird banding and other biological investigations and, under some

conditions, may be helpful in control work. A floodlight trap involving the use of a battery of flood lights placed behind a funnel-shaped net has proved useful in taking relatively large numbers of starlings and blackbirds at their roosts. A lighter, more portable structure was developed in 1961 by using aluminum octahedral towers for masts to support the net at the trap entrance. The towers make possible a trap entrance 50 feet high. Light trap operations on 14 nights in Arkansas, Maryland, North Carolina, and Pennsylvania yielded 240,000 birds. The most successful operations were at a winter roost near Walnut Ridge, Arkansas, where 200,000 blackbirds and starlings were captured on 2 nights. The Australian crow trap modified for starlings, and cannonnet traps also proved useful under different conditions.



Newly designed 50-foot funnel net and gathering cage for capturing blackbirds at winter roosts. Floodlights set back of the net lead the birds into the trap. As many as 200,000 blackbirds and starlings have been captured in a 2-night operation. (Photo by F.C. Schmid.)

Exploratory tests were made of the effects of oral anesthetics and hypnotics on gulls, with a view to finding effective methods of capture. Eighty-five tests with 41 compounds showed that speed and extent of hypnotic action are related to certain aspects of the chemical structure of compounds. Studies are being continued to determine effective concentrations and to find better chemicals. In preliminary field trials with one of the chemicals, herring gulls were captured successfully in four of nine baiting tests.

Banding and biological studies of birds. -- Regional Directors of the North Central



The Australian crow trap, modified for starlings, will capture many birds in farmyards.

(Photo by Denver Wildlife Research Center.)

Agricultural Experiment Stations rated bird depredations as their second most urgent problem. One of the first steps Branch personnel have taken in their efforts to find a solution to the problem has been to learn where the depredating birds breed and where they winter. For this reason, trapping and banding operations were accelerated in the Atlantic and Mississippi Flyways in 1961. Patuxent Wildlife Research Center biologists banded 22,000 starlings and blackbirds, including 5,500 redwinged blackbirds. Volunteer cooperators banded 3,200 nestling redwings. An immediate result was learning that birds damaging the Arkansas rice crop were locally bred birds--birds coming into Arkansas from the north in fall and early winter get there after the rice has been harvested and therefore are not part of the local problem.

In the vicinity of the Sand Lake National Wildlife Refuge, South Dakota, however, Bureau personnel and cooperators who banded 2,500 blackbirds learned that only a small fraction of the birds causing serious damage to corn were locally produced.

Focal points of blackbird populations were located through a cooperative search for fall and winter roosts in eastern States. Fifty major roosts, each containing a million or more birds, were located. Three of these roosts contained from 10 to 20 million birds each.

To discover the weak link in the makeup of birds, basic avian physiological studies are being conducted at the Massachusetts Cooperative Wildlife Research Unit. This work may provide guidelines as to whether the sight, taste, hearing, or other sensory systems are most vulnerable.

Reproductive inhibitors.--The Massachusetts Cooperative Wildlife Research Unit is investigating the possibility of controlling depredating bird populations by sterilization, a technique used effectively against the screwworm fly in the Southeast. Experimentation with three oral progestin hormones indicated excellent potential for inhibiting bird reproduction. Lipamone, a female sex hormone, failed to block egg production. High-energy microwave exposure had no observed effects on fertility of chickens, quail, and exposed eggs. Enheptin fed to nesting gulls proved to be ineffective in inhibiting reproduction, although this chemical has high potency in this objective with other species. Investigations are underway, also, to determine whether radioactive perches might cause avian sterility.

At the Denver Center experiments have been initiated to develop reproductive inhibitors as a means of regulating coyote numbers. Later the studies will be extended to include other control chemicals such as antimetabolite and antifolic agents.



Locations of 41 major blackbird roosts in southeastern United States. Each of these roosts contained a million birds or more. Three contained 10 to 20 million birds each.



Blackbirds coming to roost in a thicket near Slovak, Arkansas. Fifty major roosts have been located in a nationwide survey. Studies of blackbird populations and blackbird production in relation to depredation areas are part of the research directed toward solution of the crop damage problem in grain growing areas through the United States. (Photo by F.C. Schmid.)



The leader of the coyote control methods research project at the Denver Center is shown here with two of the devices used in handling the animals. (Photo by the Denver Wildlife Research Center.)

Classification, distribution, and life history studies

In addition to providing staff services on matters related to the taxonomy, distribution, and life history of birds and mammals, maintaining extensive study collections, and providing identification services for cooperators and scientists throughout the country, the staff of the Bureau's Bird and Mammal Laboratories located at the U.S. National Museum is engaged in several active research projects. Brief mention is made of some of these.

