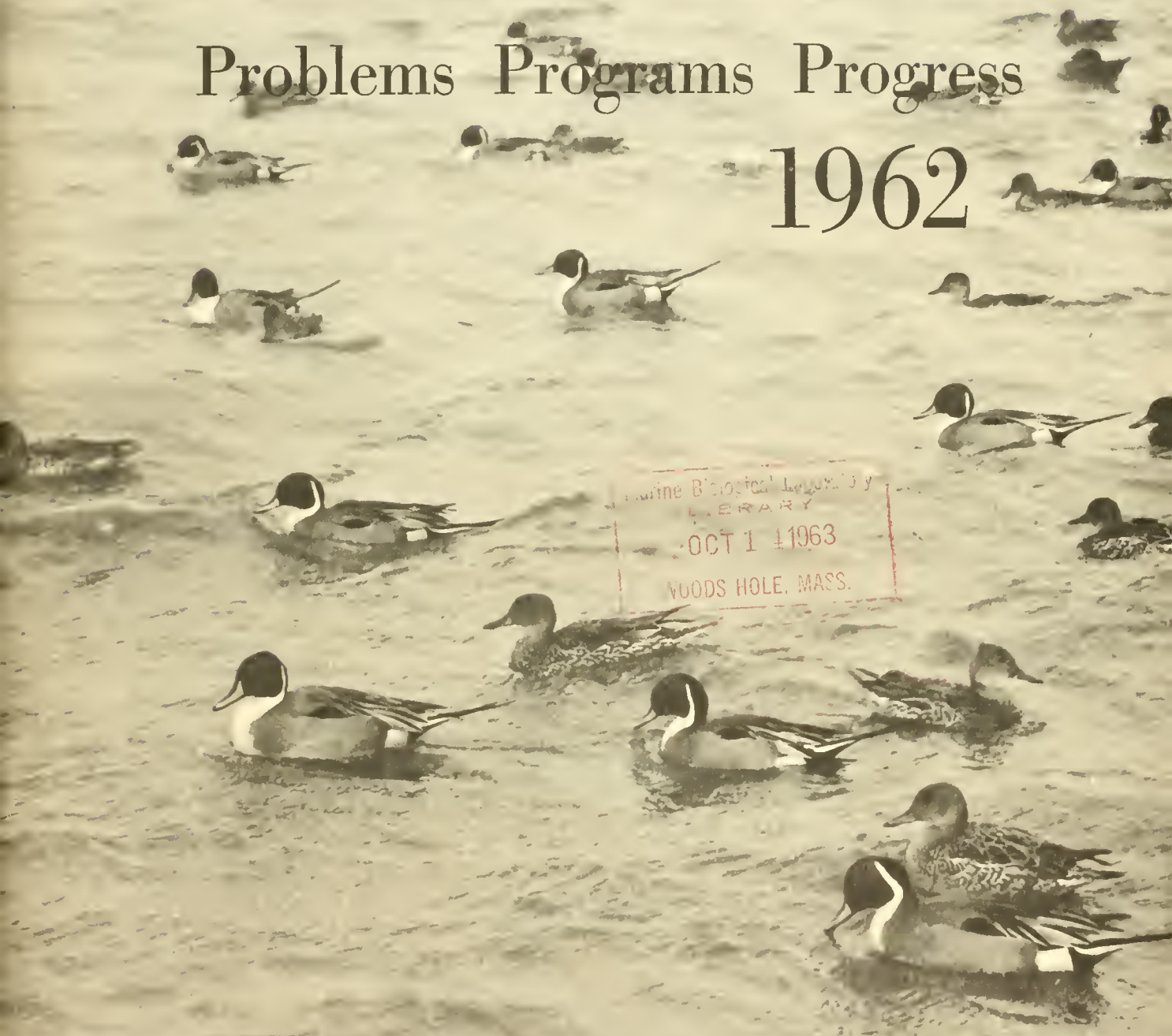
Wildlife Research

Problems Programs Progress

1962



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

Circular 166

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

Frank Dufrense, retired

Back cover photos by

Lee E. Yeager, Leader

Colorado Cooperative Wildlife Research Unit

WILDLIFE RESEARCH
PROBLEMS PROGRAMS PROGRESS
1962

Activities of the Branch of Wildlife Research in the Bureau of Sport Fisheries and Wildlife for the Calendar Year 1962

"Scientists see that before the factors of productivity can be economically manipulated, they must first be discovered and understood . . ."

Aldo Leopold
Game Management, p. 20

Circular 166

UNITED STATES DEPARTMENT OF THE INTERIOR

Stewart L. Udall, *Secretary*

Frank P. Briggs, *Assistant Secretary for Fish and Wildlife*

FISH AND WILDLIFE SERVICE

Clarence F. Pautzke, *Commissioner*

BUREAU OF SPORT FISHERIES AND WILDLIFE

Daniel H. Janzen, *Director*

Washington, D.C. • May 1963

CONTENTS

CONTENTS

FOREWORD

There are twice as many people in the United States now as there were 50 years ago. The gross national product is twice what it was 20 years ago. Demand by the people for outdoor recreation has doubled in the last 10 years. Rapid and accelerating growth is a main reason for many of the wildlife problems of the times.

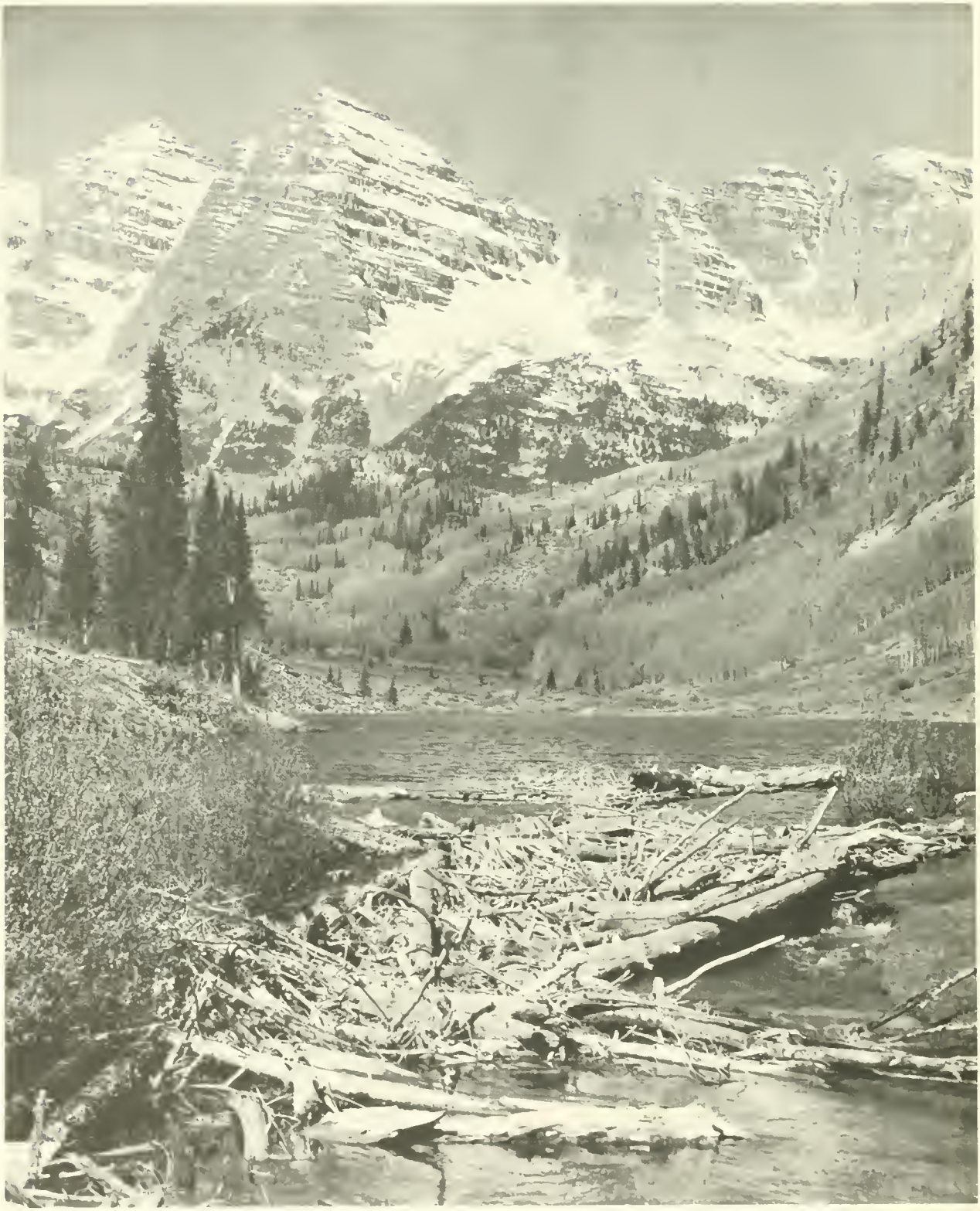
The very large number of people affected by wildlife is a compelling reason for better management of wildlife. Millions want wildlife that can be seen and enjoyed; millions want more hunting and fishing; millions want to protect crops, trees, products, and goods from wildlife damage. Most Americans are affected one way or another by the wildlife of the country.

Wildlife, people, and economic growth all require land and water. One hundred and eighty million people and a 550 billion gross national product require proportionately more land and water than when people and the economy were only half of these totals. Land and water are running out, and wildlife's allotments in the future will be increasingly difficult to obtain. Decreasing habitat and conflicts of interest are the great wildlife problems of the times.

Wildlife, however, has not decreased in proportion to human and economic growth. Fish poundage is as much as in 1915. There are currently more deer than at any time in the past. Overabundance of some species is as much of a problem in some areas as is scarcity in others. Wildlife ups and downs and great changes in kinds and quality are due to two main things: changes in environment, and application of knowledge in management. Wildlife can be retained as a great natural resource, for the benefit of all, if we can learn enough—and in time—about its critical life requirements.

The function of the Branch of Wildlife Research of the Bureau of Sport Fisheries and Wildlife is to provide the answers required: and the purpose of this report is to relay for administrative and management use some of the answers obtained in 1962.

Daniel H. Janzen
Director



Symbolic both of the country and of the resources for which the Bureau has wildlife research responsibility, the complex of land and water, mountain and valley, forest and park, lake and stream, conifer and hardwood, grass and forb, depicted here is home range for fish, big game, upland game, waterfowl, fur animals, rodents, songbirds—space and fauna of incalculable value to the American people. (Photo by Lee E. Yeager)

THE BRANCH OF WILDLIFE RESEARCH

The Branch of Wildlife Research is the wildlife fact-finding arm of the Bureau of Sport Fisheries and Wildlife, which has broad authority for conducting research on all wildlife species—game and nongame, resident and migratory, harmful and beneficial. Results of these investigations are used by the Bureau and cooperating Federal and State agencies in managing wildlife resources for the production of more recreational enjoyment for the people, and more effective control of wildlife injurious to agricultural, industrial, and urban interests.

The general program.—The current programs of the Branch include research on waterfowl management, other migratory birds, upland wildlife, pesticide-wildlife relations, diseases and parasites, control methods, and classification, distribution, and life-history studies of wild birds and animals.

In meeting its wildlife research responsibilities, the Branch cooperates with various land-managing agencies of the Department of the Interior, the Department of Agriculture, the Department of Health, Education, and Welfare, and the Department of Defense. In its game-bird introduction program, the Branch cooperates with the Wildlife Management Institute, the International Association of Game, Fish, and Conservation Commissioners, the several State conservation departments, and, of course, with the foreign countries concerned; and much of this research is in the native ranges of game birds considered potentially adaptable for release in selected game-deficient areas in the United States.

The Branch is concerned with many other instances of cooperative research, made possible by the interest of various conservation agencies, scientific institutions, and individuals. These programs include the bird-banding record center at the Migratory Bird Populations Station, Laurel, Md., where banding data on more than 11 million birds of all kinds, and recovery records on more than 1 million migratory birds, are kept, and where more than 3 million cards on the distribution and migration of North America birds are filed. The world's largest collections of North American birds and mammals are maintained at the U.S. National Museum, in cooperation with the Smithsonian Institution. These records, together with the professional taxonomic services provided by Branch employees, are available to investigators both in and out of the Bureau. The assistance of thousands of banders, observers, and collectors who have cooperated in obtaining these specimens or in providing data on them makes this comprehensive service possible.

One of the oldest and best known of the Branch's cooperative programs is that of the Wildlife Research Units. The Units are supported and administered under terms of a memorandum of understanding signed by officials of the Bureau, the Wildlife Management Institute, and the land grant colleges and the game and fish departments of the 18 participating States. In addition to the research endeavor, the Units facilitate the training of qualified graduate students in the wildlife field and promote conservation education through publication, demonstration, lecture, and consultation. Readers who may wish more detailed information on the program should feel free to write the Bureau or any of the Units, listed in appendix D.

Organization.—The Branch of Wildlife Research, in the Division of Wildlife of the Bureau of Sport Fisheries and Wildlife, is organized on a line-and-staff basis, with directors of the four research centers, leaders of the 18 Cooperative Wildlife Research Units, and the foreign game introduction project leader reporting directly to the Branch's central office in Washington. Program planning, coordination, and administration for all Branch research is a function of the Washington office; while fiscal, personnel, and property management are handled through the Bureau's six regional offices. In the fiscal year 1963 the Branch had 171 professional and 145 nonprofessional employees and a budget of about $3,700,000. Details of organization, administrative and supervisory channels, location of research installations, and financing are given in the several appendixes to this report.

Waterfowl, on wintering grounds, give the impression of great abundance, but in reality major concentrations at this season may involve an appreciable portion of the ducks, or geese, of a flyway. The Bureau of Sport Fisheries and Wildlife, responsible for the well-being of the resource, must therefor operate in the field of public relations and education as well as the actual management of migratory birds. (Photo by David B. Marshall)

SPECIAL ACTIVITIES AND EVENTS

SOME BUREAU SERVICES THROUGH THE BRANCH

Bird and Mammal Laboratories for all.—The Bureau's small staff of mammalogists and ornithologists, housed in the National Museum and concerned professionally with the identification and distribution of wild mammals and birds, has plenty of opportunity to serve the general public. In 1962, they were called upon to supply information by Members of Congress, Federal bureaus and agencies, various conservation organizations, a score or more of nationally circulated magazines, museums throughout the world, professors and graduate students from many universities, and hundreds of individuals who queried by letter or telephone. Visitors to the laboratories included 92 parties from 28 States, the District of Columbia, and 14 foreign countries, among whom were more than 70 nationally and internationally known scientists and wildlife officials.

Bird banding.—There have been marked changes in the past 2 years in the method of processing banding data and reporting the results to banders and band recoverers. These changes increase efficiency through greater use of machine data-processing methods, and reduce errors inevitably associated with manual handling of large volumes of data. Reports as now prepared are being well received by hunters and the general public.

Restoration of banding records following the fire of 1959 was completed during the year. The data are in better shape for research use than ever before, reflected by the sharp increase in requests for tabulations of banding data not only by Bureau personnel, but also by the States, Canadian Provinces, and individuals.

Visitors to the Bureau's bird-banding record center came from Asia, Africa, Europe, and South America, the countries represented being Japan, Malaya, South Korea, South Africa, Argentina, Brazil, Poland, England, and other European countries. Most of the visitors were in charge of active or planned banding programs.

Although bird-banding records for the calendar year 1962 have not been completely tabulated,

The Bureau has responsibility for wildlife research on the Public Lands, where it works cooperatively with State and Federal agencies concerned with game management and land administration. (Photo by Lee E. Yeager)

Millions of Americans are nonhunting wildlife enthusiasts, and find much or all their recreation afield. The Bureau recognizes the enormous recreational potential of birds, mammals, and other wild creatures in natural habitat, and has incorporated such interests in its program policy. (Photo by W. F. Kubichek)

Biochemistry and Wildlife Pathology Laboratory at the Patuxent Wildlife Research Center, Laurel, Md. The Laboratory, erected in 1962, was dedicated on April 25, 1963, by Secretary of the Interior, Stewart L. Udall. It is the first Federal building designed specifically for research in pesticide-wildlife relations, including its pathological aspects. (Photo by F. C. Schmid)

waterfowl banding totaled over 230,000. This is a decrease of about 13 percent from 1961 when about 264,000 were banded. A total of 37,523 bands were recovered and reported to the record center during the year, 4.2 percent less than during the previous year. The decreases are attributed to severe drought on key nesting areas which reduced the continental supply of waterfowl.

Pocket gopher burrow-builder widely accepted.—Various models of the burrow-builder—a machine for dispensing pocket-gopher baits underground—developed jointly by the Bureau's Denver Wildlife Research Center and Colorado State University, are now available from commercial sources. In nearly every western and high-plains State, acceptance of the burrow-builder as an aid in pocket-gopher control has been widespread and enthusiastic. Its success is indicated by the following comments, chosen at random from the large number received.

Oklahoma-Kansas District: It has been estimated by peanut growers that the pocket gopher control demonstrations in their fields resulted in a saving of $17–$20 per acre.

Oregon District: The pocket gopher burrow-builder has proven to be a boon to the agricultural interests with pocket gopher problems.

Toxicological studies and pen tests.—Feeding tests, in which captive birds and mammals are given access to diets containing known amounts of pesticides, offer rapid and dependable means for determining relative hazards of the various compounds to wildlife. More than 500 such tests involving 42 insecticides and herbicides were made at the Patuxent Wildlife Research Center, using coturnix and bobwhite quail, ring-necked pheasants, mallard ducks, red-winged blackbirds, cowbirds, grackles, herring gulls, and starlings as test subjects. Objectives of these studies were to determine (1) quantities of pesticides in diets required to produce 50-percent mortality in 10 days (acute poisoning), (2) quantities required to produce chronic poisoning resulting in 50-percent mortality after the tenth day, and (3) effects of sublethal exposure on growth and/or reproduction. Data from these studies have been summarized in Circular 167, Pesticides Wildlife Relations: Review of Investigations During 1961 and 1962.

Aid to the President's Council on Science and Technology.—Dr. John L. Buckley, Director of the Patuxent Wildlife Research Center, was detailed from among the many Federal agencies concerned with pesticides to serve as consultant on

Bureau personnel regularly participate in wildlife and other resource-oriented field trips, demonstrations, and educational activities. Here, Future Farmers study high-country range, forests, and wildlife in Colorado, under the leadership of State and Federal specialists in these fields, including a Bureau representative. (Photo by Lee E. Yeager)

pesticide problems to the President's Council on Science and Technology, an appointment that extended from October 1962 to March 1963. Dr. E. H. Dustman of the Washington Office served as Acting Director of the Patuxent Center during Dr. Buckley's absence.

Albatross problem at Midway.—Because the incidence of albatross strikes on military aircraft is still dangerously high at Midway Island Naval Station, a critical 30-acre area adjacent to the two operational runways was graded and hard-surfaced during the summer of 1962. The Department of the Navy has taken steps to grade and surface nesting ground along both runways during the winter of 1963–64, recommended by the Bureau of Sport Fisheries and Wildlife as the most practical means of reducing the strike rate. Grading removes dunes and trees that provide updrafts for soaring birds, and hard-topping, of course, prevents the albatrosses from nesting close to the runways. Studies have consistently shown that birds nesting in the immediate vicinity of the runways are the ones most frequently involved in aircraft strikes.

