

BIRD BANDING IN AMERICA

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[With 9 plates]

INTRODUCTION

The progress of our knowledge of birds necessarily involves a continued examination of concentrations of material and data brought together through the application of various methods, each of which furnishes definite contributions to the science of ornithology. Viewed in perspective, the splendid achievements of ornithologists during the past 75 years can not fail to impress the most critical reviewer with their magnitude and scope. This period witnessed the appearance of the modern standard works based upon original researches, which when passed in review are found to be as diversified as they are numerous. Explorations, critical reviews, monographs, and studies on migration and other phases of the life histories of birds have all received attention.

It is with the two last subjects that the present paper is chiefly concerned because of the new and pertinent facts that are being brought to light through an intensive application of the banding method.

The mysterious seasonal movements or migrations of birds have attracted the attention of students for hundreds of years, but it is only within comparatively recent times that adequate attention has been paid to the equally fascinating theme of their other life habits. With reference to migration, Dr. Glover M. Allen wrote in 1925 that:

Mankind delights in a mystery of whatever sort, that thrill of something unknown to be discovered. For long years the migration of birds has stood as a delightful and mysterious riddle of Nature, but now bids fair to clear away and unfold more wonderful things than we dreamed of.

The monumental biographical works by Maj. Charles E. Bendire and Arthur C. Bent and the migration bulletins by Prof. Wells W. Cooke stand not alone as standards but they will also form the stimulus for further and more exhaustive investigations. In examining

the brilliant efforts of these scholars, replete though they are with copious information assembled for the first time, it will be observed that all are lacking in detailed accounts of the movements or actions of individual birds. Heretofore necessity has required that such studies should treat species en masse, for obviously no other course was possible. In this respect the anatomist, osteologist, and systematist, with their unchanging material ready before them, possess an enormous advantage over the student of the occult phases of the science. It is evident, however, that through the introduction of the banding or marking method systematic studies of these subjects may be carried on with a great degree of precision. It is, in fact, now possible to study birds as individuals, possessed of all the traits and mannerisms that are to be expected when the unit is separated from the group.

HISTORICAL

The widespread interest that has been developed in this subject during recent years has caused many to believe that it was merely a "new fad" that would soon wane as such. Bird banding, however, has already demonstrated its worth and claims a place with the shotgun, field glass, scalpel, and microscope, as a means of acquiring precise information relative to the birds around us. Furthermore, it is not an entirely new method even in America, for an examination of the literature reveals the fact that marking birds for a definite purpose was tried as long ago as 1803 when Audubon used silver wire to band a brood of phœbes (*Sayornis phæbe*) and was fortunate in obtaining two returns.

To Dr. Leon J. Cole must go the credit, however, for bringing the advantages of the method to the attention of American ornithologists, which he did in a short paper printed in the Third Report of the Michigan Academy of Sciences (1902). Following this came the work of Dr. Paul Bartsch, who in 1902 and 1903 banded black-crowned night herons (*Nycticorax n. naevius*), in the District of Columbia, with bands (Pl. 1: m.) that carried the address of the Smithsonian Institution (1904), from which he received several interesting return records. The records from these birds are apparently the first returns in modern times to be obtained from American birds, banded with the deliberate intent to learn something of their travels. About this time P. A. Taverner announced through the pages of *The Auk* (1904) that he proposed to take up this work and had had made aluminum bands inscribed with the legend "Notify The Auk, N. Y." (Pl. 1, a.) Some of these bands were actually attached to birds, J. H. Fleming, of Toronto, Ontario, placing "Number 1" on a robin, on September 24, 1905. A few return records also were obtained, the

most noteworthy being the case of a flicker (*Colaptes a. luteus*) banded May 29, 1905, at Keota, Iowa, and killed the following Christmas Day at Many, La. Fragments of this bird are preserved in the Canadian National Museum at Ottawa, Ontario. Unfortunately these pioneer experiments did not receive their merited attention, and it was not until 1908 that the matter was again revived, this time by the New Haven (Conn.) Bird Club, which appointed a committee, under the able chairmanship of Doctor Cole, and issued to such of their membership as volunteered for the work both open and seamless bands stamped with the legend "Box Z, Yale Sta., New Haven, Conn." (Pl. 1, l.) A comparatively small number of these bands were used and within a year the legend was changed to the one used by Taverner ("Notify The Auk, New York"). (Pl. 1, b.) More than 5,000 of these bands were distributed, and about 1,000 were attached to birds as shown by Doctor Cole's report before the meeting of the American Ornithologists' Union in New York City in December, 1909, printed in *The Auk* for April, 1910. It also was during this period that the experiments of Dr. John B. Watson were carried on at the Tortugas Reservation in Florida (1909). In this work, paint was used to mark specimens of the noddy and sooty terns (*Anous stolidus* and *Sterna fuscata*) which were then shipped to Galveston, Tex., and to Cape Hatteras, N. C., air-line distances of between 800 and 900 miles, from which points the marked birds returned to their nests.