Studies of the sea otter in Alaska have been made sporadically since 1936, and more intensively by Branch personnel since 1955. During 1961, progress was made on analyzing and organizing, with a view to publication, the accumulated information on natural history and behavior, experimental transplanting, populations, pelage, ecology, aging, reproduction, and pathology of this species.

During March 1961 an aerial survey of the Pacific walrus over parts of the Bering Sea was made with the cooperation of personnel of the Alaska Regional Office and the Alaska Fish and Game Department. This resulted in an estimate of 90,000 walrus in the area surveyed. This was followed by a survey of marine mammals in the Chukchi Sea in the vicinity of Cape Thompson at the request of the Atomic Energy Commission.

Progress was made, also, in a taxonomic review of the bobcats; on research on the mammals of Maryland, Delaware, and the District of Columbia; and on the mammals of Alaska. Among the bird research projects were studies of the geographic variation in the hermit thrush, the sandhill cranes, and the Canada geese. A color chart using color values from the Munsell Book of Color was developed to aid in field identification of Canada geese.

Through the cooperation of the Juneau Regional Office of the Bureau, critical specimens representing breeding populations of Canada geese in Alaska were obtained for the study collection in the Bird and Mammal Laboratories, U.S. National



Group of walrus resting in close pack ice near an open lead, southwest of St. Lawrence Island. Photographed from survey plane by Karl W. Kenyon. There are 182 walrus in this picture.

Museum. These specimens have enabled Bureau taxonomists to gain a much clearer picture of the distribution of six markedly different appearing populations of Canada geese which nest in Alaska. The characteristics of the endangered Aleutian Island Canada goose were more precisely defined to aid in selecting geese for possible restocking of depopulated islands, when breeding stock is located.

Analysis of measurements and weights of sandhill cranes examined at checking stations during the open season on this migratory gamebird in eastern New Mexico in January 1961, corroborated results of previous studies by failing to disclose any examples of the relatively rare greater sandhill crane. An examination of specimens of sandhill cranes collected previously in the depredations area of central North Dakota indicated that the intermediate-sized cranes from the Prairie Provinces of Canada together with a few greater sandhills move through that area in early September, followed later by typical Arctic-breeding lesser sandhills which, in 1959, reached peak numbers in early October.

Also, at the Bird and Mammal Laboratories, coordination and servicing were

provided for a rapidly growing bat-banding program. In 1950, about 10,000 bands were issued to cooperators throughout the country. In 1961 over 100,000 bands were issued and 9,280 record cards were received containing data on approximately 50,000 banded bats. A little brown bat (Myotis lucifugus) banded in Ontario in 1941 was recovered in good health at the same locality almost 20 years later. Other interesting records on bat longevity and movements were obtained.