Employees on Fulbright fellowships.—Two veteran biologists of the Bureau were awarded Fulbright fellowships during 1962. W. Leslie Robinette, Chief, Section of Upland Ecology, returned to the Denver Center early in July after nearly a year's study of big game in Northern Rhodesia, Africa. Mr. Robinette was requested by Rhodesia's Department of Game and Fisheries to make management proposals in three big-game areas, one of which involves the largest remaining

concentration of red lechwe, an endangered antelope, whose numbers have declined 80 to 90 percent during the last 25 years because of poaching and loss of habitat.

Lyle K. Sowls, Arizona Unit Leader, departed for Southern Rhodesia early in September, after being granted a 9-month lectureship at the University College of Rhodesia and Nyasaland, a branch of the University of London. Dr. Sowls is assisting in the development of a wildlife training curriculum for this institution, and expects to do some research on the warthog during the time he is in Africa. Appropriately, this research will be on a species having some of the characteristics of the peccary, Dr. Sowls' main research interest in Arizona.

Researchers serve as expert witnesses.—In June 1962, three employees of the Denver Wildlife Research Center, Dr. R. B. Finley, J. R. Tigner, and J. E. Peterson, were called as witnesses in a civil trial at Greeley, Colo. The case was a damage suit involving aerial spraying of endrin on a farm with a subsequent kill of several species of warm-water fish.

In other instances where expert testimony was required, Dr. J. W. Aldrich, Staff Specialist, identified scores of dressed carcasses and the cleaned bones of confiscated ducks at Lafayette, La., resulting in conviction of illegal duck hunters. Dr. Aldrich is regularly called upon to identify birds hit by flying aircraft, when such birds or feathers are recovered. A recent and highly interesting

To obtain information required for waterfowl management, the Bureau, in cooperation with Canadian authorities, conducts extensive banding operations of young, preflight birds on the far-northern nesting grounds. Banding returns serve to identify breeding populations with flyway routes; provide means of determining longevity and the effects of drought on flight routes; and make possible the identification of wintering grounds of given populations. (Photo by Rex G. Schmidt)

case was the identification of a feather which proved to be that of a mallard duck, struck by an Electra at 4:15 p.m., July 9, 1962, cruising at a speed of 345 knots near Elko, Nev., at 21,000 feet. A second case involved the whistling swan that caused the crash of a Viscount airliner late in 1962. About 30 species of birds, including game birds, songbirds, and birds of prey, have been involved in strikes with flying aircraft.

New Cooperative Wildlife Research Units.—In 1962 two new Units were activated and another was authorized for a total of 18, the highest at any time in the 27-year history of these training and research cooperatives. The two Units manned during the year were New York, Cornell University, Ithaca, Dr. Daniel Q. Thompson, Leader; and Louisiana, Louisiana State University, Baton Rouge, John D. Newsom, Leader. The South Dakota Unit will be at South Dakota State College, Brookings.

New Leaders were appointed at two of the older Units during the year. Dr. David R. Klein, formerly Federal Aid Coordinator, Alaska, now heads this Unit, and Dr. James S. Lindzey, formerly Leader of the Virginia Unit and more recently Chief, Section of Upland Ecology at Patuxent, became Leader of the Pennsylvania Unit in September 1962.

A major objective of one Bureau activity is training of qualified graduate students for careers in natural-resource management, made possible through cooperation with the Wildlife Management Institute and Land Grant colleges and Game and Fish departments of participating States. There are now 18 Cooperative Wildlife Research units, the largest number in the 27-year history of the program. (Photo by the New York Cooperative Wildlife Research Unit)

Cooperative Units conduct 240 projects.—The 16 Cooperative Wildlife Research Units active during the full year in 1962 worked on a total of 240 projects. Studies were conducted on 18 species of game mammals, 15 species of game birds, 8 species of waterfowl, 10 fur animals, 8 other mammals, and 8 other birds. In addition, there were 9 projects on diseases and parasites, 53 on habitat analysis, 12 on pesticides and related activities, 13 on techniques, and 52 miscellaneous investigations. This research resulted in the publication of a total of 113 bulletins, papers, scientific notes, and other releases.

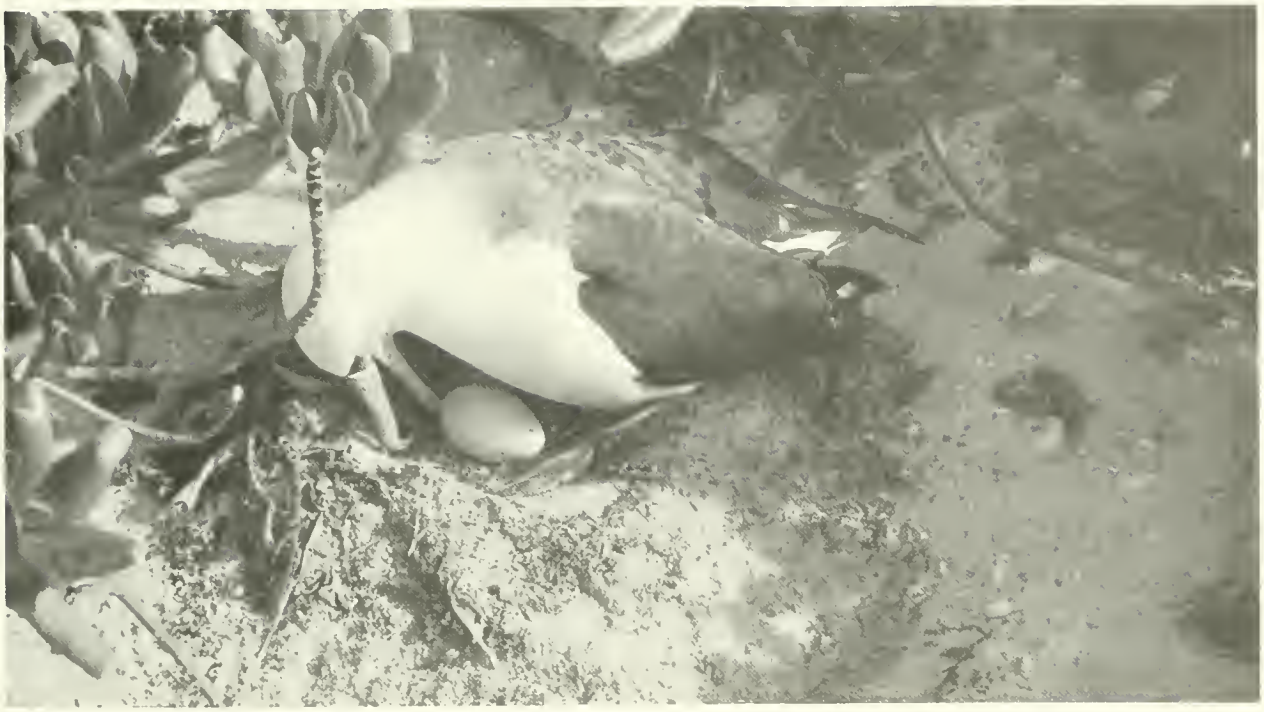
In the six Units where there are both wildlife and fishery studies, 45 fishery projects were conducted during 1962, the program involving 22 species of fishes, several limnological and water-quality studies, and a number of miscellaneous inquiries. The fisheries research findings accruing from this work were reported in 19 publications.

Financial support for the research programs manned by the 16 Units during 1962 was obtained from a total of 46 sources other than the Bureau of Sport Fisheries and Wildlife.

Bureau aids in establishment of new timber crops.—A major forest-wildlife problem in the Northwest, and elsewhere, is the destruction of tree seeds and seedlings by various species of wildlife. Seed eating by rodents and seedling loss due to clipping, browsing, and gnawing by hares, porcupines, big game, and several genera of mice, may delay the reestablishment of forest stands on cut- and burned-over lands for decades. The annual loss from this source is large and occurs on both private and public forest lands. The problem as a whole has long been serious enough to justify continuing studies by the Bureau in search of selective and effective control methods.

A notable achievement to this end, developed by the Denver Wildlife Research Center, is the coating of Douglas-fir seeds with an endrin-arasan formulation to reduce losses by white-footed mice. Commercial foresters, using aircraft, now employ this technique as an effective and economical practice in reseeding Douglas-fir, the most important tree species in the Northwest.

Of considerable promise is the continuing search for systematic repellents, selective toxic agents, and chemosterilants. One material now under test has shown a repellency index much greater than that of previously tested compounds. Another appears to have a differential of several hundredfold



Alabatrosses on Midway Island constitute a major hazard to military and commercial aircraft using this Pacific base. Birds, nesting adjacent to the runways, may strike both ascending and descending planes, at times with loss of life and craft. Grading and hard-surfacing of land parallel to the runways, recommended by Bureau biologists, has reduced the bird hazard appreciably. (Photo by Karl W. Kenyon)

between its avian and mammalian toxicity. These developments, still to be perfected, are nevertheless definite steps toward the control of small mammals, mostly mice, in the interest of forest reestablishment.

SOME PUBLICATIONS—RELEASED AND NEAR RELEASE

Mention is made here of major publications by Branch personnel in 1962. Several books or bulletins in advanced stages of preparation are included. A complete list of publications by the central-office and field staffs is given in appendix E.

The *Journal of Forestry*, January 1962, was devoted primarily to forest-wildlife relations, including values, animal damage, depredations control, and needed research. An editorial by Lansing A. Parker, Assistant Director of the Bureau of Sport Fisheries and Wildlife, and Arthur B. Meyer, Editor of the *Journal of Forestry*, introduced this series of 19 articles, 6 of which were authored or coauthored by employees of the Bureau. Mr. Parker is Associate Editor for Forest-Wildlife Management of the *Journal of Forestry* staff.

Albatrosses were the subject of two important papers by Dale W. Rice and Karl W. Kenyon. North Pacific albatrosses, in *The Auk* (79: 365–386), and Laysan and black-footed albatrosses, also in *The Auk* (79: 517–567) are highly informative evaluations of these populations.

The Denver Wildlife Research Center contributed significantly to the proceedings of the Vertebrate Pest Control Conference, Sacramento, Calif., last February. D. Glen Crabtree wrote *Review of Current Vertebrate Pesticides* (pp. 327–362); Weldon B. Robinson prepared *Methods of Controlling Coyotes, Bobcats, and Foxes* (pp. 32–56); and Adolph Zajanc authored *Methods of Controlling Starlings and Blackbirds* (pp. 190–212).

Factory unit, the mother duck. (Photo by C. J. Henry)

In *Nutria Feeding Activity and its Effect on Marsh Vegetation in Southwestern Louisiana* (Bureau of Sport Fisheries and Wildlife, Special Scientific Report—Wildlife No. 64, 51 p.), Van T. Harris of the Denver Wildlife Research Center and Fred Webert, formerly Biologist of the Louisiana Wildlife and Fisheries Commission, reported information of much interest and value on this exotic rodent, introduced from South America.

Effects of Pesticides on Fish and Wildlife: A Review of Investigations During 1960 is a timely and informative publication of the Bureau of Sport Fisheries and Wildlife (Circular 143, 52 pp.)

The Colorado Department of Game and Fish issued a distinctive bulletin, *Chemical Composition and Digestibility by Mule Deer of Selected Forage Species, Cache la Poudre Range, Colorado* (Technical Bulletin 8, 89 p.), by Donald R. Dietz, Robert H. Udall, and Lee E. Yeager. The technical aspects of this research were performed by Mr. Dietz, 1957–60, while employed by the Bureau of Sport Fisheries and Wildlife.

Important works in press or in advanced stages of 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, retired; a book on the marshes of the United States by Neil Hotchkiss; a book on the white-winged dove by George B. Saunders; and a book on the history and philosophy of predator control by Stanley P. Young, retired. Works in less advanced stages of preparation include a book on the birds of Idaho by Thomas Burleigh; and a book, *Waterfowl Tomorrow*, written by nearly a hundred authorities and edited by Joseph P. Linduska, former employee and now Collaborator of the Bureau. Of the authors, about half are employees of the Bureau of Sport Fisheries and Wildlife. Publication of the monograph is expected late in 1963.

RESEARCH HIGHLIGHTS

WATERFOWL MANAGEMENT RESEARCH

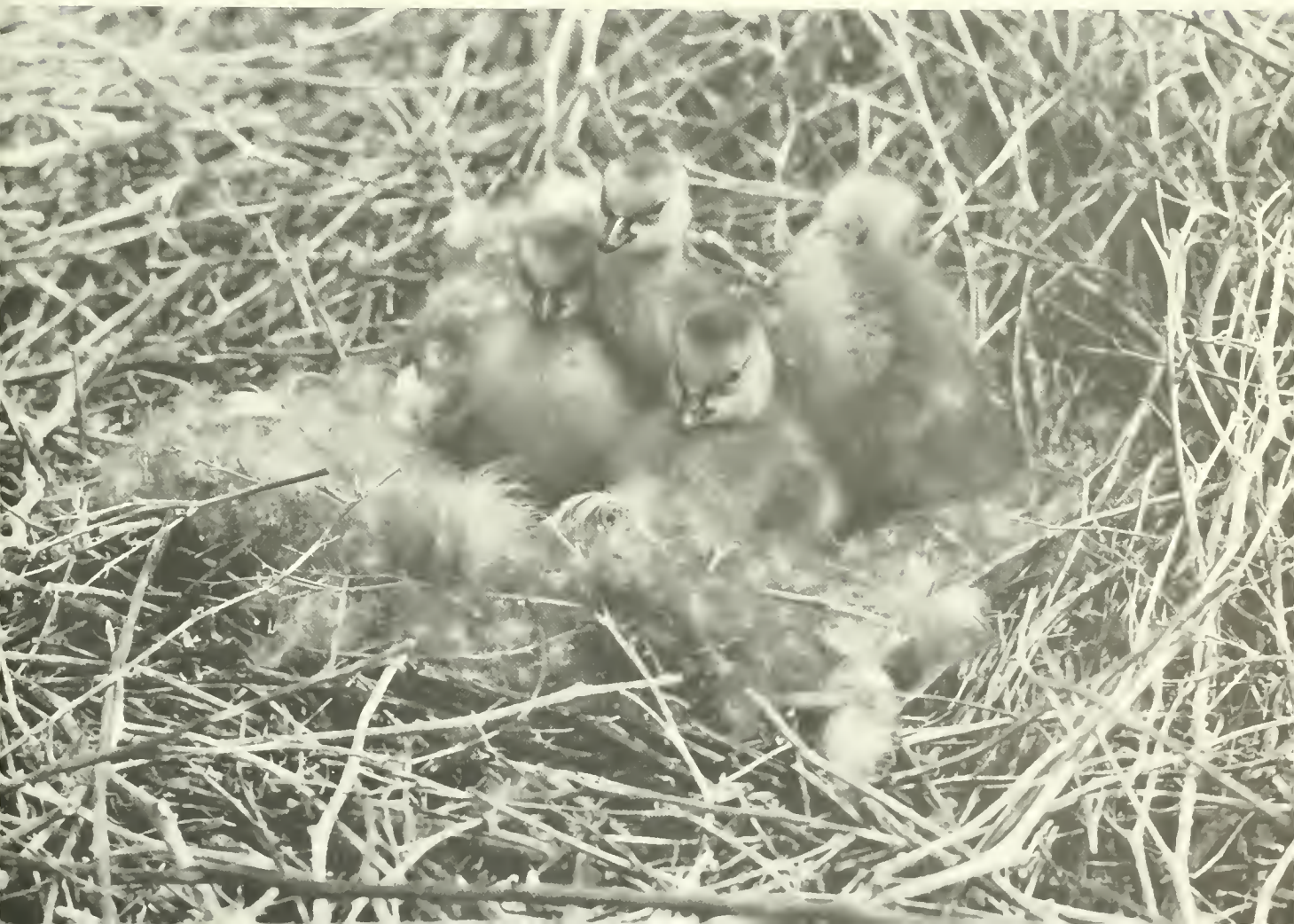
Two of the primary responsibilities of the Bureau of Sport Fisheries and Wildlife are the conservation and management of the migratory bird resources, of which waterfowl are of paramount importance. In carrying out these responsibilities, continuing research is needed to improve techniques of managing existing habitat, both on breeding areas and on migration and wintering grounds; to develop means of creating new habitat; to provide guidelines for habitat acquisition to best fill the year-long requirements of migratory birds; to evaluate the effects of regulations and other management measures on the birds; and to improve inventory techniques.

Production cycle on the Lousana and Redvers areas.—The Lousana and Redvers areas are located in the aspen-prairie parkland type of Canada. Initiated in 1952, investigations have been continued here for 11 years under the same project leaders. Field work has been conducted from May 1 through July 31 each year, when measurements were made of the many factors influencing waterfowl production. Studies, fortunately, have been carried on through the excellent production years of the early 1950's and, now, through the drought years which began in 1958 and continue to the present.

Plans are to continue these studies until the drought has broken and habitat conditions return to a more nearly normal condition. Then the Bureau will have compiled vital information on waterfowl habitat and production for an entire weather cycle.

Missouri Unit works on Manitoba potholes.—Results of a 4-year investigation by the Missouri Unit in the Erickson pothole country of Manitoba

Indispensable product, young of the year. (Photo by Ray C. Erickson)



Factory unit, the mother goose. (Photo by C. J. Henry)

revealed some further information on the effects of drought on duck production. The water level was unusually high in 1957, declined abruptly during the 2 drought years that followed, and almost attained the 1957 stage in 1960. The resident duck population on the square mile of pothole habitat under observation showed marked fluctuation during the 4-year period, increasing the first 2 years, but declining 63 percent below the peak in the third year and 29 percent below the peak in the fourth year. Production thus showed close correlation with water levels during the period of study.

Production on the Yellowknife.—Duck studies on the Yellowknife study area, Northwest Territories, showed that productivity in 1962 was somewhat low as compared with 1961, but varied considerably among species. Located within the western edge of the Precambrian shield north of Great Slave Lake, this area is in a part of the northern transition forest, containing an average of 15.7 natural ponds and puddles per square mile.

A late, prolonged breakup during the spring of 1962 resulted in moderately low water levels, with about one-third fewer birds than were present the previous year. Since far-northern breeding populations of many species fluctuate inversely with good water conditions on the prairies, most of the decline in the Yellowknife region last year can be attributed to improved conditions to the south. Breeding birds on the Yellowknife averaged 46.1 pairs per square mile, and production averaged 12.2 broods per square mile, indicating that about 26 percent of the pairs were successful in hatching clutches of eggs and that average productivity per

pair was 1.6 young raised to the downy ducklang stage.

Comparison of duck production.—Data obtained in 1962 permit comparison, on a sample basis, of duck production for three important continental nesting areas—the Yellowknife-Great Slave Lake in the Northwest Territories, the aspen-prairie parklands to the south and east, and the pothole country of the Dakotas. Investigations were initiated in the first- and last-named regions only 2 years ago, but production studies on the parkland samples go back to 1952.

In 1962, broods per square mile for the samples representing these regions were: Yellowknife, 12.2; the parklands (two areas)—Redvers, 6.2, Lousana, 14.9; and the average for three areas in North Dakota, 39.0. Peak production on Redvers was 121.2 broods in 1952, and for Lousana, 49.8 broods in 1958. Reduction in nesting habitat on these two areas, due to extreme drought was the reason for the very low production in 1962.