The results demonstrated so well the possibilities of such activities that on December 8, 1909, an organization known as The American Bird Banding Association was formed. The legend was again changed and the bands issued by the new association bore the inscription "Notify A. M. [=American Museum], N. Y." (Pl. 1, c, d.) Under the guidance of this organization, and particularly through the interest and zeal of its secretary, Howard H. Cleaves, bird-banding work was carried on until 1920, when it was taken over by the Bureau of Biological Survey of the United States Department of Agriculture.

Previous to this, Dr. Alexander Wetmore, while making investigations of the duck sickness at the Bear River marshes, Utah (1914 to 1916), banded about 1,000 ducks, using bands that carried the address of the Biological Survey. These were the first bands of this series. (Pl. 1, f.) The report by Doctor Wetmore (1923) of the 174 returns obtained amply demonstrated the possibilities of the method when applied to migratory waterfowl.

As originally practiced the banding of birds was used solely as a means of obtaining information pertaining to migration, and it is certain that this will always be a most valued phase of the subject.

It is, however, important to direct attention to one of the most interesting and important chapters in the annals of American bird-banding activities, written by S. Prentiss Baldwin, of Cleveland, Ohio, and which opened a new field for the study of life histories. In 1913, while engaged in a campaign to rid his premises of the English sparrows (*Passer domesticus*) he found that the elimination of these birds had the usual effect of attracting desirable native species to the vicinity. To reduce the sparrows, Mr. Baldwin used several traps of the type originated and recommended for this purpose by the Biological Survey. These traps, known as Government sparrow traps, capture the birds uninjured, leaving to the trapper their manner of disposition. Mr. Baldwin's first report of his banding work, which was presented to the American Ornithologist's Union at New York City on November 11, 1919, and later printed (1919), well describes how his investigations were started. He states, in part:

* * * It was when I learned of the American Bird Banding Association that the traps acquired a new and much greater significance, for, as the house sparrows decreased, the traps became the resort of native birds. In the spring of 1914 I began placing bands, not only upon young birds in the nest, but upon many adults secured from the traps, and by 1915 it became evident that this could be done on a large scale, and with most interesting results in returned birds.

Mr. Baldwin's report came at a psychological time, as the results of Doctor Wetmore's work had caused Dr. E. W. Nelson, then Chief of the Biological Survey, to give serious consideration to the value of this form of study in connection with the administration of the migratory bird treaty act. In January of the following year (1920) the American Bird Banding Association dissolved its organization and turned over its records and effects to the Biological Survey. A short time later the writer was appointed to take charge of the work, now under governmental supervision.

PRESENT METHODS

The legend on the bands was again changed and those now in use carry on the outer surface, in addition to a serial number, the legend "Notify Biological Survey, Washington, D. C." (Pl. 1, e, g, h, i, j, k.) This complete legend can, of course, be impressed only on the larger bands, the smaller sizes having the words "Biological Survey," abbreviated to "Biol. Surv." or "Bi. Surv.," while the word "Notify" is omitted from the smallest sizes. The address, "Washington, D. C.," likewise is abbreviated to "Wash. D. C." and stamped upon the inner surface of the band. Any of these legends is, however, sufficiently complete to insure delivery of a letter, as the post-office officials have been fully advised of the work and have delivered promptly envel-

opes bearing such enigmatical addresses as: "Mr. Biol. Surv., 23171, Wash. D. C."; "Biol. Survey Co., Wash. D. C."; and "Boil Service, Wash. D. C." The word "boil" in the last example was due to a curious misprint in one lot of bands whereby the "o" and "i" were transposed. In addition to complicating matters for postal employees, this error caused many humorous comments from bird-banding cooperators, one of whom was fearful that the legend would be misunderstood as cooking instructions, since the bands plainly stated: "wash, boil, and serve."

As the services of volunteer observers had been already successfully utilized by the bureau in other lines of work, it was decided to extend the system and to offer to the bird students of the United States and Canada this new form of research according to basic plans made by the Biological Survey. Since, however, nearly all American birds are protected by both Federal and State laws, it was apparent that prospective cooperators must comply with certain requirements. It was not proposed to have bird banding an excuse for indiscriminate nest hunting by school classes, Boy Scout troops, or other juvenile organizations, but to make it a method of study to be pursued only along lines that would make of unquestioned value the information obtained. Properly qualified persons are accordingly supplied with special Federal permits (fig. 1), permits that usually are supplemented by additional State authority. Through the cooperation of the Canadian National Parks Branch similar permits are granted to persons residing in Canada, and a foundation is laid for chains for bird-banding stations to cover the most populated parts of the continent north of the Rio Grande.

It will be at once apparent that American students of this means of research possess an enormous advantage over their coworkers in Europe. Not only are many species common to both the United States and to Canada, but there is also the added benefit of two large adjoining countries extending from the Tropics to the Arctic with a common language, while even in the Latin-American countries American influence renders reasonably certain a large number of return records.