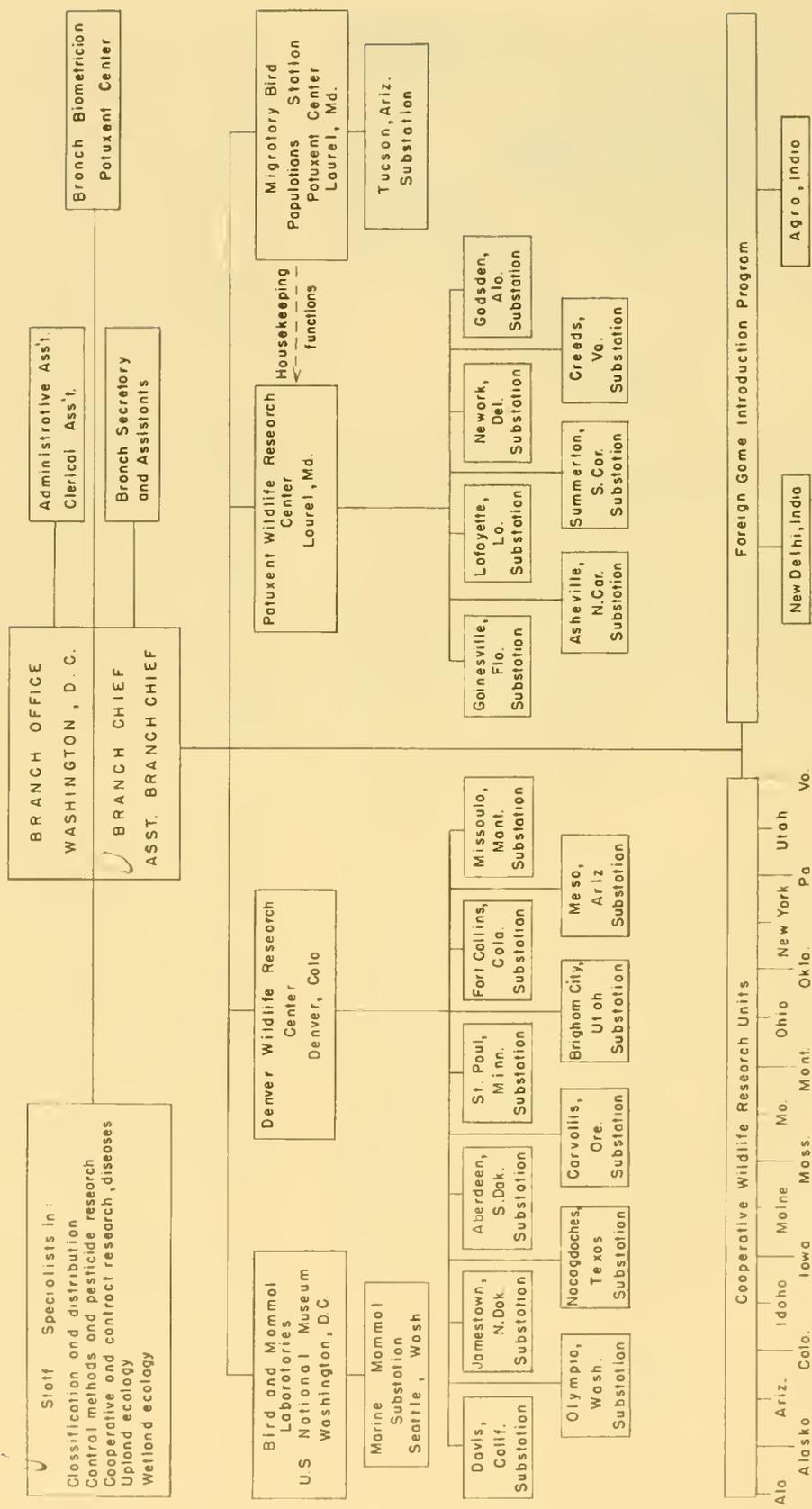
PUBLICATIONS

During the period July 1, 1960, to December 31, 1961, a total of 144 publications by Branch personnel exclusive of Unit Leaders appeared. (See Appendix C.) In the same period 221 publications including 27 fishery papers emanated from the Cooperative Wildlife Research Units. The fishery papers were based upon research financed primarily by non-Federal funds and were generally accomplished by university staff members or by graduate students supervised by these staff members.

Branch reports issued in the various publication series of the U.S. Fish and Wildlife Service are available from the Bureau of Sport Fisheries and Wildlife or the Superintendent of Documents, Washington, D.C. Reprints of most of the articles published in outside technical journals or in transactions of scientific meetings are obtained in limited numbers to facilitate the distribution of the findings to conservation agencies and individuals having need for information on specific topics. Most of the publications listed under the Cooperative Wildlife Research Units are available from the respective Units.

Wildlife Review, an abstracting service for wildlife management, has been prepared, published, and distributed by the Branch of Wildlife Research since 1935. In 1961, authority was received by the Bureau to increase to 5,000 the number of each issue, and arrangements were made to have the printing done quarterly by the Government Printing Office. This increased the availability of this publication inasmuch as copies can now be purchased by individuals or institutions not on the free mailing list.

APPENDIX A -- ORGANIZATION CHART OF THE BRANCH OF WILDLIFE RESEARCH



APPENDIX B--FUNDS AVAILABLE FOR OBLIGATION

	<u>Budget subactivity</u>	<u>For fiscal year</u>	
Appropriated funds:		<u>1961</u>	<u>1962</u>
Waterfowl management.....		\$322,000	\$439,000
Other migratory bird studies.....		259,300	314,000
Upland wildlife.....		156,000	199,000
Pesticide-wildlife research.....		371,000	423,000
Diseases and parasites.....		146,500	167,000
Control methods research.....		358,000	393,000
Classification, distribution, and life history		144,000	144,000
Cooperative Wildlife Research Units.....		186,500	221,000
		<hr/>	<hr/>
Total, research projects		1,943,300	2,300,000
Management of Patuxent Wildlife Research Center		89,000	157,000
Foreign Game Introduction Program.....		52,940	53,000
Construction.....		700,000*	120,000
		<hr/>	<hr/>
Total.....		2,785,240	2,630,000
Funds from other sources:			
Federal Aviation Agency.....		100,000	200,000
Army Corps of Engineers		12,000	13,750
Private contributions		9,400	2,100
Quartermaster General		17,000	15,000
Bureau of Land Management.....		4,000	4,000
U.S. Forest Service		5,000	5,000
		<hr/>	<hr/>
Grand total		2,932,640	2,869,850

*Biochemistry-Wildlife Pathology Laboratory (Patuxent).

APPENDIX C--LIST OF PUBLICATIONS, JULY 1, 1960, TO DECEMBER 31, 1961

*Authors affiliated with two or more stations; publication listed under the affiliation of each author.

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1961. Research problems in wildlife administration. *Journal of Wildlife Management*, vol. 25, no. 3, p. 265-271.
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