Goose production in Flathead Valley.—The Montana Unit, completing an 8-year study of Canada goose productivity and factors affecting its reproduction in the Flathead Valley of Montana, reported a population average of 815 during the 8-year period, over half of which were nonbreeding geese. A total of 1,609 nests were located, indicating that an average of 2.8 young per breeding pair reached the flying stage and, theoretically, a harvestable age.

The population reached a peak of 285 nesting pairs in 1955, dropped sharply to 154 in 1956, and showed slow recovery during the next 4 years. There were 172 pairs in 1960. Heavy hunting pressure was largely responsible for the decline, and restrictive hunting regulations were effective in bringing about the slow recovery. Only 10 percent of a theoretical population of 1,000 birds attained breeding age and survived to nest during a population-turnover period of 6 years.

Indispensable product, young of the year. (Photo by Ray C. Erickson)

Blue, snow, and white-fronted goose production.—Since blue, snow, and white-fronted geese nest in inaccessible areas near to and north of the Arctic Circle, it is difficult to conduct breeding-ground studies of their productivity. However, the difference in plumage between adults and young, and the birds' habit of traveling in family groups, make it possible to determine productivity with a high degree of accuracy through wintering-ground surveys. Records so obtained provide, over a period of years, a continuous picture of the population dynamics of the species, and form the basis for a progressive management program. Surveys during the winter of 1961–62 showed generally poor nesting success, with 7 percent young for blue geese, 20 percent for lesser snow geese, 1.2 percent for greater snow geese, and 33 percent for white-fronted geese. Preliminary results of surveys during the winter of 1962–63 showed better success, with corresponding percentages of 31, 29, 28, and 38.

Wood ducks.—Studies of wood ducks on Pool 10 of habitat in the marshes and swamps of Pool 10, of the Upper Mississippi National Wildlife Refuge by the Iowa Unit indicated that 65 percent of an estimated 470 pairs nested off the Refuge, mostly on tributary streams or on the bluffs. Nesting density was about three pairs per square mile of habitat in the marshes and swamps of Pool 10.

A special project was conducted by the Massachusetts Unit on techniques for aging wood ducks in the fall. Adults and juveniles of a captive colony of known-age birds were periodically examined. The most reliable age criterion proved to be the metallic blue color of the middle wing coverts of the juveniles, which persisted until April, well after the gunning season. A detailed description of the age criteria developed was forwarded to the Patuxent Wildlife Research Center and the findings helped to confirm techniques being used by research personnel handling waterfowl wings.

Blue and snow geese, nesting near to and north of the Arctic Circle, are difficult to study on their nesting grounds. The difference in coloration between adults and young, and the species' habit of flying in family groups, however, permit easy and accurate determination of nesting success and productivity. Left to right, adult blue, adult lesser snow, first-winter young lesser snow, and first-winter young blue, in "sooty" and "pearl-gray" phases. (Photo by John J. Lynch)

The trumpeter swan, threatened by extinction as late as 1935, may now be regarded as "safe"—a status reached through protection of the residual population of breeding birds at Red Rock Lakes and Yellowstone National Park, where nesting and other habitat conditions were favorable. (Photo by A. C. Hill)

A method of trapping wood ducks in the fall by driving flocks into a large collecting pen at night was developed by Patuxent biologists, who banded 565 of these birds as a result of a single drive. Increased banding made possible by this method will enable workers to learn more about this important species.

Maine duck study nearing completion.—The Maine Unit's long-term waterfowl renesting and homing study is now in the seventh year and nearing completion. Emphasis is being placed on the black duck, mallard, and ring-necked duck. In 1961, 32 percent of the nest-trapped females had been marked in previous years in the same nesting covers. Homing by hand-reared birds, however, continued to be very low, as noted during earlier years of the investigation.

A 38-year hunting record.—The waterfowl harvest records of the Bear River Club Company in Box Elder County, recently analyzed by Utah Unit personnel, span 38 years (1922–60), and permit tabulation of the kill for this entire period. Analysis showed the total kill per season, the number of birds of any one species taken in a season, the number of hunters utilizing the marsh in a season, and the average kill per man-day.

Effectiveness of hunting regulations on kill is shown by the average of 23 ducks per man-day for 1922–29, when the bag limit was 25 ducks; 12 ducks per man-day for 1930–33 with a 15-bird limit; and 3.97 ducks per man-day for 1960 and a 5-bird limit. The canvasback was the main species killed on these marshes during the period of record.

Biologists test herbicides to find satisfactory methods of controlling alligatorweed and other pest plants in waterfowl habitats. (Photo by Gerald H. Townsend)

Maintenance of "balance" between two wildlife species or groups dependent on the same habitat is an acid test of management skill. Here, ducks and muskrats meet, the birds requiring a certain amount of water for food production and resting space, and muskrats enough aquatic vegetation to provide their main food supply. Fortunately, the desired balance can be maintained fairly well through careful annual harvest of the muskrat population. (Photo by V. B. Scheffer)

Mail kill surveys.—The 1961–62 survey of waterfowl hunters revealed marked nationwide decreases from the previous season in the numbers of active hunters and in the total bags of ducks, geese, and coots. Decreases were generally more pronounced in the Central and Mississippi Flyways, where restrictive regulations were imposed as a result of poor duck production on drought-stricken breeding grounds. Based upon these surveys, 22 percent fewer Americans hunted waterfowl during the 1961–62 season than during the previous year. The estimated total bag of 4,950,000 ducks was 33 percent below that of 1960–61, while the kills of 637,000 geese and 167,000 coots were, respectively, 15 and 45 percent lower.

Findings of the Bureau's 1961–62 duck-wing mail-collection survey, conducted for the first time on a nationwide basis, substantiated the fact that summer production had been poor. For example, in 1961–62 every State in the Mississippi Flyway had fewer immatures per adult mallard bagged than during the previous season. In the Atlantic and Mississippi Flyways, respectively, mallards averaged 21 and 39 percent fewer immatures per adult. Mallard age ratios in the Central Flyway were among the lowest in the country, although the percentage change cannot be computed since this was the first year of the survey in that flyway. Similarly, most other species of ducks showed decreases in the proportions of immature birds in the bag.

Several new surveys were begun in 1962: (1) a nationwide goose-tail collection, using tail feathers mailed in by cooperating hunters to age and speciate the goose bag, which will complement the duck-wing survey; (2) a hunter-opinion to determine, in years when ducks are scarce, how restrictive hunting regulations can be made before most hunt-

Biologists assigned to the cooperative study at Back Bay and Currituck Sound strain bottom samples to determine the abundance of tubers and other foods available for waterfowl. (Photo by L. G. Kesterloo, Virginia Commission of Game and Inland Fisheries)

Wood-duck nest box protected against furred predators by the metal panel-type guard attached to steel post. (Photo by F. C. Schmidt)

ers would prefer a closed season; (3) determination of the most important reasons why hunters fail to hunt during restrictive seasons; (4) a measure of the amount and success of hunting on various types of land ownership has been undertaken; and (5) an analysis of the 1962 controlled whistling-swan season in Utah, now approaching completion.

Drawdowns and waterfowl use.—Studies at the Patuxent Center have shown that low-value shrub swamps and soggy woodlands characterized by acid, dark-stained waters—such as occur throughout much of the East and the Lake States—can be cleared and shallow-flooded to form attractive waterfowl breeding and feeding grounds. A biennial summer drawdown followed by fall reflooding permits germination and production of over 50 species of useful waterfowl food and cover plants in the mid-Atlantic region. Constant flooding during alternate years provides breeding areas for waterfowl and inhibits the establishment of weed species. Operation of these units in pairs insures that one pond is always flooded for waterfowl utilization, even when the other is drawn down. Over 90 nests and broods, made up principally of wood ducks, Canada geese, mallards, hooded mergansers, and black ducks, were observed in 20 impoundments totaling about 200 acres during the 1962 nesting season. Wintering flocks, consisting mostly of ring-necked ducks, mallards, black ducks, and Canada geese, have reached peaks of 2,000 in recent years.

Aquatic plant studies.—The control of aquatic plants, whether invading exotics or overgrowths of native species, continues to be a major problem in the management of waters for fish and wildlife. An associated problem, although usually not so troublesome, is the development of aquatic plant growths on depleted and newly impounded waters suitable for waterfowl and other aquatic wildlife.

Alligatorweed.—Although rooted stands of alligatorweed can be killed with granular formulations of silvex, no herbicides have been found that will give consistent control of floating mats. Limited success has been obtained from the application of several chemicals on lodged mats during periods of low water, if treatment is followed by freezing weather and a rise in the water level.

Plants that initiate their growth at the same time as alligatorweed are best able to compete with it. Nearly half of the common plants associated with alligatorweed on the Santee Refuge in South

Summer drawdown of the water level permits growth of waterfowl food plants finding favorable conditions on moist soil. Reflooding in the fall makes these foods available to the ducks and geese using them. (Photo by F. M. Uhler)

Quality as well as quantity of water is important in the growth of marshland plants, as shown by the effects of salinity levels at five different concentrations tested at Utah State University by graduate students in wildlife management. (Photo by Utah Cooperative Wildlife Research Unit)

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Carolina were used by waterfowl, according to food-habits studies. Alligatorweed was replaced in treated plots by valuable waterfowl food plants, including southern cutgrass, arrowhead, and smartweeds.

Eurasian watermilfoil.—Continued investigations on Eurasian watermilfoil revealed that, in addition to its previously known range from New York to Alabama, this important pest plant also occurs in Ohio, Indiana, and California. Control in the Chesapeake Bay area with granular formulations of 2,4-D is limited to a very short period in late May and early June.

Salinity and aquatic plant growth.—A severe storm in March poured ocean water into Back Bay and Currituck Sound, raising the average salinity for most of the remainder of the year to about 11 percent of sea strength. This influx caused a clarification of the water and an increase of over one-third in the production of submerged vegetation, particularly wigeongrass, sago pondweed, and claspingleaf pondweed. Southern naiad was the only important plant to become less common. There was also a marked increase in production of sago pondweed seed and tubers. Some species of invertebrates increased; others decreased. A spectacular rise in the numbers of a brackish-water clam occurred. Overall abundance of invertebrate food organisms was about the same after the storm as before. All indications were that the salt-water intrusion did not harm the fishing of the area, and that it led to considerably improved food conditions for waterfowl. Waterfowl utilization of the area during the fall and early winter of 1962 was higher than during any of the 4 previous years despite severe ice conditions in December.

Water birds on mosquito-control impoundments.—Contract studies were continued by the Florida State Board of Health on the effects of mosquito-control impoundments on wildlife. These have revealed some of the reasons for the consistently greater use by water birds of impounded areas than of unimpounded areas. Raising and stablizing water levels increased the amount and availability of submerged aquatic plants and of certain fish and invertebrates that serve as food for aquatic birds. Impoundments with stabilized levels also provided attractive resting areas. Ducks, coots, grebes, and cormorants were most abundant in areas with the greatest amount of open water, whereas the reverse was true for herons and related birds. Areas flooded continuously with water of low salinity became choked with cattails and showed decreased use by birds. Impoundments generally decreased the number of clapper rails and killdeers.

Hydrated lime on goose pastures.—Fertilization experiments at the Patuxent Wildlife Research Center have shown that goose pastures treated with hydrated lime produce over twice as much clover 1 year later than pastures treated with the cheaper ground limestone. There was a limited gain in production during the second year after the pastures had been treated with ground limestone.

Waterfowl nesting structures.—A new type of shallow-water nesting structure for Canada geese has been developed. It consists of a basket constructed of wire netting and steel rod mounted on four steel fenceposts. Straw is added for nest material. Geese readily accept this structure and are able to defend it successfully against swimming predators.

A simple guard has been developed at the Patuxent Center for excluding raccoons and other climbing predators from duck-nesting boxes mounted on steel fenceposts. It consists of a piece of thin sheet aluminum with the free edges fastened together to form a panel 9 inches wide and 38 inches long. The panel is constructed so that it encloses, lengthwise, a fencepost in sandwich fashion.

OTHER MIGRATORY BIRD STUDIES

Mourning dove studies.—It was found in an Arizona Unit investigation that male doves tend to call less often when their nests were successful than when their nests were broken up. Males of active nests called very little or not at all, but, in contrast, males known to be unmated or to have lost a mate called 7 to 16 times more frequently.

In a Missouri Unit project, cooing behavior of wild mourning doves was studied during two breeding seasons. Unmated wild birds cooed an average of 13 times more per 3-minute listening period than mated birds. The probability of hearing an unmated dove call in any 3-minute period is at least 3 to 6 times greater than the maximum probability of hearing a mated dove call.

Preliminary analysis of nesting data obtained by the Colorado Unit during the summer of 1962 disclosed great variability in dove production by habitat types in the north-central part of the State.

The mourning dove is the most widely distributed game bird in the United States and is adaptable to a wide range of habitat conditions. (Photo by Allen M. Pearson)

The urban type (in Fort Collins) was more than 20 times more productive on a unit-area basis than the foothills type, next in rank. Comparative figures for the four types investigated, in terms of doves fledged per 100 acres, are 57.3 for urban, 2.7 for farmland, 8.0 for foothills, and 1.1 for short-grass plains. However, the very large area occupied by all except the urban type gives them greater significance in total production than implied by these figures.

In the analysis of dove-banding data, preliminary estimates of recovery and mortality rates have been derived for those States with sufficient banding data; and determination and analysis of the kill for the hunting States are now available for use in more firmly establishing management-unit boundaries. Continued research on trapping, banding, aging, and sexing techniques was carried on in efforts to improve further the tools of dove research.

Three new technical dove committees were formed during 1962. The activities of these new committees in the Northeast, Midwest, and Western areas of the United States, together with the long-established Southeastern Technical Dove Committee, demonstrate growing interest in this important migratory game species.

Woodcock.—The annual status of woodcock is determined from surveys of reproductive success and breeding population levels. Age ratios obtained in 1960 and 1961 from 20,000 woodcock wings contributed by hunters from many States and Provinces suggested no significant change in reproductive success (1.8 young per adult female in 1960 and 1.9 in 1961). Singing-ground counts made in 1961 and 1962 on 263 routes located in

Woodcock on nest in typical nesting habitat. (Photo by G. L. Burley, North Carolina)

24 States and Provinces showed no significant change in size of breeding population (index value, 2 percent).

Because of the serious need for banding information, an investigation, carried out in Maine in 1962, led to effective methods of capturing large numbers of woodcock in summer. Birds were found to fly to open fields in the evening, where 265 were taken subsequently by means of spotlights and mist nets. Results indicate that, with more manpower, it would be feasible to conduct a large-scale summer banding program. Similar studies are planned for other portions of the woodcock's breeding range.

Sandhill crane investigations.—A sandhill crane study in central and western Mexico, conducted in January 1962, resulted in determination of the number and the subspecies of cranes wintering in this area. A total of 20,475 birds, the majority in the Bustillus and Babicora valleys in the State of Chihuahua, were found during the course of the study.

On the basis of mid-toe measurements, taken at random from footprint impressions at roost sites and feeding grounds, it was determined that most if not all of the cranes using the central highlands of Mexico are lesser sandhill cranes. By the same technique, it was found that a population of 1,000

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Young sandhill crane at 38 days of age, hand reared at pens operated by New Mexico Game and Fish Department, Santa Fe. (Photo by E. L. Boeker)

cranes wintering near the United States-Mexico border near Columbus, N. Mex., consists of a mixed group of the greater and lesser forms.

Experiments concerned with the development of techniques for capturing and color-marking sandhill cranes were carried out on the Muleshoe and Bitter Lake National Wildlife Refuges by refuge staff members and New Mexico Game and Fish Department personnel.

Methods of trapping included the cannon net, foot snares, modified steel traps, pen-type "walk in" bait traps, "jacklighting," and electrical stunning. Aerial spraying, hand marking, and smear lines were employed in color-marking experiments.

A sandhill crane rearing study was initiated in early April 1962. On May 10, 29 eggs were collected from 15 greater sandhill crane nests on the Malheur National Wildlife Refuge in southeastern Oregon and transferred to Santa Fe, N. Mex., where hatching and rearing facilities were available through the cooperation of William S. Huey, Biologist, New Mexico Department of Game and Fish. Bantam hens and an electric incubator were used for the completion of incubation. Both methods proved to be highly successful as only 2 of the 29 eggs failed to hatch. During the rearing period, 7 young cranes were lost owing to various causes, but 20 were successfully reared to adult size. In early August, 14 of the hand-reared young were transferred to the Monte Vista Wildlife Refuge where they are being held in captivity for propagation purposes. The remaining six are being retained at Santa Fe for detailed behavior studies.

Desert mule deer drinking, at night, at a deer-trap tank, Tucson Mountain Park, Arizona. (Photo by J. B. Elder)

The mule deer is the number-one big-game species in the West, and a species for which the Bureau has research responsibility on the Public Lands. Most of these mule-deer studies are manned and carried out cooperatively with State and Federal agencies. (Photo by Ray C. Erickson)

UPLAND WILDLIFE ECOLOGY

Much of the resident game in the United States, both birds and mammals, is produced on private land, where wildlife management responsibilities are primarily those of the State game and fish departments. The Bureau of Sport Fisheries and Wildlife, however, assists in research on upland wildlife problems and, through cooperative agreements and legislation, conducts wildlife studies needed to provide management information for Federal land-managing agencies.

A large part of this work is on national forest land, and current investigations are concerned particularly with wildlife affecting forest regeneration and range condition. The primary approach in this country-wide program is close cooperation with Forest and Range Experiment Station personnel of the U.S. Forest Service.

Wildlife habitat research program setup for Southwest.—In July a biologist from the Denver Center was stationed at Arizona State University to work cooperatively with the Rocky Mountain Forest and Range Experiment Station on wildlife habitat problems. One study will investigate the response of wildlife to manipulations designed to enhance water yields.

Another proposed study has been set up in the Fort Bayard area of southwest New Mexico, involving the cooperation of both the research and administrative branches of the Forest Service, the New Mexico Department of Game and Fish, and the Bureau. Here, attempts will be made to improve the habitat for deer, elk, and turkey on the

The Cooperative Wildlife Research units, working closely with State Game and Fish Departments, are actively studying deer and other big game in nearly all of these cooperative programs. Here, graduate students of the Arizona Unit are taking data from a whitetail buck. (Photo by C. R. Hungerford)

15,000-acre tract of forest and range land where vegetation changes will be correlated with changes in wildlife numbers and use.

Sampling techniques developed for measuring acorn yields.—Personnel of the Southern Forest Experiment Station and the Denver Center have developed a technique for sampling acorn yields from individual trees. The study revealed that 35 percent of the acorns fell two-thirds of the crown radius from the trunk, and further indicated that the fall could be adequately sampled by random location of three traps at the two-thirds-crown radius from the trunk.

Browse increased with timber cutting.—A Bureau biologist has reported substantial gains in available deer browse with various cutting methods in mixed conifer swamps in upper Michigan. Nine years after cutting, the yield was 46 pounds per acre in the light-selection cutting, 130 in the diameter-limit cutting, 134 in the block cutting, 161 in the strip cutting, and 184 in the shelterwood cutting, compared with only 18 pounds per acre on the uncut control area. Distribution of pellet counts and utilization of browse during the winter indicated that, from the standpoint of deer management, shelterwood cutting in strips would perhaps be best. This would combine optimum browse production in proximity to cover.