At the present time over 1,200 persons have been supplied with bands, most of whom operate stations (pl. 2, fig. 1) where birds are systematically trapped and banded throughout the year. Most of these station operators are well-informed amateurs, it being obvious that the majority of the trained ornithologists are so occupied by their life work that they are unable to devote much time to bird banding. It is nevertheless a pleasure to record the fact that almost all workers in the science have given their full approval of the work, many of them are serving as regional advisers or councilors,

and some are operating trapping stations as actively as their time will permit.

The development of suitable traps and other equipment naturally received first attention and to certain ingenious individuals this phase of the subject will always hold a large measure of fascination. Inability with equipment at hand to capture certain species is a chal-

Collaborator's)
Permit No.) 1000

UNITED STATES DEPARTMENT OF AGRICULTURE

PERMIT FOR CAPTURING MIGRATORY BIRDS FOR
SCIENTIFIC BANDING PURPOSES

WASHINGTON, D. C., August 1, 1927.

Permission is hereby granted, until revoked, under Regulation 9 of the Migratory Bird Treaty Act Regulations to John Doe of Washington, D. C., to trap, in the States of Maryland, Virginia, & in D. C., except on Federal or State bird or game reservations, at any time, migratory birds for banding purposes, and to possess such birds only for such period of time as may be necessary securely to band the same.

This permit is issued subject to the conditions printed on the back hereof and is not valid unless countersigned by the Chief, Bureau of Biological Survey.

James M. Redman
Chief, Bureau of Biological Survey.

W. M. Jardine
Secretary of Agriculture.

This permit is not transferable and is revocable in the discretion of the Secretary of Agriculture. It must be carried on the person of the permittee when he is trapping and banding birds hereunder and must be exhibited to any person requesting to see the same.

This permit is granted by the Secretary of Agriculture and accepted by the permittee on the express condition that the permittee will comply with the provisions of the Migratory Bird Treaty Act and the Regulations thereunder. Failure to render the reports required will be sufficient cause for revocation of this permit.

This permit shall not be construed to authorize the taking or possession of migratory birds for any purpose whatsoever other than banding, and such bird when securely banded must be immediately released.

Form B1-475 a.
2-24

GOVERNMENT PRINTING OFFICE

FIG. 1.—Front and back of Federal bird-banding permit. The specimen shown authorizes the banding of all kinds of migratory birds, but most cooperators hold permits permitting work only with nongame species

(Photograph from Biological Survey)

lenge that receives a ready response from cooperators with an inventive and mechanical turn of mind. Proper traps are moreover of great importance, and since thus far none but the hummingbirds have been excluded from the possible field it will be apparent that there is ample opportunity to work out traps of different types. As fast as these are perfected they are described and figured by the Biological Survey for the benefit of everyone interested. Usually it is found that the more simple and inexpensive the trap the greater

its efficiency. The records of banded birds are transmitted regularly to the bureau, where they are indexed and filed so as to be readily available for reference and study.

The foundation that has been laid through these activities at the present time (July 1, 1927) consists of about 300,000 banded birds, from which a total of about 15,000 returns have been received, not counting the thousands of repeat records which in themselves show many interesting facts. Explanation of the term "return" is necessary, because of its broad application in the records of banded birds. By return is meant the record of any banded bird recovered in a succeeding season, or the record of any bird terminated by its death. This means that the returns available consist of the records of birds banded at one point and recovered at another, retrapped at the point of banding during a different season (it being assumed that in the meantime migration has taken place), or of those that for one cause or another die at the point of banding without having left the vicinity. Ducks and other birds killed by hunters supply most of the data of the first type, the activities of station operators in retrapping the smaller nongame species furnish the records of the second class, while in the third are included those cases of adult birds accidentally or otherwise dying at the trapping stations within a short time of banding and of fledgling birds that die before reaching maturity.

It is obvious that data of the first two kinds have the most interesting features, but those of the third class, which are termed "short-time returns," also are being carefully assembled with the belief that through their study it will be possible to furnish valuable information on the mortality rates of certain species under known conditions. During the early phases of the work the activities of many persons were concerned solely with the banding of fledglings, which no doubt led to more or less organized nest hunting. For a time such work was tolerated as it was hoped that the interest of the participants would reach a point where they would operate the more productive trapping stations. Being well aware, however, of the attendant menace to bird life on account of unskillful handling of the birds and to human scent trails unwittingly laid from nest to nest for prowling house cats and other predators, the Biological Survey finally stopped all work of this character, except for the nests located upon the grounds of a trapping station where it is assumed that natural enemies of birds are kept under control. The banding of the young of colonial birds is authorized, however, when undertaken by operators who are thoroughly familiar with such special work.

Some birds acquire "the trap habit," that is, they will repeatedly return to a trap (pl. 2, fig. 2), occasionally being taken several

times during a single day. Records of these are called "repeats" and they, too, are carefully tabulated by the station operators. Through these opportunities to continually study an individual bird, noting its traits and personal habits, the progress of plumage colorings and growth, and many other items, important contributions are anticipated to our knowledge of life histories.