Snap-trap catches give estimates of small-mammal populations.—Biologists have long relied on live-trapping in grid pattern as the principal method of estimating small-mammal populations. In fact, there has been some question whether results from snap-trapping, as used in the Annual

Determination of utilization rates for key browse species is important in big-game management. Graduate students of the Utah Cooperative Wildlife Research Unit determining the utilization rate for bitterbrush on the Cache National Forest, Utah. (Photo by J. B. Low)

North American Small Mammal Census, are reliable even for trend indications. A Denver Center researcher has reported a high degree of correlation between white-footed mouse populations determined from grid live-trapping and subsequent catches in snap traps along a transect bisecting the grid area. The correlation of .964 suggest the possibility that white-footed mouse populations may be approximated from snap-trap data by using a regression of populations per unit area on snap-trap catches.

Inventory of pocket gopher populations.—Counting fresh mounds thrown up by pocket gophers over a 48-hour period on sample units shows promise as a census method for pocket gophers. The study carried out cooperatively by the Denver Center and Colorado Agricultural Experiment Station on Black Mesa in Colorado has shown a correlation of .80 (significant at the 1-percent level) between fresh mounds in late summer and gopher numbers as revealed by subsequent traponts. If the correlation holds for such variables as vegetative types and density or soil moisture, it will become a most welcome technique for range managers as well as biologists.

Factors affecting small-mammal numbers being studied.—After 6 years of small-mammal trapping in Colorado, an employee at the Denver Center has observed high populations of mountain voles following a year of good precipitation. Pocket gopher numbers appeared to be up following winters with a high accumulated snowfall. Mountain vole numbers were highest where herbaceous ground cover was thickest, this being ungrazed plots in open grasslands. White-footed mouse populations could not be associated with weather, but were found generally to be more numerous on grazed than on ungrazed areas.

In the grizzly bear project conducted by the Montana Unit, the huge beasts are live-trapped, immobilized, and tagged to permit later recognition on their natural range. Here, Unit personnel are attaching ear tags of yellow plastic. (Photo by F. C. Craighead, Jr.)

Cedar Island red squirrel study.—Branch personnel have studied red-squirrel populations on 23-acre Cedar Island in Flathead Lake in western Montana for the past 4 seasons, giving primary attention to squirrel population dynamics on forest-tree seed crops. Squirrel numbers during the fall were very similar in 1959–61, varying from 8 to 13 animals per acre. But, in the fall of 1962, there were 21 per acre. The 11 squirrels per acre the previous fall had survived the severest winter in 6 years; and this high survival may have been related to the good crop of Douglas-fir cones in 1961. The ponderosa seed crop in 1962 was excellent, and its possible influence on overwinter survival of the 1962 squirrel population will be watched with interest.

Mule deer investigations.—Further information on the effects of snow on mule-deer behavior was obtained by Colorado Unit personnel during late January and February 1962, a period of unusually deep snow at middle and high elevations (8,500–12,000 feet). The significant result was spectacular concentrations of animals on areas well below most transition ranges, where appreciable numbers of deer remain during open winters. For example, the annual midwinter count by the Game and Fish Department on Cedar Ridge in Middle Park showed 723 deer in 1962 as compared with about

350 in 1961, a winter of only moderate snow depth. However, as south-facing slopes—with the best winter browse—open up because of snow melt and evaporation, the deer disperse in response to food demand. During years of heavy snowfall, forced concentration of deer for long periods on restricted areas of the winter range sets the stage for above-normal dieoff due to starvation and malnutrition.

According to an Idaho Unit study, the age structure of the Middle Fork (Salmon River) mule-deer herd has all the characteristics of a herd grossly underharvested. Animals 8 years old or older constituted 25 percent of the population as compared with about 12 percent in highly productive herds sustaining continued good hunting. In 1961, the Middle Fork doe: fawn ratio was 100: 159. By late fall the ratio was 100: 65, and by spring it was down to 100: 19. For years two deer per hunter have been allowed; now, in response to this information, three deer may be taken during the 3-month hunting season, one of which must be a doe.

Estimated birth dates of 1,137 mule-deer fetuses measured in Utah by Denver Center biologists revealed a fawning peak of June 19 and extremes of May 16 and August 22. However, 86 percent of the estimated fawning dates fell within the 30-day period of June 4–July 3, and two-thirds within the 20-day period of June 9–28.

Returns from mule deer fawn tagging research in Utah have emphasized the desirability of placing a tag in each ear. Of 117 bucks, from 4 months to 8 years of age and for which tag-loss records are available, 17, or 14.5 percent, had lost one tag. For 71 does 4 months to 7 years of age, 7, or 10 percent, had lost one tag. These records provide a mathematical means for determining the probable number that had lost both tags. Such an estimate is not possible when a single tag per animal is used. Computations indicate that, for the number of tagged deer returns received to date, one could expect one buck and no does to have lost both tags.

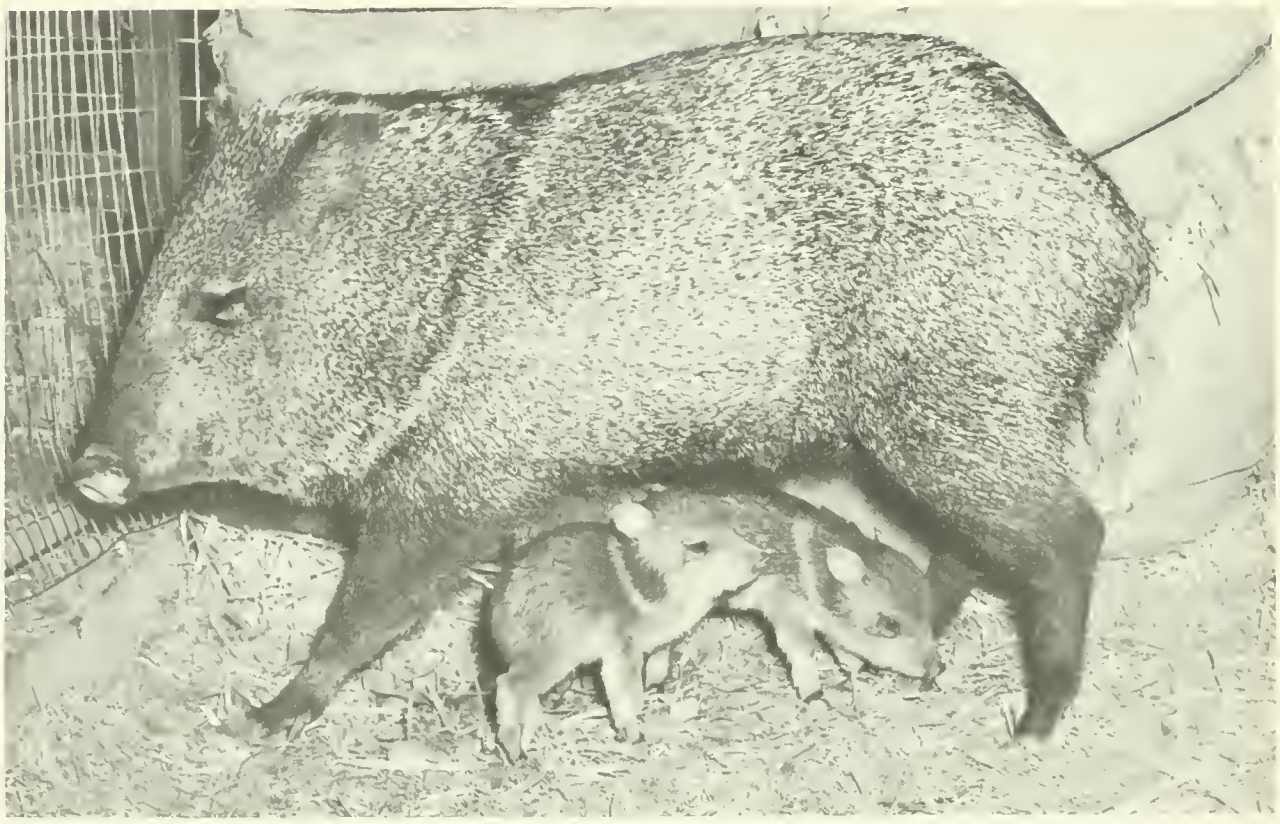
Records and observations of deer, ear-tagged as fawns in Utah, indicate a rather high dispersal rate of young from the area of birth. These observations provide fairly good evidence that most dispersals take place during the second summer of life. The movements appear to be largely initiated by antagonism of the mothers, induced by the approach of the fawning season. Approximately 60 percent of the bucks and 45 percent of the does seemingly wander for varying distances from the place of birth, the records showing from 1 to 42 miles for bucks and 1 to 20 miles for does. The mean distance between the summer-range tagging and kill sites for 78 males, yearlings and older, was 4.3 miles, as compared with 2.3 miles for 35 females of similar age, again indicating greater movements by bucks. A practical aspect of dispersal is the mechanism it provides the herd for more equitable distribution over the range soon after decimations due to hunting or disaster, or in response to localized food contingency.

Sprayed plots remain attractive to whitetail deer.—In 1958, on the Tamarack Refuge in Minnesota, 16 plots in four vegetative types (aspen, oak, jack pine, and upland brush) were sprayed with 2,4-D. Four years later it was unmistakably evident from pellet-group counts that both browsing and bedding use had increased on the 2-acre plots in contrast to the unsprayed controls.

Grizzly bear investigation.—The Montana Unit, in studies carried on for 3 years, has revealed definite social stratification among members of grizzly-bear populations. Males were most pugnacious during the breeding season. A distinct hierarchy existed among large, older males, wherein the same males retained the dominant positions for all 3 years. Fights were observed between males in breeding condition, but none resulted in serious injury to any of the combatants. Sows with cubs were extremely hostile toward males and shared status with many of the large bears. The breeding season extended from about June 10 to July 10, reaching its highest intensity in late June.

In another phase of the Montana study, a radio tracking system was completed and tested during the summer of 1962. This system has the capability of picking up a radio signal so that an instrumented bear can be located by triangulation and approached to within sighting distance by means of portable direction finders. It was possible to follow an instrumented bear constantly for 48 hours, and some bears were under observation intermittently for as long as 3 weeks.

Collared peccary and prickly pear.—In an Arizona Unit study, penned peccaries remained healthy for 3 months on a diet of prickly-pear cactus pads with no free water, cactus being the only source of moisture. Peccaries can live for 5 months on the cactus without undue loss of weight.



The peccary is one of the least studied game mammals in North America. The Arizona Unit has found it prolific and adaptable to its desert or semidesert range. (Photo by L. K. Sowls)

This game animal has shown high potential productivity. Females bear young at less than 1 year of age and breed again in slightly over 1 month when the young are lost. The early breeding age and ability to breed again soon after loss of young are important factors in maintaining populations at fairly high levels.

Bighorn sheep.—Periodic observations by Montana Unit personnel were made on 46 color-marked bighorn sheep of known age on Wildhorse Island. Nineteen lambs were tagged in May of 1959, nine of which were known to be alive in June of 1962, 37 months later. Eleven lambs were similarly marked in the spring of 1960 and three were alive 25 months later. Only 7 of 16 lambs tagged in May of 1961 were known to be alive at the age of 13 months. Survival of lambs to adulthood was somewhat in favor of males, 44 percent of which were alive at the end of the observation period, as compared with 38 percent of the females. Rams had a longer life span than ewes, resulting in an unbalanced sex ratio in favor of males in this unhunted population.

Cottontail chemistry, biology.—In an Ohio Unit study with cottontail rabbits, preliminary analyses showed that sex was significantly related to red blood cell volume, serum calcium, and dry liver weight. The serum calcium-phosphorus ratio was related to the age of the specimen. Cottontails collected from eastern and southeastern Ohio had significantly lower bone calcium, bone-calcium-to-phosphorous ratios, and dry liver weights than those taken in west-central Ohio.

In another Ohio study the numbers of corpora lutea, implantation sites, and living embryos found in pregnant cottontails taken in four different physiographic regions of Ohio differed significantly. The lowest reproductive rate was in animals from the unglaciated sandstone and shale region of southeastern Ohio. Variations in the ovulation rate, rather than total prenatal mortality, seemed the cause of regional differences in productivity.

Carrying capacity for bobwhite quail.—In the fall of 1961 both pen-reared and wild-trapped bobwhite quail were released by the Alabama Unit in an effort to build up the wintering population and test the winter carying capacity of the habitat under study. In December of 1961, a total of 299 quail were present, as compared with the 11-year average of 119. Hunting subsequently accounted for 101, but only 119 were present in the spring of 1962, leaving 79 unaccounted for. Then 110 of the surviving quail were trapped and removed from the area, leaving a known breeding population of only 9 birds. It was determined in the trapping operation that 74 of the 79 birds unaccounted for were pen-reared individuals released the previous fall. The population in the fall of 1962 compared favorably with the wild populations of 1959–61, and was well above the 11-year average of 119.

Wild turkey studies.—A study by the Pennsylvania Unit indicated that the best wild-turkey range in Cameron County has four important characteristics: (1) a diversified physiography, (2) available water, (3) diversified forest-plant communities, and (4) good roosting cover.

The wild turkey has been studied extensively by the Virginia, Pennsylvania, and Missouri Units, and findings from these investigations have provided much of the information now used in the management of the species. (Photo by F. B. McMurry)

Personnel of the Alaska Unit taking a break beside overflow ice in early August in the upper Sheenjek River Valley during a 110-mile trek through the Romanzof Mountains. This wilderness travel was in conjunction with a study of the wildlife and recreational potential of the Arctic Wildlife Range. (Photo by David R. Klein)

A turkey project executed by the Virginia Unit was designed to study distribution and population dynamics of turkeys as influenced by forestry and wildlife-management practices. Procedures included live-trapping with a cannon net and marking birds with a photo-identification band. Trip cameras were erected to photograph marked birds on bait lines and to record flock movements. Ten birds were marked and several excellent flock photos were obtained, suggesting the usefulness of this type of photography as a field technique.

Prairie chicken habitat preference.—In an Oklahoma Unit study, a highly significant difference in the habitat of greater and lesser prairie chickens is apparently associated with their use of food resources. The greater chicken is highly granivorous in feeding, while the lesser is highly insectivorous. Greater chickens favor areas of close-cropped, turflike vegetation over which there are scattered clumps of the taller grasses, while lessers favor areas of fairly bare soil where the taller grasses are replaced with brushy vegetation.

Ruffed grouse moisture requirements.—Research conducted at the Idaho Unit in 1962 pointed out the significance of dew on the distribution and activity of ruffed grouse. The technique used in these determinations was the measurement of dew at 50 sites on a number of different surfaces at different elevations and under different degrees of cover. Clover was planted on clear-cut blocks adjacent to micro-climate stations, and leaves of the vegetation from a square foot of each plot were randomly clipped and weighed. Availability of succulent vegetation, particularly clover, was found to be a major factor in the survival of grouse broods. Clover-succulence studies and measurements of dew accumulation on clover leaves showed that ruffed grouse obtain their daily moisture requirements from this source.

FUR ANIMALS

Beaver.—Preliminary studies by the Alaska Unit on the effects of beaver impoundments on the Kenai National Moose Range suggest that

these animals play an important part in the ecology of other wildlife species. Beaver-impounded waters are used extensively as nursery areas by young red and silver salmon, and provide habitat for waterfowl, moose, and other fur bearers. No evidence of obstruction to migrating salmon has been found, but this may be due to the presently low numbers of beavers and favorable water levels during the period of salmon migration.

Mink.—Studies on the Kuskokwim Delta indicated that the presence and condition of permafrost governs to a large extent the location and success of mink dens, the Alaska Unit reported in 1962. Dens are consistently located on frost-free mounds (pingos) or adjacent to streams where the banks are thawed to greater depths. Because of the presence of permafrost, drainage is poor, and abnormally wet springs and summers lead to low mink productivity through den flooding. The "taluyak," a modified fyke net, is used to catch minks in the Kuskokwim Delta region and is more efficient than the standard steel trap. The average catch for the region is 15,000 to 20,000 annually, valued at $375,000 to $500,000. The 1961–62 catch of 7,000 is the lowest on record.

Arctic fox.—Studies in northern Alaska indicated that arctic fox populations are presently low, corresponding to a low in the cycle of the brown lemming, the primary prey species. Results of den surveys showed low production of pups during the summer of 1962. Pelt studies indicated that adult foxes are prime during the first 2 weeks of November, whereas young animals were unprime at this time.

Throughout its almost continentwide range the beaver has increased in numbers during the last two or three decades. In numerous localities it has "eaten out" its habitat, creating problems arising from extensive dam breakage and erosion in mountainous country, and stagnating water and deteriorating game-fish habitat in regions of low relief. Low prices for beaver pelts complicate the problem of management. (Photo by Lee E. Yeager)

Sea otter.—During the year work was conducted in six general areas of the sea-otter range, requiring several thousand miles of flight. A total of nearly 11,000 sea otters were observed by the personnel assigned. Much additional time was given to study of specimens, analysis of data, and preparation for publication of all material on the sea otter in Bureau files.

Marten.—For several years the Montana Unit studied the breeding physiology of the pine marten under the direction of Dr. P. L. Wright of Montana State University. The Anaconda Creek population under observation showed evidence of recovery after declining from a peak in 1953–54. These fluctuations coincided roughly with a small-mammal peak in 1953, a low in 1955, and return to high density level in 1957 and 1958.

More general studies by the Colorado Unit disclosed indications of fluctuations in marten numbers, and very definite cyclic behavior in several genera of mice. Marten numbers are considered relatively high in this State at the present time.

Fisher.—The Maine Unit is now completing a 9-year investigation of the fisher, and results are being used in a doctorial dissertation by Malcolm W. Coulter, who conducted the primary study. This "wilderness" fur animal has demonstrated pronounced adaptability to habitat variations in its recent and widespread extension of range in the upper Northeast States and Provinces.

Dog team waiting for its trapper owner to return from checking a trap. A mink and snowy owl are shown on the sled. Travel incident to the Alaska Unit's study of mink in the Yukon-Kuskokwim Delta. (Photo by John J. Burns)

The glamorous sea otter, producing the most luxurious of all furs, is increasing in numbers on its Alaskan coastline range. The present population of thousands has grown during the last three or four decades under Bureau protection and management from a residual stock of a very few hundred animals. (Photo by Karl W. Kenyon)

GAME BIRD INTRODUCTION

Acceptance of the Bureau's foreign game introduction program by the States has been substantial, and cooperative agreements are currently in force with 45 of the 50 States. Trial liberations of 16 species or subspecies of foreign game birds are now underway in 23 States and the Territory of Guam. In addition, all but two species, obtained in southern Asia, are being reared in appreciable numbers for trial release on State game farms. Cooperating in these propagation attempts are 21 States.

Program personnel devoted the latter half of 1962 to evaluation of results and servicing State requests for technical assistance. It is much too soon to predict results for most of the species liberated, but it can be reported that Iranian and Japanese green pheasants, francolin, and red-legged partridges give cause for guarded optimism.

Work in India was completed during 1962 with the trapping and shipping of about 6,300 individuals of five species. Of these, only six birds were lost in shipment to the United States, and losses in quarantine were insignificant.

Typical kalij pheasant and red junglefowl habitat in northern India. (Photo by Gardiner Bump)

The red junglefowl is a woodland pheasant potentially adaptable to southern forested or woodlot habitats. (Photo by USIS, India)

The kalij is a forest pheasant partial to hilly country and wooded slopes. (Photo by Gardiner Bump)

CLASSIFICATION, DISTRIBUTION, AND LIFE-HISTORY STUDIES

Research and services performed by the Bureau's Bird and Mammal Laboratories, located at the U.S. National Museum, involve all of the activities of handling and maintaining the extensive study collections, identification services to cooperators and scientists throughout the country and in foreign nations, and much in the way of extension education to many of the very large number of people who visit the Museum and the Smithsonian Institution.

Curatorial work.—In 1960, the Laboratories received, prepared, cataloged, carded, and loaned a total of 3,390 bird and 8,753 mammal specimens. In addition, the entire bird collection, including that of the Smithsonian Institution, with facilities, was moved from its old location to quarters on the top floor of the new, air-conditioned, east wing of the Natural History Museum. The moving job required the handling of about 325,000 bird skins, including 2,744 type specimens. The mammal portion of the collection, containing 305,000 skins and 2,980 type specimens, will be moved to new quarters when they are available.

Taxonomic and distribution studies.—Historically, taxonomic research is one of the oldest functions of the Bureau and its predecessor agencies. In 1962, formal studies included geographic variation in Canada geese and hermit thrushes, birds of the northern Rocky Mountain region, methods of determining sex in cranes, a taxonomic review of the bobcats, distribution of Alaskan mammals, the mammals of Delaware, Maryland, and the District of Columbia, and characteristics of game-bird carcasses to permit positive identification in court trials involving migratory birds. Various other lesser and informal studies were active.

Walrus.—By agreement with the U.S. Public Health Service, Dr. Francis H. Fay of the Arctic Health Research Center was engaged to prepare for publication the results of his many years of research on the Pacific Walrus, mostly on St. Lawrence Island. Dr. Fay is proceeding on a manuscript concerned with the distribution and biology of the species throughout its range.

During the aerial survey of sea otters on April 8, 1962, about 100 walruses were observed on Amak Island in the Bering Sea, about 20 miles northeast of Cold Bay near the tip of the Alaska Peninsula. This occurrence on Amak Island, a traditional hauling ground, is the first in many years and may be an indication of an expanding walrus population. The Bureau's estimate of walruses in Alaskan waters, made in 1961, is 90,000.

Careful identification of wild birds and mammals is one of the important jobs of the Bureau's Bird and Mammal Laboratories in the U.S. National Museum. Often positive identification is possible only through exacting measurement and comparison of a large series of individuals. (Photo by Richard H. Manville)

Bat banding.—In 1962, approxiamtely 80,000 bats were banded by Branch cooperators, the largest number in any single year. A total of 1,087 recoveries were reported to the Laboratory during the year. Out of this program, now several years old, there has come new knowledge on the homing instinct in bats, discovery of bat flyways to the coasts of Connecticut and Massachusetts, a longevity record of 19 years for the big brown bat, other valuable records on age and movements, and a growing interest in this unique group of mammals.

Rare and endangered species.—Current interest in the preservation of rare and endangered species has brought to the Bureau of Sport Fisheries and Wildlife many requests for information. A tabulation indicates that approximately 16 species of

Adult male walruses resting on rocks, Round Island, Bristol Bay, Alaska. The total walrus population in Alaskan waters was estimated at 90,000 by Bureau biologists in 1961. (Photo by Karl W. Kenyon)

birds and 16 species of mammals have become extinct in North America since 1844; there presently are 41 species of birds (including 19 Hawaiian) and 31 of mammals in the endangered category. Lists of birds and mammals needing protection, as well as other vertebrate species of North America, have been provided, together with distribution maps, notes on habitat requirements, space needs, and other matters by the Bureau's Bird and Mammal Laboratories. The current status of endangered species of birds was reported by a Bureau specialist in a paper given at the annual meeting of the International Council for Bird Preservation, in New York City. If the trend toward extinction, in the face of a burgeoning population and increasing development of the country, is to be controlled, there is very real need to apply seriously all possible effort to matters of basic ecology, population dynamics, decimating factors, and life-history data for all the species concerned.

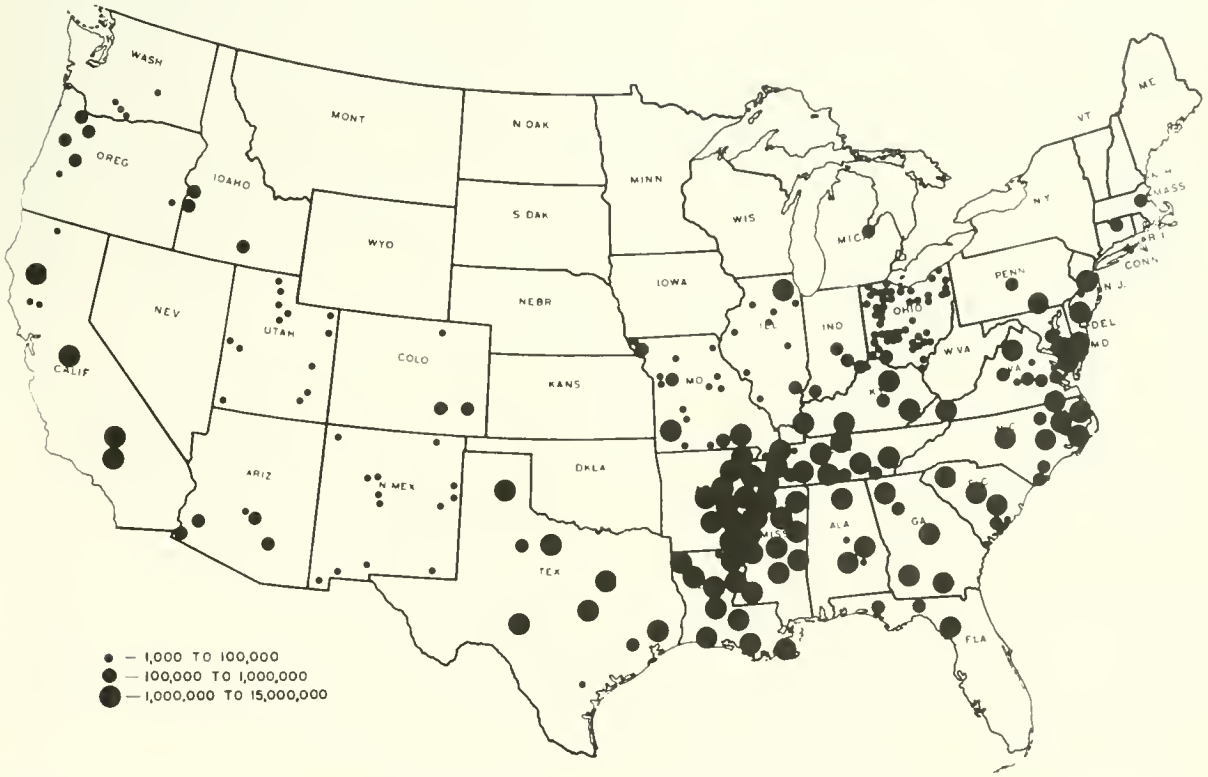
ANIMAL DAMAGE CONTROL

As competition between man and wild animals increases, the problems of animal damage inevitably become more acute, increasing the need for more selective and effective control measures, whether the pest is bird or mammal or the damage is to forest, crop, rangeland, stored goods, or air-

craft. Many approaches are being used by the Branch in developing such measures: cultural practices, including the encouragement of agricultural experiment stations in the development of damage-resistant crops; manipulation of habitat; chemical repellents and scaring devices; drugs and lethal substances; sonic and electronic installations; traps; radiation; reproductive inhibitors; and disease organisms, to give a partial list.

Blackbirds.—During the last 2 years 252 winter roost sites, holding an estimated 214 million blackbirds and starlings, were located in the United States. The search is continuing and at this time it is not known what portion of the countrywide population is represented by these millions of birds. The buildup of starlings in the West has continued, and concentrations in some California feedlots have become a matter of real concern. About 1 million blackbirds and starlings have been banded—38,700 in 1962—as part of the effort to obtain basic information on migrations, seasonal movements, and concentration areas, knowledge of which facilitates control.

Red-winged blackbird feeding on corn. Because of its wide distribution, great numbers, and fondness for corn in all stage of kernel development, the redwing is responsible for more damage to this crop than other blackbirds. (Photo by Brooke Meanley)



Blackbird and starling roosts, winter, 1962–63. An estimated 214,000,000 birds are represented in the 252 roosts indicated. (Photo by Patuxent Wildlife Research Center)

Control methods that have shown much promise and which are now undergoing further tests are lethal baits and specially designed traps. Lethal baits used in cattle feedlots resulted in the destruction of about 260,000 starlings in one Idaho instance; and a method of using TEPP, an organophosphate, for the control of feedlot-using birds has been perfected and released for use under Bureau supervision. In Delaware, Maryland, and Virginia, nine decoy traps took 50,000 blackbirds in one season, and a single trap took 20,000 birds in a 35-week period. A total of 132,000 birds were captured in light traps at five winter roosts in 1962. During the year, sterility-inducing chemicals were tested, and these materials show great promise as control agents. Branch biologists are working closely with agricultural interests in the development of still more effective control methods.

Birds and aircraft.—Birds were blamed for the loss of two aircraft in 1962. One was the crash of an Air Force fighter plane on takeoff because of engine failure due to ingestion of starlings, and the other was the crash of a Viscount airliner after colliding with two whistling swans. The Air Force pilot escaped injury, but there were no survivors in the airliner crash. These two accidents, plus the 321 additional bird-plane strikes reported in 1962, have emphasized the potential hazard of birds to aviation and the need for continuing research on the problem. Most of the strikes were at altitudes of less than 2,500 feet, and engines and wings were struck most often. Over 30 species of birds were involved in the 323 collisions. The Denver Center averted a bird hazard at the Stapleton Airport, Denver, by burning the cover provided by a small marsh a few hundred yards from the main east-west runway where about 135,000 starlings and redwing blackbirds had established a winter roost.

Biologists examine ears of several varieties of corn in plantings exposed to blackbirds to determine ear characters resistant to bird attack. (Photo by John T. Linehan)

Blackbird and starling damage to white pine, Hanover, Pa., Municipal Watershed. Several million birds roosted in this area during the winter of 1958–59. (Photo by F. C. Schmid)

At the suggestion of the Federal Aviation Agency, the Denver Center is studying the similarity of sound waves produced by Electra aircraft engines and hoards of singing crickets by which starlings may be attracted to the vicinity of airports.

A better gopher poison.—A better poison than compound 1080 for gopher control, to be used in conjunction with the burrow-builder, apparently has been found, and it is now up to industry to determine whether the material can be produced for marketing. This is a chemical supplied to the Denver Center by the Bayer Co. of Leverkusen, Germany, coded as DRC–714. The chemical is accepted readily by gophers, and field tests have given better than 90 percent control under favorable conditions. Moreover, coyotes, bobcats, and domestic cats are 5 to 12 times more resistant to the toxicant than gophers, indicating minimum hazards to animals that may eat the poisoned rodents. Of birds so far tested, including poultry and various game species, none have been found as susceptible to DRC–714 as the gophers themselves.

Rangeland spraying in pocket-gopher control.—The effectiveness of 2,4–D sprayed on grazed rangeland in gopher control showed the following

results at the end of 7 years: Grass production increased the first 3 years after spraying but returned to its original level by the sixth year; perennial forbs, a favorite food of gophers, declined the first year after spraying, but were two-thirds as productive as originally by the sixth year; gophers were scarce the first two years following spraying, but increased until, at the end of the sixth year, they were more abundant on sprayed plots than on adjoining unsprayed lands. These results show that some degree of pocket-gopher control can be expected for about 5 years after 2,4–D spraying on bunch-grass-type rangelands, but that the effects are largely neutralized a year or two later.

In an attempt to develop more effective control of gophers with spraying techniques, Bureau researchers at the Denver Center joined with the Bureau of Land Management in 1960 in a cooperative 5-year investigation. The basic design for the work involves paired acre plots in which the relative effectiveness of gopher control through poisoning, herbicide spraying, and grazing regulations are appraised as range-restoration practices.

The successful and widely accepted burrow-builder as a gopher control is described on page 5.

Forest animal damage control.—Several chemicals, all selected products of the Denver Center screening program, are being evaluated at the Olympia field station to determine their effectiveness in preventing animal damage to reforestation. These evaluations are carried out first in outdoor holding pens against deer, porcupines, mountain beaver, hares, and field mice, the mammals most often involved in conflicts with reforestation activities. Chemicals which show up well in the enclosure tests are then tried in the field.

A vast amount of initial screening is necessary to identify materials for preliminary field testing. During 1962, the forest animal damage screening laboratory at Denver received 438 chemicals from chemical companies. Subsequently, 690 bioassays were conducted to determine the toxic and repellent characteristics of these chemicals. Active compounds then were subjected to more than

View of a pilot model of a boom which provides a "curtain of spray" through which roosting blackbirds are driven. The chemical drips from arms of the boom, is retrieved in the catch-basin, and re-used. (Photo by Jerome F. Besser)

Blackbird catch in decoy trap being driven into gathering cage in upper corner of trap so that they can be caught for banding or other research. (Photo by John T. Linehan)

Research biologist banding blackbirds in decoy trap during late summer depredations period at Newark, Del. Over 20,000 blackbirds were captured in this trap during a 35-week interval. (Photo by John T. Linehan)

140 phytotolerance tests, 52 toxicity determinations, and 5 translocation studies. In addition, 104 secondary bioassays, 79 toxicity determinations, 92 phytotolerance tests, and 12 translocation studies were made with compounds examined earlier. As a result of continued screening, it is anticipated that as many as 10 new compounds may be sent to the Olympia field station for further trials during the coming year.

On the basis of experience gained in the past 2 years, it has been possible to reduce the initial screening bioassay from 100 to 15 animal-days without loss of reliability. This change will make it possible to devote more time to developmental research with promising chemicals.

Protection for packaged goods.—Sixteen years of research in cooperation with the U.S. Quartermaster Research and Development Command has resulted in the appraisal of approximately 8,500 candidate chemicals as rodent repellents for use on packaging materials. Such factors as toxicity, handling hazard, cost, and migration of the chemical into packaged contents have been enough to eliminate all the active repellents so far discovered. Research has now evolved to a polyethylene-textile-polyethylene multiwall cover or tarp, with only the middle layer being treated with a highly active rodent repellent. The multiwall tarp will be used as a cover for stacked packaged goods and will greatly reduce handling and contamination hazards.

Nutria control.—From numerous releases, both intentional and accidental, nutria have become established in many sections of the United States. As so often happens with introduced species, these animals are conflicting with man's interests in many ways. The problem is particularly acute in the coastal regions of Louisiana and Texas, where nutria are causing serious damage to water structures and to such agricultural crops as sugarcane and rice.

As a result of congressional action, $50,000 was made available during fiscal year 1963 for research on methods of controlling nutria damage, and a similar amount was appropriated for direct control purposes. A Nutria Research Station has been established at Houma, La., which will serve as headquarters for field and laboratory studies on methods of alleviating property and crop losses to these rodents. A smaller station was established at Beaumont, Tex., for study of the problem as it exists in that area.

Reproduction inhibitors for controlling coyotes.—One phase of the study of reproductive inhibitors as a means of coyote control was completed in the spring of 1962 when experiments

Pens for holding coyotes used in testing chemicals potentially useful in inhibiting reproduction, Denver Wildlife Research Center. (Photo by Donald S. Balser)

The new nutria research station at Houma, La., which will provide office and laboratory space for research and control biologists assigned to study this pestiferous rodent. (Photo by A. Loren Ward)

with more than 40 live coyotes were terminated. The objective was to determine the acceptance, tolerance, and effects on reproduction of diethylstilbestrol, an orally administered, synthetic estrogen. Pen trials showed good acceptance of the drug both in tablet form and when dissolved in lard.

Experiments in the inhibition of reproduction in coyotes by blocking ovulation were inconclusive since neither the treated nor control animals came into estrus during the normal period. A degree of success was attained in terminating pregnancy; there were several instances of resorbtion of embryos following administration of stilbestrol. Ten additional holding pens and a new feed building were constructed in preparation for more extensive tests during the winter of 1963.

PESTICIDE-WILDLIFE RELATIONS

The controversial pesticide question finds the Bureau in the responsible position of seeking facts on the immediate and long-term effects of pesticide use in the wildlife field. Its several investigational programs are to the end of pesticide use with the greatest possible safety to man and wildlife; and, in the Bureau's concept, safe use requires a multiple approach in research: more selective chemicals, more acurate dosage, substitution, where feasible, of biological or ecological methods for chemicals, less toxic but still effective chemicals, rigid adherence to prescribed direction, and, above all, thorough testing prior to release for general application.

Pesticide-quail studies at Patuxent.—Results of preliminary tests indicated that zytron is moderately toxic to adult quail, but that the other herbicides tested have relatively low orders of toxicity. No effects on survival or body weight were found in trials with amiben, casoron, tiphenamid, and diphenatrile; however, effects of these compounds on quail reproduction have not been determined. Amitrole, amitrole-T, dacthal, dalapon, MCPA, and chlorinated phenoxy herbicides also had slight effects upon growth and survival, but sublethal exposure to these compounds had marked inhibitory effects upon reproduction. Quanities producing inhibitory effects ranged from less than 10 to approximately 50 percent of the estimated lethal dose.

Similar inhibitory effects on reproduction resulted from feeding diets containing 50 or 100 p.p.m. of kepone before and during the breeding season. The lack of reproductive success thus induced was acompanied by changes in feather pigmentation of males, wherein the plumage of male quail resembled that of adult females, and male pheasants and ducks did not exhibit the usual characteristic coloration. Mirex, which is closely related to kepone, is less toxic and did not have any apparent effects on reproduction or secondary sex characteristics.

Data from these feeding tests were supplemented by studies in which birds were confined in areas which had been treated with heptachlor in accordance with accepted insect-control practices. Thirty-two covered pens, each 20 by 50 feet, were constructed for the tests; eight remained untreated, and the others were treated with granular heptachlor at the rates of 2.0 (6 pens), 1.25 (6 pens), and 0.25 (12 pens) pounds per acre. One pair of adult, pen-reared bobwhite quails was placed in each pen immediately after application of the insecticide. When mortality occurred in any pen, the surviving member of the pair was sacrificed and a new pair was used in replacement.