RESULTS OF COOPERATION—REGIONAL ASSOCIATIONS

In administering the bird-banding work the Biological Survey has offered to bird students a scientific method by which they may study birds and procure new and important information. The charm of intimate acquaintance with birds, brought about by the repeated handling of the same individuals, has had the effect of starting a wave of interest and enthusiasm unparalleled in the history of American ornithology. At the beginning, efforts were made to bring the matter to the attention of the public, but for the past four years nothing of this kind has been necessary, the number of new stations continuing to increase with remarkable rapidity.

In countries as large as the United States and Canada it is obviously difficult for any directing agency to be fully informed and to maintain proper contacts with the conditions that give rise to the local problems that appeal to the imagination of widely scattered station operators. For this reason and in order that their investigations might be better coordinated, both with the bureau and with each other, the field observers have been organized into regional associations.

The first of these was the New England (now the Northeastern) Bird Banding Association which was organized early in 1922 and assigned the territory of the New England States, Quebec, and the Maritime Provinces of Canada. Edward H. Forbush, State ornithologist of Massachusetts, was chosen as its first president. In October of the same year, at the Chicago meeting of the American Ornithologists' Union, a second organization, the Inland Bird Banding Association, was formed, with S. Prentiss Baldwin as president. The territory assigned to this organization was the vast area extending from the Allegheny Mountains to the Rocky Mountain States, including the Canadian Provinces of Saskatchewan, Manitoba, and Alberta. During the early part of 1923 the Atlantic coast area, exclusive of New England, but including New York and the Province of Ontario, was organized into the Eastern Bird Banding Association, with Dr. Arthur A. Allen, of Cornell University, as its first president. There remained only the territory represented by the Pacific coast and Rocky Mountain States and Provinces where a banding chapter of the Cooper Ornithological Club had been in

operation. Early in 1925, this group was definitely organized as the Western Bird Banding Association, with J. Eugene Law, of Altadena, Calif., as president.

It will be observed that each of these associations includes in its area at least one important migration highway, along which trapping stations may furnish data on certain specific problems. Such information will supply the stimulus for the continuation of the work, and in time will help solve other problems some of which can not now even be anticipated. To further such plans, the Eastern and Northeastern associations have both issued bulletins setting forth some of the results obtained by their members and other material of importance in the work. Similar information is made available by the Inland and Western associations through the pages of two well-established journals, *The Wilson Bulletin* and *The Condor*, as well as by special mimeographed circulars or news letters.

RESULTS

General.—Among the results of these studies there is one that while purely incidental nevertheless is important. This is the benefit to the birds. It seems scarcely necessary to state that bird-banding methods are neither cruel nor harmful, as the approved traps are merely cages of wire netting, while the weight of the bits of aluminium from which bands are made is utterly insignificant. Furthermore, a successful banding station necessarily must be the highest type of bird sanctuary. It is the object of the bander to attract more and more birds to his station in order that he may extend his studies, and to that end care is taken to keep it free from natural enemies. This coupled with abundant and varied food and water for bathing and drinking will ultimately make the trapping station a mecca for the birds of a wide area. A study of the conditions at certain stations has demonstrated that this is a fact. In other words, a banding station is a sanctuary or refuge that is made to yield information that serves for the increase of knowledge.

Occasionally, it is true, a bird is injured or even killed through an accident at the traps or while in the hands of the operators. Such cases are decidedly rare and do not average one to each thousand birds handled. One of the surprising features has been the rapidity with which new cooperators have mastered the technique of properly handling living birds. The small percentage of fatalities accordingly may be heavily discounted, for by no other method would it be possible to examine such a large number of individual birds without first transforming them into museum specimens.

Biological Survey bands have been placed on 437 species of North American birds, of which 231 have yielded at least one return

record. It will be recalled that with nongame species returns are secured mainly through retrapping by station operators, and thus far satisfactory methods have been devised for trapping only a relatively small number of species. Accordingly, the 206 species for which no returns have been received represent those banded largely or solely as nestlings. Such negative results are as expected, and it is axiomatic that marking such birds is not likely to be productive of important results (except over a very long period of time), if dependence for their recovery is placed solely upon the uncertain element of chance.

It is therefore apparent that the best prospects for early results lie in certain definite directions and that diversion of effort into minor channels is likely to diminish or delay them. With this in mind campaigns have been carried on through the regional associations which have resulted in the banding of large numbers of certain groups of birds such as gulls, terns, herons, swifts, swallows, and others. Invariably such efforts have yielded an increased percentage of data.

MIGRATION

It is safe to say that the underlying reason for all banding work has been the growing desire for more knowledge concerning the migrations of birds. Comprehensive reports on this subject can not be prepared by the individual worker, for it is only by the study and correlation of a mass of data from many different points that the subject can be satisfactorily treated. Dr. Witmer Stone (1908) has stated this condition with his usual precision. He says, in part:

The meagerness of the data that it is possible for one individual to gather on bird migration, compared with the magnitude of the phenomenon, must be apparent to all, and yet we are constantly attempting all sorts of estimates—as to rapidity of flight, the relation of fluctuation of migration to temperature variation, etc.—based for the most part upon the records of individual observers.