Mortality occurred in 20 of the 22 pairs placed in pens treated with 2.0 pounds to the acre, and the survival times for these birds were approximately equal to those of birds fed diets containing 100 or 200 p.p.m. of heptachlor. The two surviving hens produced a total of seven chicks. Sixteen pairs were started in pens treated with 1.25

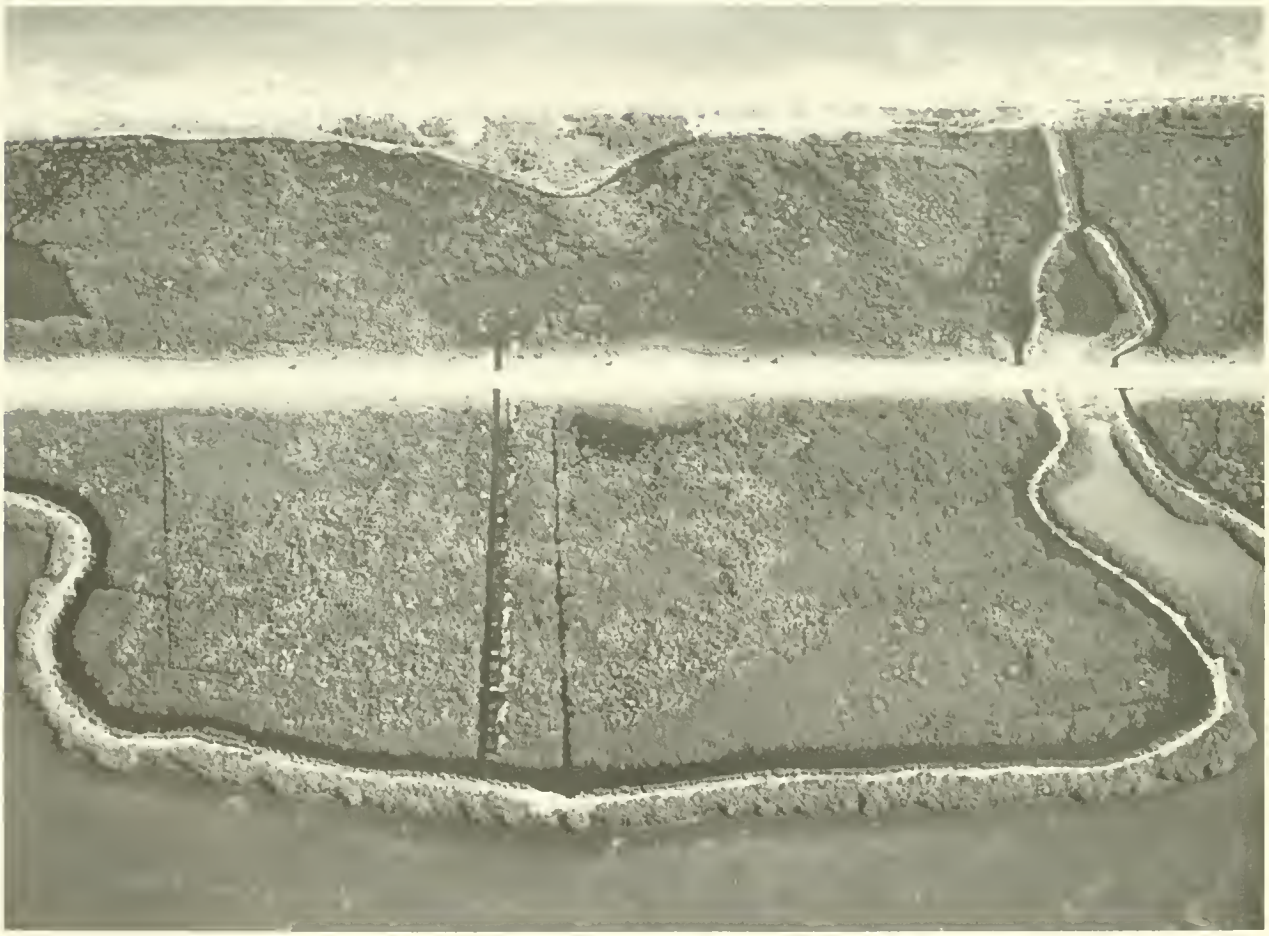
Biologist dipping for mosquito larvae in impoundment at the Patuxent Wildlife Research Center. The main objective of this research is the development of specifications for impoundments suitable for wildlife use but relatively nonproductive of this insect pest. (Photo by F. C. Schmid)

pounds to the acre, but only four pairs survived; survival time in the pens was approximately equal to birds fed 50 or 100 p.p.m. All four of the surviving hens produced eggs, and a total of 19 chicks was hatched from the two successful nests. Mortality rates and survival time for birds in pens treated with 0.25 pound to the acre were similar to those of quail fed diets containing 10 or 25 p.p.m. of heptachlor. Six of the 18 pairs lived and produced a total of 24 chicks from three successful nests. Five out of 10 pairs in the untreated pens survived and produced 21 chicks from three nests.

Pesticide residues in animal tissues.—Residues of DDT, heptachlor, dieldrin, or toxaphene were found in approximately 70 percent of the 590 specimens analyzed at Patuxent during 1962. Of the 26 bald eagles examined, 25 contained residues of DDT in amounts ranging from traces in one or more organs to concentrations comparable to those found in experimentally dosed birds which died of DDT poisoning. Three eagle eggs, taken from unsuccessful nests after abnormally long incubation periods, also contained relatively high concentrations of DDT.

Pesticide projects at the Denver Center.—Considerable progress was made in 1962 in acquiring and training new personnel, and in extending physical facilities for chemical and biological investigations in determination of pesticide effects on resident and migratory wildlife in western United States.

Added facilities include new chemical laboratory space and acquisition of a liquid scintillation spectrometer, permitting the use of radioactive pesticides containing carbon 14 for evaluating the accuracy of analytical methods in determining (1)



Type of impoundment developed by the Florida State Board of Health, under Bureau contract, that shows promise of controlling mosquitoes and serving the main needs of wintering waterfowl. (Photo by Florida State Board of Health)

the fate and distribution of various pesticides in the animal body, and (2) the isolation and identification of metabolites arising from physiological reactions in the animal, which bring about detoxification or elimination of these foreign substances. Techniques available and currently employed for biochemical research and pesticide residue determinations include thin-film chromatographic apparatus, together with infrared spectroscopy, gas chromatography, ultraviolet and visual spectroscopy, and paper chromatography.

The biological laboratory has been equipped with an Auto-technicon and the necessary facilities for preparing tissue sections for histological examination in detection of possible pathological changes resulting from exposure of wildlife to pesticide applications. This line of investigation is expected to prove invaluable in detecting, at an early stage, the development of adverse effects in various species due to pesticide action.

Surveillance was continued of large operational pesticide applications such as those for the control of spruce budworm in forests and grasshoppers on rangelands. Through the collection of prespray and postspray specimens of wildlife resident in the treated area, the accumulation and retention of pesticides acquired by various species was studied by chemical analyses of tissues.

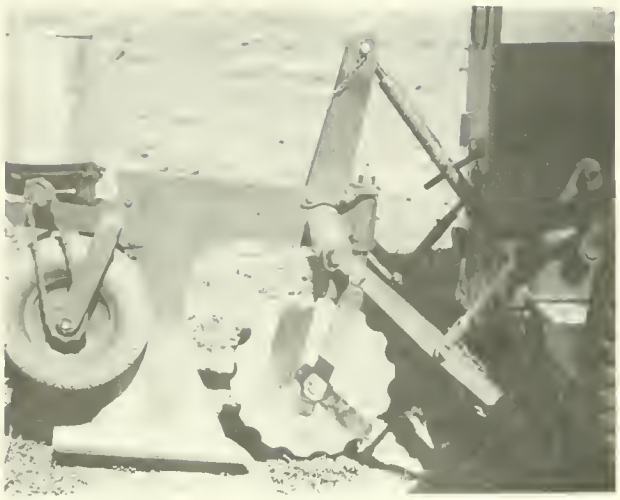
Knowledge of the problem of pesticide residues in nesting waterfowl in the Far North, and the apparent transfer of the pesticide to progeny through the egg, was extended by the collection and examination of additional specimens in the summer of 1962.

Studies of the effect of agricultural pest control on wildlife were pursued in the Klamath basin and on the Tule Lake Natural Wildlife Refuge in California. This is a situation where pesticides applied on agricultural lands are transported by irrigation water draining into a "sump irrigation system" where they are apparently concentrated, ultimately, in fish to a level where fish-eating birds acquire acute lethal amounts of poisons. Twenty-eight pelicans and 135 other fish-eating birds, considered pesticide casualties, were found dead on the Refuge in 1962. The solution of pesticide problems of this nature is difficult since it requires reduction of the toxic concentrations in pooling areas. This can be accomplished only by elimination or greatly reduced use of pesticides in the watershed, which may be inconsistent with the need for protecting croplands from pest damage.

Captive bald eagle, Petersburg, Alaska. This bird was one of an experimental group used to measure DDT accumulation in eagle's body tissue, an effort on part of the Bureau to learn if the increasing scarcity of the bird designated as the National Emblem of the United States is related to pesticidal contamination of eagle's food. (Photo by Paul A. Stewart)

A field study having the positive objective of evaluating a grasshopper-control insecticide having minimum hazard to wildlife was initiated at the Lostwood National Wildlife Refuge in North Dakota, in cooperation with the Plant Pest Control Division of the Agricultural Research Service and the Union Carbide Corporation. Two plots of 2,000 acres each were selected as an experimental and a control area. The experimental plot was sprayed by aircraft in July 1962 at the rate of 1 pound of the insecticide Sevin per acre. Careful surveillance of the two areas through October 1962 indicated little, if any, immediate harm to wildlife. Continued observation of these plots will be maintained in 1963 and, if indicated, in 1964 to determine possible chronic effects. This field investigation is adequately supported by chemical analyses of environmental and wildlife specimens collected at specified intervals.

Accomplishments in the chemical and biochemical area of research resulted in an improved ana-



Three models of the famous burrow-builder developed by the Denver Wildlife Research Center and Colorado State University, now being manufactured by commercial companies. (Top and bottom photos by A. Loren Ward, middle photo by the Colorado District, Predator and Rodent Control)

lytical method capable of detecting and measuring, in most field samples, 2 micrograms of Sevin in the pure compound. A study of the metabolites of DDT established the conversion of DDT in the animal body to DDD and other metabolites, some of which are as yet unreported in the literature.

WILDLIFE DISEASE AND PARASITES

Investigations in the field of diseases and parasites, particularly in migratory birds, is an important responsibility of the Bureau. Studies involving both birds and mammals at the Disease Laboratory at the Patuxent Center, and confined largely to diseases and parasites of waterfowl in the Denver Center program, were active in 1962. The latter were carried on mainly at the Bear River Station in Utah.

Botulism studies at Bear River.—The Bear River staff undertook a study concerned with the role of invertebrates in the transmission of botulinal toxin and the effects of invertebrate control on the incidence of botulism in waterfowl in 1962.

Botulism mortality on the Bear River National Wildlife Refuge was somewhat more severe in 1962 than in 1961 in spite of the smaller population of ducks, the peak of which was little more than half of that of the year before. Personnel on the Refuge estimated a loss of 3,240 birds of all species, as compared with 2,000 in 1961.

Aquatic invertebrate population studies were continued. Mud and water samples for invertebrate analyses were collected from the study area once a week at each of 60 collecting stations randomly distributed within a 2.9-square-mile plot. Only 747 sick and dead birds were picked up during the summer. Of these, 455 were collected on the the area proper. Mortality began at a low level in the fifth week of the investigation (July 16), when 5 sick or dead birds were taken. Losses gradually increased in severity until the thirteenth week (September 10), when a peak of 101 birds was reached. Judging from the mortality distribution, these figures do not represent a general increase in loss over the entire area, but rather the sum of a series of irregularly distributed miniature outbreaks that increased in frequency from the fifth to the thirteenth week.

For the second time in the past 4 years, an outbreak of botulism occurred in a flock of mallards maintained for experimental use at the Bear River Research Station. Again it appeared that the

source of toxin was living blowflies which, presumably, had become toxic by feeding on the carcasses of birds that had died from botulism.

In experiments with flies fed on suspensions of *Clostridium botulinum* cells of known toxicity, it was found that the oral administration to a duck of the ground tissue suspension of 1.5 flies could induce marked symptoms of botulinal intoxication. The susceptibility of individual birds varied but, in general, an increase in the dose of fly tissue increased the severity of the symptoms.

The results of two experiments suggested that the ingestion of type C toxin by blowflies enhances its toxicity for ducks. Study is under way to determine whether the toxin molecule is broken down into two or more toxic fragments by the digestive enzymes of the fly or the apparent enhancement represents only an accumulation of toxin in the fly's tissues. The experiments will be extended in order to learn whether a similar enhancement of toxicity occurs within the bodies of aquatic invertebrates.

Chemical method of controlling botulism.—Several attempts were made to produce "outbreaks" of botulism in experimental ducks confined within plastic rings on the marsh. Progress has been hampered by technical difficulties, particularly flooding of the ring by wind action.

The experimental data are still too few to support conclusions. In two tests, however, unprotected birds in the DDT-treated rings died, while their antitoxin-protected ring-mates remained healthy. None of the birds in the malathion-treated rings or the control rings were affected. Since the unprotected birds in the DDT-treated rings were found dead, a diagnosis of botulism could not be made; but there was no gross pathological evidence of other diseases. The fact that the unprotected birds in the malathion-treated rings were not affected may be a manifestation of the inhibitory effect of the pesticide on *Clostridium botulinum*, which has been demonstrated in the laboratory.

Disease studies at Patuxent.—A growing activity in diagnostic services of the disease laboratory at the Patuxent Wildlife Research Center was evident in 1962. Most calls were from U.S. Game Management Agents, Refuge personnel, and biologists of State game agencies. Diagnostic findings from specimens submitted provided opportunity to recognize some of the important wildlife disease problems in the country. Thus, assistance given to the State of North Dakota led to a diagnosis of hemorrhagic virus disease as the chief cause of a large dieoff in deer. Similar assistance to other States led to a diagnosis of botulism in ducks in Maryland and Michigan. Increasing evidence indicates that losses of waterfowl from this disease are not confined to western alkali lakes. Several deaths of waterfowl along the mid-Atlantic Coast in the spring of 1962 were attributed to aspergillosis, a common fungus infection of the respiratory system. The causative organism was also observed in a cowbird, and was the cause of losses in several captive herring gulls.

Study of reproductive tracts of doe white-tailed deer in Iowa has indicated breeding by most female fawns and a high productivity rate for the species on much of its Iowa range. (Photo by Iowa Cooperative Wildlife Research Unit)

Collaboration with biologists in a number of State game agencies provided data for a survey of the occurrence of trichomoniasis, a parasitic infection of the throat of mourning doves. Samples (throat swabs) from 3,098 birds from 22 States were collected from nestlings, flying young, and adults before and during the 1962 hunting season. Of the total, 7.6 percent were infected, and nestlings were more frequently infected than the adults. Very few of the birds in hunter's bags showed infection. The highest prevalence of the disease was in June and August, with 22.2 percent (the highest noted) of the August sample showing the disease. Trichomonads were present in all States adequately sampled. The infection is readily passed from parent to offspring in the normal process of feeding the young; thus, the nestlings of infected parents are usually diseased. A further cycle occurs in older birds, and biologists working on the problem hypothesize that contaminated food or water is the source of this

cycle of infection. Studies thus far conducted at the Patuxent Center, as well as observations and studies in the field, suggest strongly that contaminated concentration points used by doves may be important sources of infection. Most outbreaks appear to have arisen from such concentrations as backyard feeding sites and livestock feedlots, where the birds congregate in large numbers.

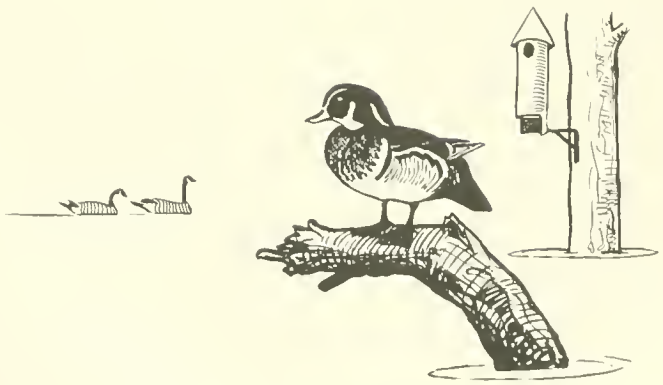
Waterfowl parasite publication.—A publication is being prepared which will treat in detail the parasite worms in waterfowl. This will be the only complete host-parasite catalog of the helminths for North American waterfowl. The release date is expected to be late in 1963.

During the calendar year 1962 a total of 101 publications by wildlife research personnel, exclusive of Unit Leaders, appeared in a wide variety of journals, bulletins, special scientific reports, and other media (appendix E). Publications by Unit personnel, including cooperative State coworkers and graduate students, numbered 135, of which 19 were on fisheries subjects.

Wildlife research 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 appearing in outside technical journals or in the transactions of scientific meetings are procured in limited numbers to facilitate the distribution of findings to conservation agencies and individuals having need for information on the specific topics involved. Most of the publications listed under the Cooperative Wildlife Research Units are available from the Unit responsible for the respective release.

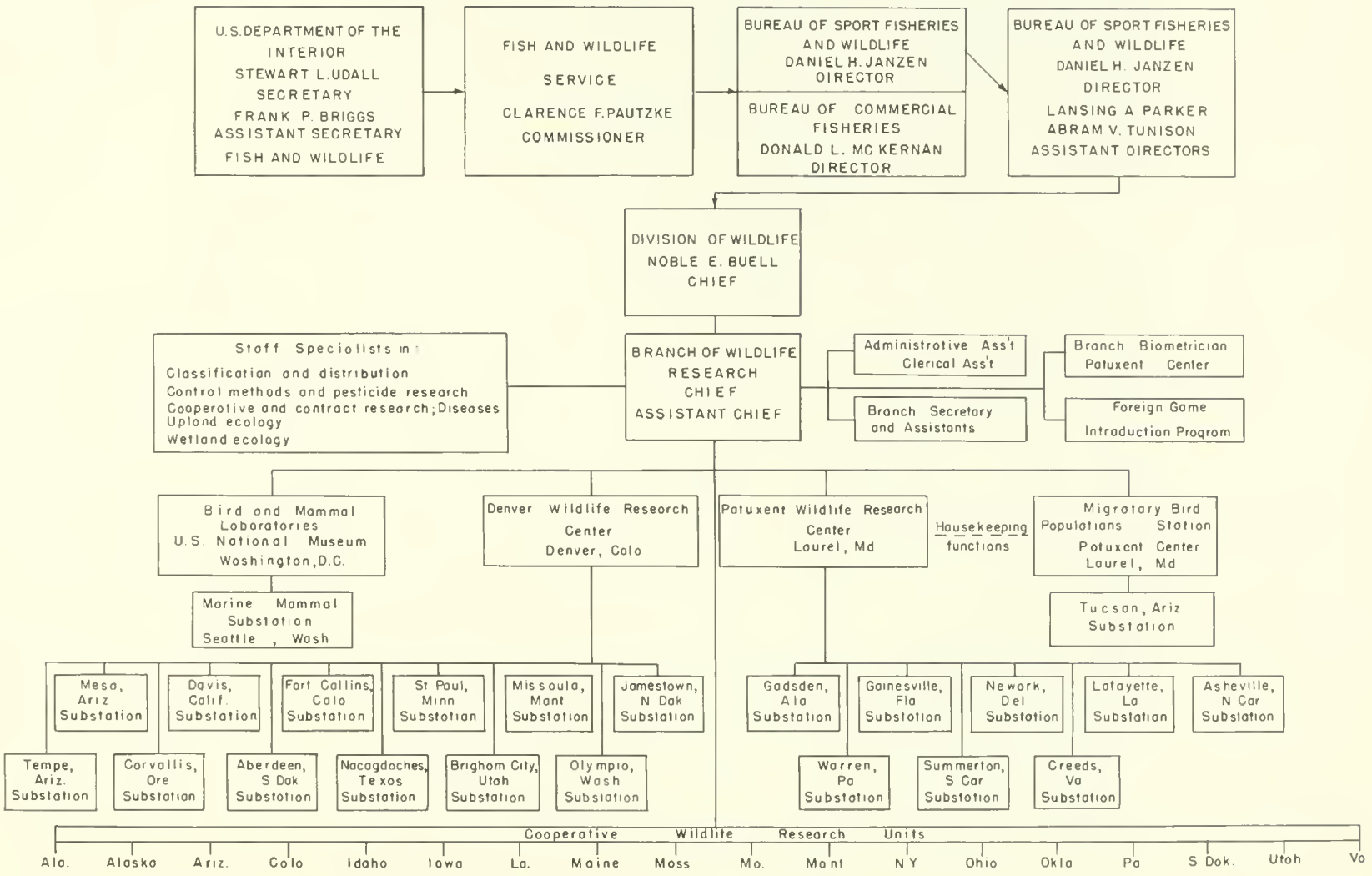
PUBLICATIONS

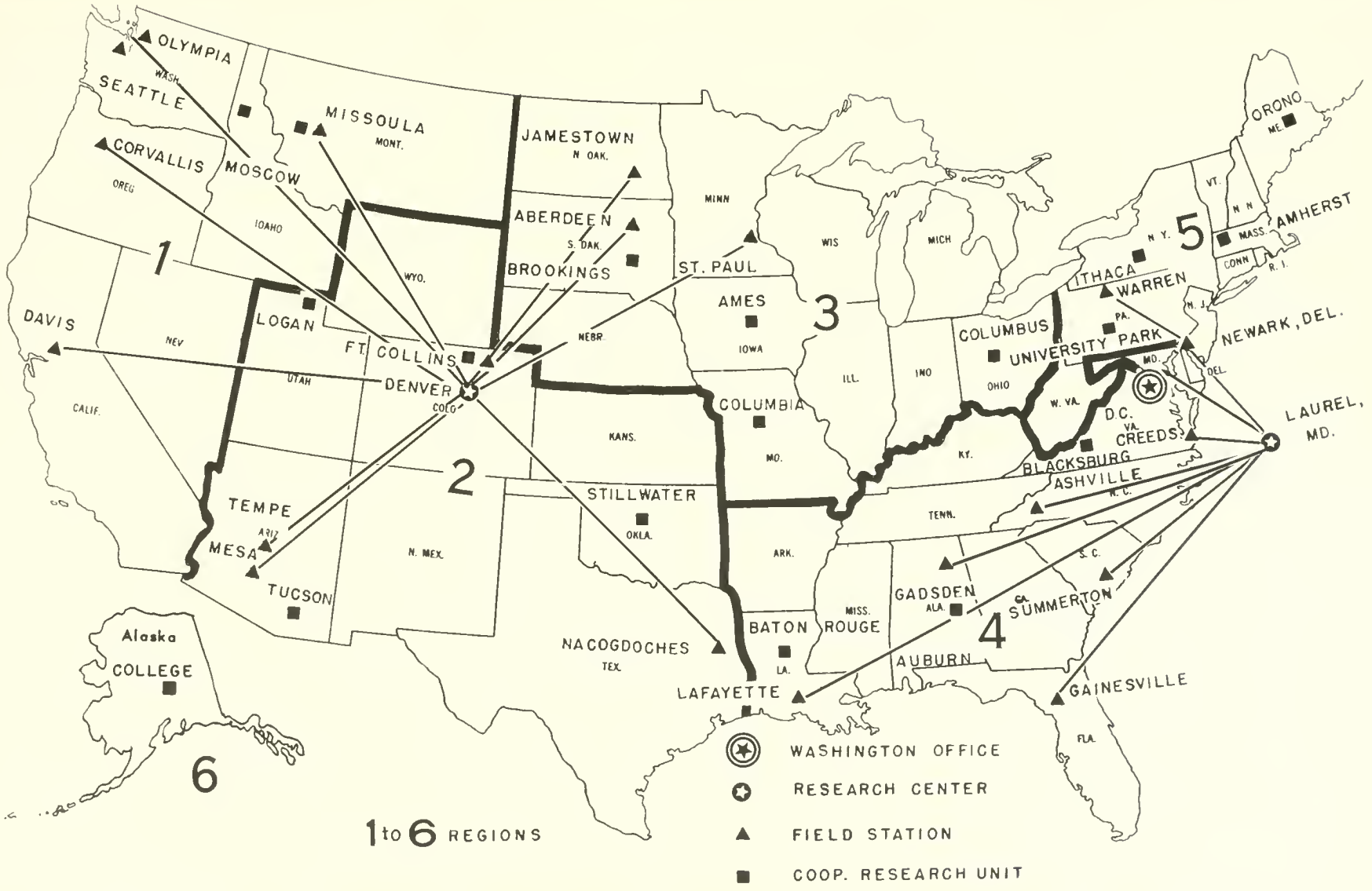
Wildlife Review, an abstracting service for the wildlife profession, has been published and distributed by the Bureau since 1935. In 1961, authority was received to increase to 5,000 the number of each issue, and arrangements were made to have the printing done quarterly by the Government Printing Office. A total of 366 libraries in the United States, Canada, and foreign countries served as repositories for Wildlife Review in 1962.



Afield, in the out-of-doors; away from tension, drive, Main Avenue, smog. Woods, waters, fish, wildlife—outdoor living, recreation—give surcease to 100 million urban dwellers, a richer life to the rural living; re-creation for the American people. (Photo by Daniel H. Chapman)

Appendix A -- Organization Chart of the Branch of Wildlife Research





Appendix B—HEADQUARTERS, RESEARCH CENTERS, AND SUBSTATIONS, BRANCH OF WILDLIFE RESEARCH, 1963

Appendix C—FUNDS AVAILABLE

Appropriated Funds	*Budget subactivity for fiscal year 1961*	*1962*	*1963*
Waterfowl management	$322,000	$439,000	$543,000
Other migratory bird studies	259,300	314,000	322,000
Upland wildlife	156,000	199,000	207,000
Pesticide-wildlife research	371,000	423,000	548,000
Diseases and parasites	146,500	167,000	172,000
Control methods research	358,000	393,000	660,000
Classification, distribution, and life history	144,000	144,000	148,000
Cooperative Wildlife Research Units	186,500	221,000	254,000
Total, research projects	1,943,300	2,300,000	2,854,000
Management of Patuxent Wildlife Research Center	89,000	157,000	157,000
Foreign game introduction program	52,940	53,000	53,800
Construction	700,000	120,000	509,000
Total	2,785,240	2,630,000	3,573,800
Funds From Other Sources			
Federal Aviation Agency	100,000	200,000	200,000
Army Corps of Engineers	12,000	13,750	11,600
Private contributions	9,400	2,100	
Quartermaster General	17,000	15,000	20,000
Bureau of Land Management	4,000	4,000	4,000
U.S. Forest Service	5,000	5,000	5,000
Grand total	2,932,640	2,869,850	3,814,400

Appendix D—OFFICES AND ADDRESSES OF THE BRANCH OF WILDLIFE RESEARCH

Central Office

Leedy, Dr. Daniel L.[1]	Chief of Branch	Department of the Interior
Carlson, C. Edward	Asst. Chief of Branch	Washington 25, D.C.

Bird and Mammal Laboratories—U.S. National Museum

Manville, Dr. Richard H	Director of Laboratories	U.S. National Museum 10th and Constitution Ave. Washington, D.C.

Foreign Game Introduction Program

Bump, Dr. Gardiner	Biologist-in-Charge	Interior Building

Cooperative Wildlife Research Units

Dustman, Dr. Eugene H	Head	Interior Building
Baker, Dr. Maurice F	Leader	Alabama Cooperative Wildlife Research Unit Auburn University Auburn, Ala.
Baskett, Dr. Thomas S	Leader	Missouri Cooperative Wildlife Research Unit University of Missouri Columbia, Mo.
Craighead, Dr. John L	Leader	Montana Cooperative Wildlife Research Unit Montana State University Missoula, Mont.
Dalke, Dr. Paul D	Leader	Idaho Cooperative Wildlife Reasearch Unit University of Idaho Moscow, Idaho
Haugen, Dr. Arnold O	Leader	Iowa Cooperative Wildlife Reasereh Unit Iowa State University Ames, Iowa
Klein, Dr. David R	Leader	Alaska Cooperative Wildlife Research Unit University of Alaska College, Alaska
Lindzey, Dr. James S	Leader	Pennsylvania Cooperative Wildlife Research Unit Forestry Building Pennsylvania State Univ. University Park, Pa.
Low, Dr. Jessop B	Leader	Utah Cooperative Wildlife Research Unit Utah State University Logan, Utah

[1] Dr. Leedy was promoted and transferred to the Bureau of Outdoor Recreation of the Department of the Interior, effective April 28, 1963. His successor as Chief of the Branch of Wildlife Rearch is C. Edward Carlson, formerly Assistant Chief. The Branch's Central Office address remains the same

McGinnes, Dr. Burd S	Leader	Virginia Cooperative Wildlife Research Unit Va. Polytechnic Institute Blacksburg, Va.
Mendall, Mr. Howard L	Leader	Maine Cooperative Wildlife Research Unit University of Maine Orono, Maine
Newsom, Mr. John D	Leader	Louisiana Cooperative Wildlife Research Unit School of Forestry La. State University Baton Rouge, La.
Peterle, Dr. Tony J	Leader	Ohio Cooperative Wildlife Research Unit The Ohio State University 1735 Neil Avenue Columbus, Ohio
Springer, Dr. Paul F	Leader	South Dakota Cooperative Wildlife Research Unit S. D. State College College Station, Brookings, S. Dak.
Sheldon, Dr. William G	Leader	Massachusetts Cooperative Wildlife Research Unit University of Massachusetts Amherst, Mass.
Sowls, Dr. Lyle K	Leader	Arizona Cooperative Wildlife Research Unit University of Arizona Tucson, Ariz.
Stebler, Dr. Adolph M	Leader	Oklahoma Cooperative Wildlife Research Unit Oklahoma State University 408 Life Science Building Stillwater, Okla.
Thompson, Dr. Daniel Q	Leader	New York Cooperative Wildlife Research Unit Fernow Hall Cornell University Ithaca, N.Y.
Yeager, Dr. Lee E.	Leader	Colorado Cooperative Wildlife Research Unit Colorado State University 243 Forestry Building Fort Collins, Colo.

Patuxent Wildlife Research Center

Buckley, Dr. John L	Director	Laurel, Md.

Field Stations

Lynch, John J	Biologist	Box 477 University of Southwestern Louisiana Lafayette, La.

Spencer, Henry J	Biologist	508 S.W. 2d Avenue (P.O. Box 131) Gainesville, Fla.
Johnson, Frank M	Biologist	c/o Southeast Forest Experiment Station U.S. Forest Service Asheville, N.C.
Linehan, John T	Biologist	Agricultural Building University of Delaware Newark, Del.
Rosene, Walter, Jr	Biologist	Room 304–5 Post Office Building Gadsden, Ala.
Sharp, Dr. Ward M	Biologist	P.O. Box 809 Northeast Forest Experiment Station U.S. Forest Service Warren, Pa.

Migratory Bird Populations Station

Crissey, Walter F	Director	Laurel, Md.
Geis, Dr. Aelred D	Assistant Director	

Field Stations

Blankenship, Dr. Lytle H	Biologist	Arizona Cooperative Wildlife Research Unit University of Arizona Tucson, Ariz.

Denver Wildlife Research Center

Williams, Cecil S	Director	Building 45 Denver Federal Center Denver, Colo.
Welch, Jack F	Assistant Director	

Field Stations

Jensen, Wayne I	Bacteriologist	P.O. Box 603 Bear River Migratory Bird Refuge Brigham City, Utah
Stoudt, Jerome H	Biologist	Van Slyke Building 116½ South Main Street Aberdeen, S. Dak.
Dodge, Dr. Wendell E	Biologist	210 East Union Avenue Olympia,Wash.
Evans, James	Biologist	Nutria Control Station Houma, Tex.
Goodrum, Phil D	Biologist	814 Sarah Ann Street Nacogdoches, Tex.
Gashwiler, Jay S	Biologist	323 Extension Hall Oregon State College Corvallis, Oreg.
Halvorson, Curtis H	Biologist	c/o Forest Experiment Station Federal Building Missoula, Mont.
Zajanc, Adolph	Biologist	Field Station Administration University of California Davis, Calif.

Krefting, Laurits W.	Biologist	204 Green Hall University of Minnesota St. Paul, Minn.
Reid, Vincent H.	Biologist	206 Forestry Building Colorado State University Ft. Collins, Colo.
Royall, Willis C., Jr.	Biologist	P. O. Box 1006 Mesa, Ariz.
Stewart, Robert E.	Biologist	118 3d Avenue, NE. Jamestown, N. Dak.
Webb, Edward L.	Biologist	Arizona State University Tempe, Ariz.

Appendix E—LIST OF PUBLICATIONS, JANUARY 1–DECEMBER 31, 1962

[*Authors affiliated with two or more stations; publications listed under the affiliations of each author]

Central Office

*Bureau of Sport Fisheries and Wildlife.
1962. Wildlife research progress, 1962. Branch of Wildlife Research. Circular 146, 50 pp. (processed).
1962. Effects of pesticides on fish and wildlife: A review of investigations during 1960. Circular 143, 52 pp. (processed).

Dale, Fred A.
1962. (Review of) Speak to the earth, by William A. Breyfogle. Atlantic Naturalist, vol. 17, no. 1, p. 73.
1962. (Review of) Introduction to the study of animal populations, by H. G. Andrewartha. Atlantic Naturalist, vol. 17, no. 2, p. 149–150.
1962. (Review of) Birth of a national park in the Great Smoky Mountains, by Carlos C. Campbell. Atlantic Naturalist, vol. 17, no. 4, p. 284.

Dykstra, Walter W.
1962. Commensal rodents. Proceedings of the National Pest Control Association. California Vertebrate Pest Control Technical Committee, Sacramento. p. 245–250.
1962. Searching for new chemicals—Coordination of effort. *In* Foreign Pest Conditions in Western North America, 1962. Annual Meeting of the Western Forest Pest Committee of the Western Forestry and Conservation Association, Portland, Oreg., December 11, 1962. p. 23–24.

George, John L.
1962. (Review of) Our synthetic environment, by Lewis Herber. Atlantic Naturalist, vol. 17, no. 4, p. 281–282.

Leedy, Daniel L.
1962. A look at the future. Journal of Forestry, vol. 60, no. 1, p. 47–49.

Bird and Mammal Laboratories, U.S. National Museum

Bureau of Sport Fisheries and Wildlife.
1962. Fur catch in the United States, 1961. Wildlife Leaflet No. 444, 3 p. (processed)
1962. Big game inventory for 1961. Wildlife Leaflet No. 446, 4 p. (processed)

Burleigh, Thomas D.
1962. Recent records of interest from northern Virginia. Raven, vol. 33, no. 2, p. 3–6.

Kenyon, Karl W.
1962. History of the Steller sea lion at the Pribilof Islands, Alaska. Journal of Mammalogy, vol. 43, no. 1, p. 68–75.
1962. Notes on phocid seals at Little Diomede Island, Alaska. Journal of Wildlife Management, vol. 26, no. 3, p. 380–387.

Kenyon, Karl W., and Victor B. Scheffer.
1962. Wildlife surveys along the northwest coast of Washington. Murrelet, vol. 42, no. 1, p. 29–37.
Manville, Richard H.
1962. Policy in issuing bat bands. Bat Banding News, vol. 3, no. 4, p. 28–29.
1962. A plea for bat conservation. Journal of Mammalogy, vol. 43, no. 4, p. 571.
1962. Specialized mammalian terminology. Turtox News, vol. 40, no. 10, p. 242–247.
1962. The nutria in the United States. Bureau of Sport Fisheries and Wildlife, Wildlife Leaflet No. 445, 4 p. (processed)
1962. (Review of) Discovery—Great moments in the lives of outstanding naturalists, edited by J. K. Terres. Lippincott, 1961. Journal of Mammalogy, vol. 43, no. 1, p. 115–116.
1962. (Review of) The world of animals, by J. W. Krutch. Simon & Schuster, 1961. Atlantic Naturalist, vol. 17, no. 3, p. 206–207.
1962. (Review of) Animals as social beings, by A. Portmann. Viking, 1961. Atlantic Naturalist, vol. 17, no. 3, p. 200.
Paradiso, John L.
1962. (Review of) The elephants, by G. Blond. MacMillan, 1961. Atlantic Naturalist, vol. 17, no. 1, p. 69–70.
Rice, Dale W., and Karl W. Kenyon.
1962. Breeding distribution, history and populations of North Pacific albatrosses. Auk, vol. 79, no. 3, p. 365–386.
1962. Breeding cycles and behavior of Laysan and black-footed albatrosses. Auk, vol. 79, no. 4, p. 517–567.
Rochstein, M., L. C. Cole, R. H. Manville, and L. S. Grandall.
1962. Life spans: mammals. p. 445–450. *In* Growth, including reproduction and morphological development, edited by P. L. Altman and D. S. Dittmer. Biological Handbook No. 2, Federation of American Societies for Experimental Biology, Washington, D.C.
Shaw, James H.
1962. The bushy-tailed wood rat in southeastern Alaska. Journal of Mammalogy, vol. 43, no. 3, p. 431–432.

Patuxent Wildlife Research Center

Buckley, John L.
1962. Future demands for wildlife and fishing. *In* The Challenge of Forestry. A compilation on the Addresses and Technical Papers Presented on the Occasion of the 50th Anniversary Celebration of the State University College of Forestry at Syracuse University, April 12–14, 1961, p. 76–87.
Bureau of Sport Fisheries and Wildlife.
1962. Indian backgrounds of the Patuxent Wildlife Research Center. Circular 138. (8 p.)
*Bureau of Sport Fisheries and Wildlife.
1962. Effects of pesticides on fish and wildlife: A review of investigations during 1960. Circular 143, 52 p. (processed).
Clark, Gordon M., and Louis N. Locke.
1962. Observations of pseudotuberculosis in common grackles. Avian Diseases, vol. 6, no. 4, p. 506–510.
DeWitt, James B., and John L. Buckley.
1962. Interim report—Studies on pesticide-eagle relationships. Audubon Field Notes, vol. 16, no. 6, p. 541.
Fankhauser, Don P.
1962. Observations of birds feeding on overwintering corn borer. Wilson Bulletin, vol. 74, no. 2, p. 191.
Hansen, Martin J., and Don W. Hayne.
1962. Sea lamprey larvae in Ogontz Bay and Ogontz River, Michigan. Journal of Wildlife Management, vol. 26, no. 3, p. 237–247.
Herman, Carlton M.
1962. The role of birds in the epizootiology of eastern encephalitis. Auk, vol. 79, no. 1, p. 99–103.
1962. Some aspects of the diagnosis of disease in wildlife. Sixty-fifth Annual Proceedings of the U.S. Livestock Sanitary Association, Minneapolis, Minnesota, October, 1961, p. 512–517.
1962. Introductory remarks: Proceedings of the First National White-tailed Deer Disease Symposium, University of Georgia, Athens, Ga., 1962, p. viii–x.
Herman, Carlton M., and J. I. Bruce, Jr.
1962. Occurrence of *Trypanosoma cruzi* in Maryland. Proceedings of the Helminthological Society of Washington, vol. 29, no. 1, p. 55–58.
Herman, Carlton M., Louis N. Locke, and Gordon M. Clark.
1962. Foot abnormalities of wild birds. Bird Banding, vol. 33, no. 4, p. 191–198.
Jacobs, L., Anastasia M. Stanley, and Carlton M. Herman.
1962. Prevalence of Toxoplasma antibodies in rabbits, squirrels, and raccoons collected in and near the Patuxent Wildlife Research Center. Journal of Parasitology, vol. 48, no. 4, p. 550.
Johnson, Frank M.
1962. Flowering dogwood, *Cornus florida* L. Deer browse plants of the southern forests, p. 16–17. U.S. Forest Service, Southern and Southeastern Forest Experiment Stations, New Orleans, La., and Asheville, N.C.
Johnson, Frank M., James S. Lindzey, and Thomas H. Ripley.
1962. Recent developments and needs in game and game habitat research in connection with pine site preparation. Proceedings of the Fifteenth Annual Conference of the Southeastern Association of Game and Fish Commissioners, Atlanta, Ga., October 22–25, 1961, p. 27–29.
Locke, Louis N., and Pauline James.
1962. Trichomonad canker in the Inca dove. Journal of Parasitology, vol. 48, no. 3, p. 497.
Locke, Louis N., J. E. Scanlon, R. J. Byrne, and J. O. Knisley, Jr.
1962. Occurrence of eastern encephalitis virus in house sparrows. Wilson Bulletin, vol. 74, no. 3, p. 263–266.
McGilvrey, Frank B., and John H. Steenis.
1961. Granular silvex used for control of alligatorweed in South Carolina. Abstracts, Weed Society of America, p. 65–66.