These statements apply equally to the returns from banded birds which can be analyzed only by the worker who has access to all similar data and who is in a position to treat them with reference to other existing material. It is true, however, that we are being placed rapidly in possession of a large number of records for certain species from which it appears that the time is not far distant when it will be possible to prepare detailed reports on their migrations based largely upon banding data.

For reasons already stated it is impossible in a paper of this kind to do more than briefly summarize for a few species the information now available.

Caspian Tern.—The Caspian tern (*Sterna caspia*) has been banded in large numbers at colonies in Lake Michigan and to a lesser degree

at other points. (Pl. 3, fig. 1.) The returns received are sufficiently numerous to indicate the probability in the near future of an interesting study of the movements of this attractive bird. Banded individuals have been recovered south through the valley of the Mississippi River to its delta, on the Atlantic coast south of Chesapeake Bay to Key West, Fla., and in four cases from South America at the mouth of the Magdalena River, Colombia. One bird was retaken in central Oklahoma and (in the succeeding season) three others were found in Nova Scotia. A small colony of this species breeds in the Gulf of St. Lawrence, and it is assumed that the banded birds recaptured in Nova Scotia had moved north in company with members of this colony rather than with those of their parent colony from Lake Michigan.

Common tern.—Breeding colonies of the graceful common tern (*Sterna hirundo*) have been regularly visited by banders, the gross result of their efforts being the banding of more than 20,000 birds. The number of returns received is, however, disproportionate, due probably to the small size of the carriers and their efficient protection under the terms of the migratory bird treaty act.

The data obtained are nevertheless of much interest and are gradually building up a chain of important evidence pertaining to their migrations and wintering grounds. (Cf. Lincoln, 1927.) Outstanding among these returns is the case of a tern banded on the coast of Maine and four years later found recently dead at the mouth of the Niger River, British West Africa. To date, this is the only record of an American banded bird crossing the ocean, although several gulls (*Larus ridibundus* and *Rissa tridactyla*), banded in England and Germany, have been recovered in American waters. (Cf. Lincoln, 1925.)

Terns banded at colonies on the Atlantic coast have been reported south to the mouth of the Chumpan River, in Mexico (pl. 3, fig. 2), Porto Rico, French West Indies, the island of Trinidad, and the coast of Venezuela. As one of the narrow parts of the Atlantic Ocean is between the coasts of Brazil and western Africa, and in view of the other data at hand, it seems reasonable to presume that occasionally birds wintering on the northeastern coast of South America strike boldly out to sea and cross to the African coast.

Common terns banded at colonies in the Great Lakes also have been retaken south to southern Mexico, but they also show a wide dispersal throughout the southeastern United States. (Pl. 4.)

Herring gull.—The herring gull (*Larus argentatus*) has a wide distribution in North America, and the large colonies have proved attractive fields for banding activities, over 6,000 having been banded.

Because of their large size, these birds, although protected by Federal law, have yielded many returns.

As a family, gulls are more or less nomadic, and true migratory flights appear to be the exception rather than the rule. This is borne out by the banding returns, as in some seasons the birds have remained during the winter in northern latitudes, even moving still farther north. Birds marked as fledglings in northern Lake Michigan have been detected during the same season in the region of the Gulf of St. Lawrence. On the other hand, long flights are not infrequent, specimens from the Great Lakes colonies having been reported south to Florida, Louisiana, and southern Texas, while two proceeded south as far as the State of Vera Cruz, Mexico.

White pelican.—Although banded in comparatively small numbers, returns from white pelicans (*Pelecanus erythrorhynchos*) have partially indicated the routes taken by these birds from some of their breeding grounds. One banded in southern Saskatchewan was recaptured five days later in South Dakota. The large colony of these birds that regularly breed at Yellowstone Lake, in the Yellowstone National Park, Wyo., was studied in 1922, and about 100 young birds were banded. Several returns were received showing that after leaving the breeding grounds the pelicans crossed a low pass northwest of the lake and then pursued a line of flight almost due south through the Great Basin. One was killed at Otatitlan, State of Vera Cruz, on the east side of the tableland of Mexico. (Cf. Ward, 1924.)

Mallard.—Of all species that have been banded, the mallard (*Anas platyrhynchos*) has yielded the largest percentage of returns, because of the many reports from sportsmen. In the United States this duck is most abundant in the Mississippi Valley, and it is here that the majority were banded, about 4,000 having been trapped in the State of Illinois by the writer alone. (Pl. 5, fig. 1.) Others have been banded on the Atlantic, Pacific, and Gulf coasts and at several points in Canada. About 1,800 returns have been received. These show the line of flight with much accuracy between points in Mackenzie, Alberta, Manitoba, and Saskatchewan in the north, to the coast of Louisiana and Texas in the south. As would be expected, the flight extends over a rather wide front through the Dakotas, Nebraska, Kansas, and Oklahoma, although the majority of the records have been received from points close to the main stream. Upon reaching the region of the Gulf of Mexico some of these birds evidently work westward, as indicated by the returns from the Texan coast. Birds banded in central Illinois and Missouri also have been taken as far west as Colorado, Wyoming, Montana, and California.

Mallards banded in southwestern Ontario in the autumn no doubt accompany the large flocks of black ducks, flying southwest to the

Ohio and Mississippi Valleys. They have been reported in succeeding breeding seasons north and west to central Alberta.

Black duck.—Among migratory waterfowl the black duck (*Anas rubripes*) is next in numerical order of banding returns. While this species has been banded in small numbers at points in the Mississippi Valley and on the northeast Atlantic coast, the majority of the data have come from birds banded in southwestern Ontario, where for several years a highly productive station has been operated. Altogether more than 1,000 returns have been received for this species.

From an examination of this material it is evident that the principal fall flight from southern Ontario is to the southwest, the ducks reaching the United States by way of the western end of Lake Erie. From this point the flight continues to the valley of the Ohio River, and extending in that general direction brings the migrating birds to the Mississippi River. There is also another route, seemingly less important, as the number of returns each season is proportionately smaller. This extends southeast to the Atlantic coast, which apparently is reached about the latitude of Delaware Bay and Chesapeake Bay. Between the banding station and the coast there are but few returns along this route, and as a range of mountains must necessarily be crossed the birds probably travel at a relatively high altitude and without intermediate stops.

The summer records from these birds are mostly from points in Quebec and Ontario north to James Bay. Only occasionally does the species extend far to the westward, although a few banded black ducks have been taken as far west as Alberta. (Cf. Lincoln, 1922.)

The scattered returns from birds banded in the Mississippi Valley supplement those from Ontario, as they are from points northeast to Michigan, Ontario, and Hudson Bay. One only from this region has been recovered from the Atlantic coast.

Blue-winged teal.—The blue-winged teal (*Querquedula discors*) has been banded in fairly large numbers and the returns received indicate that interesting results will be obtained. This little duck is the last to arrive in the spring and the first to go south in the fall, the bulk of the individuals regularly passing south of the United States, their winter range extending well into South America.

Most of the banded teals were marked in Ontario, South Carolina, Louisiana, Kansas, and Missouri. The records from the South Carolina birds help to confirm belief in the existence of the route across from the Atlantic coast to the Mississippi Valley, several having been taken on the crossing. From the Mississippi Valley the records extend northward to the Provinces of central Canada.

The birds banded in Kansas are of special interest as they were all young hatched at the point of banding. Upon migrating they moved south through Texas to the State of Campeche in southern Mexico, and the next year they traveled north through Nebraska at least to Minnesota. Blue-winged teals banded in Ontario have seemingly followed the general routes of the black duck, although the returns are more equally dispersed along the Atlantic coast and the Mississippi Valley. One bird that probably followed the coastal route was taken on the island of Trinidad, British West Indies, about 75 days after banding, while another was killed during the following autumn near Burlingame, Calif.

Pintail.—The pintail (*Dafila acuta*), which as a species is almost cosmopolitan, probably breeds farther north than any other of the *Anatinae*. Banding of these birds has been done mostly in the Mississippi Valley States and in California. It accordingly is not surprising that the general route of migration of the former group appears to be similar to that of the mallard, except that the pintails no doubt push farther north. Several records have been received from northern Manitoba, Alberta, and the Northwest Territory.

Seven birds banded in Kansas and in the Mississippi Valley have been reported from California. Pintails are notoriously high flyers, and as a matter of fact, in view of the many occurrences of this and other species of ducks on lakes and streams at relatively high altitudes, it may be considered doubtful if the mountains anywhere offer an impassible barrier to such strong flying birds, although they probably have a certain directing influence in much the same manner as does a large and important river. The records from the birds banded by Doctor Wetmore (1923) at Great Salt Lake, Utah, have already shown the existence of a flyway from that point to the great valleys of California. It is, however, curious that all returns from pintails banded in California are from points on the Pacific coast, north to Alaska, none having been reported from eastern points. (Pl. 5, fig. 2.)

Cackling goose.—Among the returns received from banded Canada geese (*Branta canadensis*) are between 40 and 50 for the smallest North American race, the cackling goose (*Branta c. minima*), that are particularly noteworthy. These birds were banded during the summer of 1924 in the vicinity of Hooper Bay, northwestern Alaska. The returns, received during the following shooting season, show well the line of flight south along the coast of British Columbia by way of the Queen Charlotte Islands to the mouth of the Columbia River. At this point the route turns inland for a short distance and then resumes a southward direction, reaching its terminus at winter quarters around the shores of Tule Lake in Oregon and California and in

the Sacramento Valley of California. The data indicate an extremely circumscribed range during winter, a fact that should be of much concern to naturalists and sportsmen interested in the perpetuation of this goose as a game bird. (Cf. Lincoln, 1926.)

Hérons.—Among the herons, returns are available for several species, but (excepting the black-crowned night heron) there is not a sufficient accumulation to warrant any statements concerning their migration. Great blue herons (*Ardea herodias*) banded in Minnesota have been recovered south in Iowa, Missouri, and Texas, the State of Oaxaca, Mexico, and at Gatun Lake, Panama.