MEANLEY, BROOKE.
1962. Pellet casting by king and clapper rails. Auk, vol. 79, no. 1, p. 113.
1962. Feeding behavior of the red-winged blackbird in the Dismal Swamp region in Virginia. Wilson Bulletin, vol. 74, no. 1, p. 91–93.

MEANLEY, BROOKE, JOHN S. WEBB, AND DON P. FANKHAUSER.
1962. Cooperative redwing banding program. EBBA News, vol. 25, no. 2, p. 47–48.

MEANLEY, BROOKE, JOHN S. WEBB, DON P. FANKHAUSER, AND ROBERT T. MITCHELL.
1962. The blackbird banding program of the Patuxent Wildlife Research Center. EBBA News, vol. 25, no. 3, p. 117–121.

*MEANLEY, BROOKE, AND DAVID K. WETHERBEE.
1962. Ecological notes on mixed populations of king rails and clapper rails in Delaware Bay marshes. Auk, vol. 79, no. 2, p. 453–457.

MENZIE, CALVIN M., VYTO A. ADOMAITIS, AND WILLIAM L. REICHEL.
1962. Determination of 2-isovaleryl-1, 3-indandione with 2, 4-dinitrophenylhydrazine. Analytical Chemistry, vol. 34, no. 4, p. 516–518.

ROSENE, WALTER, JR., PAUL A. STEWART, AND VYTO A. ADOMAITIS.
1962. Residues of heptachlor epoxide in wild animals. Proceedings Fifteenth Annual Conference of the Southeastern Association of Game and Fish Commissioners, October 22–26, 1961, p. 107–113.

SAUNDERS, GEORGE B., AND EUGENIE CLARK.
1962. Yellow-billed cuckoo in stomach of tiger shark. Auk, vol. 79, no. 1, p. 118.

SPRINGER, PAUL F.
1962. Recent developments in the use of pesticides, interests of fish and wildlife agencies. Summary of the Fourth Biennial Public Health Vector Control Conference, p. 91–94.

SPRINGER, PAUL F., ROBERT L. VANNOTE, K. D. QUARTERMAN, A. W. LINDQUIST, E. A. SEAMAN, and I. N. GABRIELSON.
1962. Report of the National Mosquito Control-Fish and Wildlife Management Coordination Committee for 1961. Proceedings and Papers of the Thirteenth Annual Conference of the California Mosquito Control Association, Inc., p. 19–20. Proceedings Fifteenth Annual Meetings of the Utah Mosquito Abatement Association, p. 21–22.

STEENIS, JOHN H., VERNON D. STOTTS, and CHARLES GILLETTE.
1962. Observations on distribution and control of Eurasian watermilfoil in Chesapeake Bay, 1961. Proceedings of the Northeastern Weed Control Conference, vol. 16, p. 142–148.

STEWART, PAUL A.
1962. Nesting attentiveness and incubation period of a wood duck. Bird-Banding, vol. 33, no. 2, p. 85–89.
1962. Like corn in a popper—wood ducks leaving the nest. Das Tier, vol. 2, no. 6, p. 4–7. (Translated into German and reprinted from Animal Kingdom, vol. 64, no. 6, p. 178–183.)

STICKLEY, ALLEN R.
1962. A black bear tagging study in Virginia. Proceedings of the Fifteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, October 22–26, 1961, p. 43–54.

Migratory Bird Populations Station (Patuxent Wildlife Research Center)

Wildlife publications

WIGHT, HOWARD M.
1962. Mourning dove status report—1962. Bureau of Sport Fisheries and Wildlife, Special Scientific Report: Wildlife No. 70, 33 p.

BUREAU OF SPORT FISHERIES AND WILDLIFE.
1962. Abstracts of mourning dove literature. Circular 136, 153 p. (processed)

MARTIN, FANT W.
1962. Woodcock status report—1962. Bureau of Sport Fisheries and Wildlife, Special Scientific Report: Wildlife No. 69, 36 p.

ROBBINS, CHANDLER S.
1962. (Obituary and Bibliography of) Seth Haskell Low, Ornithologist, Bander, Conservationist. Maryland Birdlife, vol. 18, no. 3, p. 55–61.
1962. The season—October, November, December, 1961. Maryland Birdlife vol. 18, no. 1, p. 9–15.
1962. The season—January, February, March 1962. Maryland Birdlife, vol. 18, no. 2, p. 40–43.
1962. The season—April, May, June, 1962. Maryland Birdlife, vol. 18, no. 3, p. 72–81.
1962. The season—July, August, September, 1962. Maryland Birdlife, vol. 18, no. 4, p. 101–108.

Administrative reports (In numerical order)

SMITH, ROBERT I., and AELRED D. GEIS.
1962. Comparison of black duck recovery and annual mortality rates. Administrative Report No. 1, Migratory Bird Populations Station, 15 p.

GEIS, AELRED D., and ROBERT I. SMITH.
1962. Black duck recovery rates in relation to hunting regulations. Administrative Report No. 2, Migratory Bird Populations Station, 10 p.

SMITH, ROBERT I., and AELRED D. GEIS.
1962. Contributions of various summer and winter black duck populations to the black duck harvest in New England. Administrative Report No. 3, Migratory Bird Populations Station, 13 p.

CRISSEY, WALTER F.
1962. Duck breeding population trends by species, 1954–62. Administrative Report No. 4, Migratory Bird Populations Station, 8 p.

CARNEY, SAMUEL M.
1962. Comparison of the size of 1960 and 1961 duck kill in the Atlantic and Mississippi flyways as reflected by response rates to the duck wing collection survey. Administrative Report No. 5, Migratory Bird Populations Station, 5 p.

Goddard, Stephen V., Robert P. Murphy, and Aelred D. Geis.
1962. Estimated effect that different regulations would have had on the waterfowl kill in Minnesota, Arkansas, and Louisiana during the 1960–61 season. Administrative Report No. 6, Migratory Bird Populations Station, 8 p.

Godin, Alfred J., and Aelred D. Geis.
1962. Estimated decreases in duck kill expected with reduction in daily bag limit. Administrative Report No. 7, Migratory Bird Populations Station, 5 p.

Carney, Samuel M., and Alfred J. Godin.
1962. Age ratios of ducks killed during the 1959–60, 1960–61, and 1961–62 hunting seasons. Administrative Report No. 8, Migratory Bird Populations Station, 8 p.

Carney, Samuel M., and Alfred J. Godin.
1962. Differences between the 1961–62 and 1960–61 species composition of the kill in the Atlantic and Mississippi flyways. Administrative Report No. 9, Migratory Bird Populations Station, 6 p.
1962. Mallard sex ratios in the 1960–61 and 1961–62 hunting kill. Administrative Report No. 10, Migratory Bird Populations Station, 4 p.

Geis, Aelred D., and Robert I. Smith.
1962. Geographic and chronologic distribution of the redhead, canvasback, ringneck duck, and scaup hunting kill. Administrative Report No. 11, Migratory Bird Populations Station, 27 p.

Smith, Robert I., and Aelred D. Geis.
1962. Summary of recovery rates from 1961 pre-season bandings of mallards and black ducks. Administrative Report No. 12, Migratory Bird Populations Station, 12 p.

Geis, Aelred D., Charles F. Kaczynski, and Robert P. Shanahan.
1962. The distance hunters travel to hunt. Administrative Report No. 13, Migratory Bird Populations Station, 11 p.

Denver Wildlife Research Center

Crabtree, D. Glen.
1962. Review of current vertebrate pesticides. Proceedings of the Vertebrate Pest Control Conference, Sacramento, Calif. Duplicated report of National Pest Control Association, Elizabeth, N.J., p. 327–362.

Faulkner, Clarence E., and Wendell E. Dodge.
1962. Control of the porcupine in New England. Journal of Forestry, vol. 60, no. 1, p. 36–37.

Gashwiler, Jay S.
1961. Notes on the harlequin duck. Murrelet, vol. 42, no. 1, p. 4–5.

Goodrum, Phil D.
1961. Greenbriers, *Smilax* spp. Deer browse plants of southern forests, p. 62–67. Redbay, *Persea borbonia (ibid).*, p. 46–47. U.S. Forest Service, South and Southeast Forest Experiment Stations, New Orleans La., and Asheville, N.C.

Goodrum, Phil D., and Lowell K. Halls.
1961. Fringtree, *Chionanthus virginicus*. Deer browse plants of the southern forests, p. 10–11. U.S. Forest Service, South and Southeast Forest Experiment Stations, New Orleans, La., and Asheville, N.C.

Goodrum, Phil D., and Vincent H. Reid.
1962. Browsing habits of white-tailed deer in the western Gulf region. Proceedings of First National White-tailed Deer Disease Symposium, University of Georgia, Athens, 1962. p. 9–14.

Halls, Lowell K., and Phil D. Goodrum.
1961. Japanese honeysuckle, *Lonicera Japonica*. Deer browse plants of the southern forests, p. 38–39. U.S. Forest Service, South and Southeast Forest Experiment Stations, New Orleans, La., and Asheville, N.C.

Harris, Van T., and Fred Webert.
1962. Nutria feeding activity and its effect on marsh vegetation in southwestern Louisiana. Special Scientific Report : Wildlife No. 64, 51 p.

Keith, James O.
1961. An efficient and economical pocket gopher enclosure. Journal of Range Management, vol. 14, no. 6, p. 332–334.

Kreeting, L. W.
1962. Use of silvicultural techniques for improving deer habitat in the Lake States. Journal of Forestry, vol. 60, no. 1, p. 40–42.

Kreeting, L. W., J. H. Stoeckler, B. J. Bradle, and W. D. Fitzwater.
1962. Porcupine timber relationships in the Lake States. Journal of Forestry, vol. 60, no. 5, p. 325–330.

Robinson, Weldon B.
1962. Methods of controlling coyotes, bobcats and foxes. Proceedings of the Vertebrate Pest Control Conference, Sacramento, Calif. Duplicated report of National Pest Control Association, Elizabeth, N.J., p. 32–56.

Royall, W. C., Jr.
1962. Birds' deportment subject of study. Progressive Agriculture in Arizona, vol. 14, no. 3, p. 3.
1962. Starlings do damage to crops in Arizona. Progressive Agriculture in Arizona, vol. 14, no. 3, p. 14–15.

Royall, W. C., Jr., and E. R. Ferguson.
1962. Controlling bird and mammal damage in direct seeding loblolly pine in east Texas. Journal of Forestry, vol. 60, no. 1, p. 37–39.

Spencer, Albert W.
1962. A device for holding and spreading bird bands. Bird-Branding, vol. 33, no. 2, p. 96–97.

Spencer, Albert W., and John W. DeGrazio.
1962. Capturing blackbirds and starlings in marsh roosts with dip nets. Bird-Banding, vol. 33, no. 1, p. 42–43.

Spencer, Donald A.
1962. Chemical controls as a management measure. Journal of Forestry, vol. 60, no. 1, p. 28–30.

Tigner, James R., and Jerome F. Besser.
1962. Repellents for protection of young forest trees from rabbit and rodent damage. Tree Planters Notes, No. 51, p. 1–3.

Tigner, James R., and Jerome F. Besser.

1962. A quantitative method for evaluating chemicals as rodent repellents on packaging materials. Journal of Agriculture and Food Chemistry, vol. 10, no. 6, p. 484–486.

Ward, Lorin, and Richard M. Hansen.

1962. Pocket gopher control with the burrow-builder in forest nurseries and plantations. Journal of Forestry, vol. 60, no. 1, p. 42–44.

Zajanc, Adolph.

1962. Methods of controlling starlings and blackbirds. Proceedings Vertebrate Pest Control Conference, Sacramento, Calif. Duplicated report of National Pest Control Association, Elizabeth, N.J. p. 190–212.

1962. A cage trap for starlings. University of California, Agricultural Extension Service, OSA No. 129. 2 p.

Cooperative Wildlife Research Units

ALABAMA

Wildlife publications

Baker, M. F., Gloria J. Dills, and F. A. Hayes.

1962. Further experimental studies of brucellosis in white-tailed deer. Journal of Wildlife Management, vol. 26, no. 1, p. 27–31.

Speake, D. W.

1961. Common sweetleaf, *Symplocus tinctoria* (L) L'Her. Deer browse plants of southern forests, p. 68–69. U.S. Forest Service, Southern and Southeast Forest Experiment Stations, New Orleans, La., and Asheville, N.C.

ALASKA

Wildlife publication

Klein, D. R.

1962. Rumen contents analysis as an index to range quality. Transaction of the North American Wildlife and Natural Resources Conference, vol. 27, p. 150–162.

ARIZONA

Wildlife publications

Hungerford, C. R.

1962. Adaptations shown in selection of food by Gambel quail. Condor, vol. 64, no. 3, p. 213–219.

Kirkpatrick, R. D., and L. K. Sowls.

1962. Age determination of the collared peccary by the tooth replacement pattern. Journal of Wildlife Management, vol. 26, no. 2, p. 214–217.

Fishery publication

McConnell, William J.

1962. Productivity relations in carboy microcosms. Limnology and Oceanography, vol. 7, no. 3, p. 335–343.

COLORADO

Wildlife publications

Dietz, Donald R., R. H. Udall, and Lee E. Yeager.

1962. Differential digestibility of nutrients in bitterbrush, mountain mahogany, and big sagebrush by deer. Proceedings of the First National White-tailed Deer Disease Symposium, University of Georgia Press, Athens. p. 39–50.

1962. Chemical composition and digestibility by mule deer of selected forage species, Cache la Poudre range, Colorado. Colorado Game and Fish Department, Technical Bulletin 14, 89 pp.

Dills, R. E., and J. V. K. Wagar.

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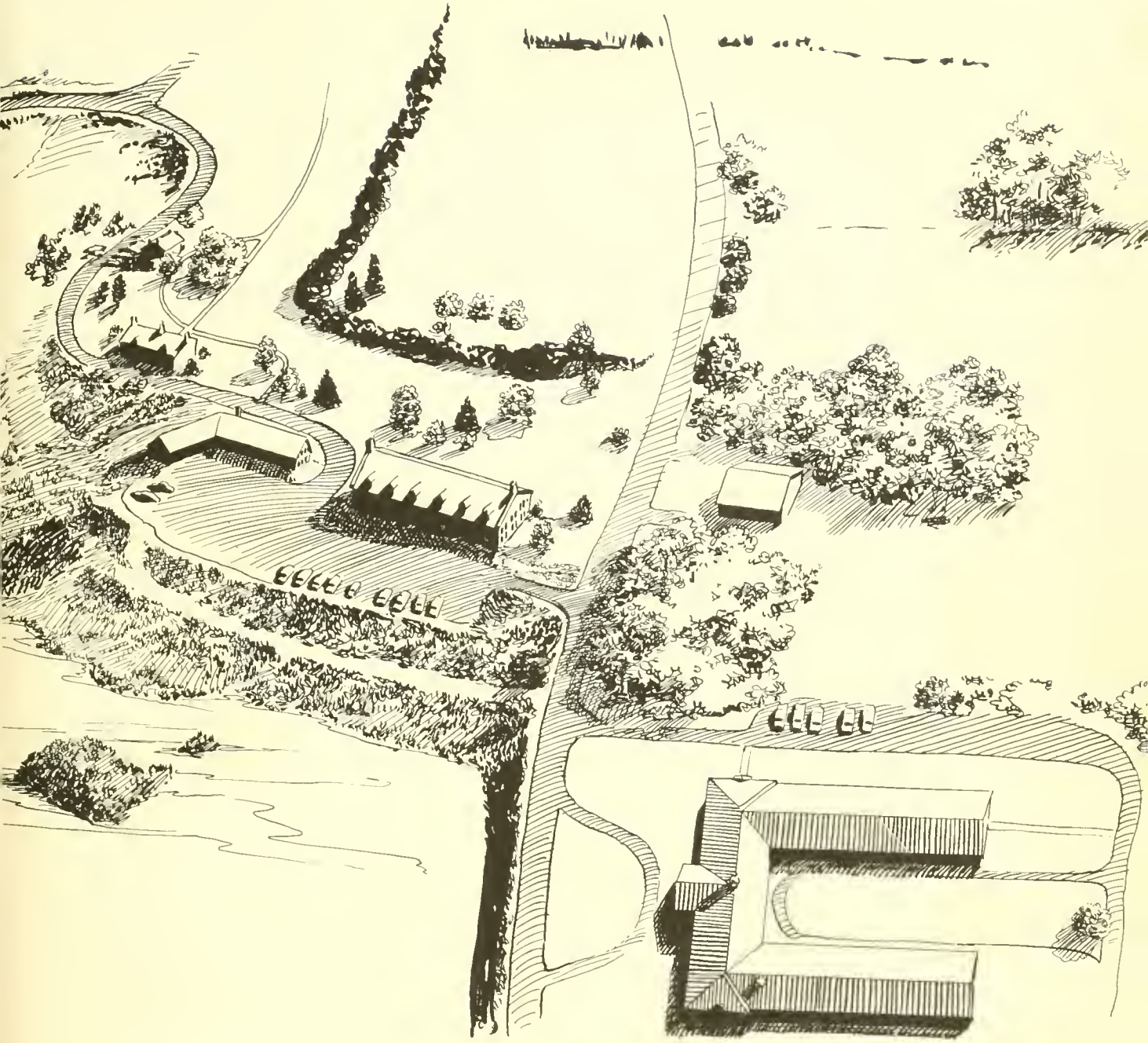
U.S. GOVERNMENT PRINTING OFFICE, 1963 O—689-962



Headquarters, Patuxent Wildlife Research Center showing general ground plan. The new Biochemistry and Wildlife Pathology Laboratory is at the lower right.

RESEARCH

THE

KEY

TO

PROGRESS

RESEARCH

HELPS TO PRODUCE

AND

MAINTAIN

OUTDOOR

RECREATIONAL

OPPORTUNITIES