Snowy egrets (*Egretta candidissima*) banded at Great Salt Lake, Utah, have been found along the Rio Grande in Texas and south to Sinaloa, in western Mexico, while two reddish egrets (*Dichrománassa rufescens*), banded on the coast of Texas, were recovered in the Mexican States of Campeche and Oaxaca.

The black-crowned night heron (*Nycticorax nycticorax*) has been banded in large numbers, particularly at a colony on Cape Cod, Mass. In common with some other members of this family, these birds have the curious habit of a northward migration after the breeding season, which is well shown by the returns received. (Pl. 6, fig. 1.) Records are numerous through the New England States and in southeastern Canada, the most northerly being one taken at Lake St. John, Quebec, while they also extend westward to western New York and Michigan. With the approach of winter the birds are driven south and the returns show the route through Pennsylvania, Virginia, North Carolina, and Georgia to Florida, Louisiana, Cuba, Haiti, and Jamaica. (Cf. May, 1926.) Night herons banded in central Canada have been retaken south through the Mississippi Valley to Texas, Florida, and Vera Cruz, Mexico.

Mourning dove.—The status of the mourning dove (*Zenaidura macroura*) as a migratory bird has been challenged, so that unusual interest attaches to the records from banded birds. These data include cases of birds retaken at the point of banding on both the summer and winter ranges and also those banded as breeding birds and retaken on migration or after arrival in their winter habitat. Doves banded in Illinois have been captured chiefly in Louisiana, Florida, and Georgia, although one wandered west to east-central Texas. There also are a few other records of recoveries in Texas from birds banded in Indiana, Ohio, and Missouri, but, to judge from the bulk of the returns reported for these birds, the principal wintering grounds are in Georgia.

Birds of prey.—The migration of the birds of prey (pl. 6, fig. 2) have long excited much interest and while these birds are not easily obtained for banding and records will accumulate slowly, nevertheless important results may be confidently expected.

Thus far, banded marsh hawks (*Circus hudsonius*) have yielded the largest number of interesting returns. Birds banded north as far as Ontario have been recovered in North Carolina and Florida; and birds banded in central Illinois have been reported from Texas and also from Michigan. A Cooper's hawk (*Accipiter cooperi*) banded at Willoughby, Ohio, was killed during the winter of the same year at Sublime, Tex.; and a ferruginous rough-leg (*Archibuteo ferrugineus*) banded at Red Deer River, Alberta, was taken about three months later, at Kimball, Nebr. Two young duck hawks (*Falco p. anatum*), banded on the same day at Russell, Mass., were both killed during the following spring, one at Canton, Pa., and the other at Nokesville, Va. Another bird of this species, banded at Kings Point, Yukon, in July, 1924, was taken at Duchesne, Utah, during the following February, about 2,300 miles from the point of banding.

Some interesting light has been shed on the movements of some of the owls (pl. 7, fig. 1), although much more data are needed.

The screech owl (*Otus asio*) seems to be sedentary throughout its range. Returns from birds banded at points in New England, through the plains, and Rocky Mountain areas to the Pacific coast, all are in the same general vicinity of banding. On the other hand, banded barn owls (*Tyto pratincola*) have yielded a few returns showing that these birds can and do perform lengthy journeys. One banded at Oradell, N. J., in summer, was taken the following January, at Savannah, Ga.; another, also banded in New Jersey, was recovered at Wilmington, N. C.; while a third, banded at Nashville, Tenn., was killed about six months later, at Opp, Ala.

An interesting record also is at hand for a snowy owl (*Nyctea nyctea*) banded early in July, 1924, at Hooper Bay, Alaska, and killed in November of the following year, on King Island, off the coast in Bering Sea.

Chimney swift.—Among the smaller birds the migrations of the chimney swift (*Chaturya pelagica*) (pl. 7, fig. 2) holds an unflinching interest, principally because of the lack of definite information regarding its winter home. The innumerable host of these birds that gathers in the Gulf States, disappears suddenly and completely in the fall, causing many of the credulous to still maintain that they spend the winter on hibernation beneath the waters of the Gulf of Mexico.

Although banding was not considered as a means of tracing them beyond the borders of the United States, it was obvious that a species available in such large numbers should receive attention. During the last few years more than 11,000 have been captured for banding by means of specially constructed traps (pl. 8) that literally take

every bird that enters a chimney to roost for the night. Most of these have been taken in the vicinity of Thomasville, Ga., and Tallahassee, Fla., and through the continued operation of the traps, twice each year, many return records are being obtained. Several swifts have been recaptured at the banding points in both spring and fall, showing that the route for the individual birds is apparently the same for both migrations. Birds also have been taken from a chimney in one town, and a week or ten days later recaptured at another 15 to 30 miles distant. Swifts banded at these points have been recovered north through Pennsylvania and New York to New Brunswick and Nova Scotia.

Crows and jays.—The migration flights of the *Corvidæ* are not well understood, due principally to the fact that the different species are frequently observed continuously throughout the year in many localities. Their journeys are, however, more or less regular, banding returns showing some interesting and lengthy flights. Blue jays (*Cyanocitta cristata*) banded in Illinois and Iowa (pl. 9, fig. 1) have been retaken in Missouri and Arkansas; and a magpie (*Pica p. hudsonia*), banded near Laramie, Wyo., in May, was killed near Rosita, Colo., during the following January. The crow (*Corvus brachyrhynchos*) appears to make the longest flights of any member of this family. Birds banded in Illinois have been retaken in Wisconsin and Michigan; one banded in Saskatchewan in June was killed in Oklahoma in the succeeding January, while one banded in Oklahoma in January was recovered three months later in Minnesota.

Blackbirds.—In this family there are two species for which return data are rapidly accumulating, due to the large numbers that are being marked. Because of their local economic importance, it is expected that information from recovered birds will be useful in the formulation of adequate control measures.

The total number of banded red-winged blackbirds (*Agelaius phoeniceus*) is only slightly more than 3,000, but, nevertheless, many interesting returns have been obtained. Many gaps remain to be filled in, but the data at hand indicate the route followed by these birds, from Connecticut through New Jersey and Maryland; from Michigan, Minnesota, and Wisconsin south through Illinois and Tennessee to Alabama and Texas.

The grackles (*Quiscalus quiscula*) come so readily into yards and gardens that it is not surprising that more than 7,000 have been marked by station operators. From these the returns exceed 350. They can, of course, be only briefly mentioned in this paper, but it is apparent that eventually these data will be sufficiently numerous to form the basis of an independent contribution. Birds banded in the extreme eastern part of the range (Ontario, New York, Massa-

chusetts, and Pennsylvania) apparently adhere to the coastal route, as the majority of the returns come from points in Maryland, Virginia, and the Carolinas; while those marked in the Central States (Michigan, Wisconsin, Ohio, Indiana, Illinois, and Iowa) follow the great Mississippi River flyway through Tennessee, Arkansas, and Missouri to winter quarters in Mississippi, Louisiana, and Texas. Records showing the return flight in spring are similar but contain also a few instances of erratic wandering, which is best shown by one banded at Auburn, Ala., in March and retaken two months later at Pawnee City, Nebr.

Sparrows and finches.—The members of the family *Fringillidæ* easily constitute the majority of the birds banded at small bird-trapping stations. Responding readily to many kinds of bait and traps, every station reports them regularly. Naturally, when traps are operated every year after year many birds are recaptured, some supplying an unbroken series of records for several years. Such data are highly important but obviously must be analyzed in connection with information from other sources. With this in mind it is desirable here to mention only a few of the more striking cases, returns that give evidence of the length of the flights made by these diminutive travelers.

Purple finches (*Carpodacus purpureus*) are favorites at many stations and among the great numbers of "station returns," there also are some recoveries from distant points. Birds banded at Sault Ste. Marie, Mich., have been found later in Tennessee and Arkansas; one banded at Pasadena, Calif., in March was recovered in June, at Porter, Wash.; and one from Wellesley, Mass., was found dead at Rockingham, N. C. The most remarkable flights for this species are shown by two birds, one banded at Norwalk, Conn., and retaken at Haynesville, La.; and the other banded at Peterboro, N. H., and recovered five months later at Thornton, Tex.

A few miscellaneous returns for other species in this group will show the character of the information that is being accumulated. A white-crowned sparrow (*Zonotrichia leucophrys*) banded at Indianapolis, Ind., was retaken in the following year at Doucet, Quebec; and another of this species marked at Seattle, Wash., was caught again at Watsonville, Calif. A white-throated sparrow (*Zonotrichia albicollis*) banded at Ithaca, N. Y., in April was found the following January at Cumming, Ga. A chipping sparrow (*Spizella passerina*) was banded at Westfield, Mass., and later recovered from Pamplico, S. C. A remarkable return for a Junco (*Junco hyemalis*) is the case of one banded at Crystal Bay, Minn., and retrapped at Demarest, N. J. Another Junco from Cleveland, Ohio, was retaken at Alexis, N. C., while a third was banded in

central Saskatchewan and found a few months later at Forest City, Iowa. Even the song sparrow (*Melospiza melodia*), which as a species is frequently noted throughout the year in one locality, can and does make extensive flights. The longest flight reported for one of these birds, is the case of one marked at South Waterford, Me., and taken four months later at Jacksonville, Ga. There are several other records for this species from birds banded in New England and recovered on the South Atlantic coast, while one banded at Danvers, Mass., was recaptured between two and three months later at Weymouth, Nova Scotia.

Robin.—It seems desirable to end the migration portion of this survey with a brief résumé of the flights of the well-known robin (*Planesticus migratorius*), of which more than 11,000 have been marked with aluminum bands, yielding a net result of more than 500 returns. The records of special interest come from birds banded in the Central States—Michigan, Minnesota, Wisconsin, Ohio, Indiana, and Illinois—which in moving south have spread out fan-wise to Georgia, Kentucky, Tennessee, Mississippi, Alabama, Arkansas, Louisiana, and Texas. It is curious that so many returns for robins banded in Michigan, Ohio, and Indiana should come from Georgia, and it is interesting to speculate upon the course that they followed. Eventually the chain of evidence will be complete and it will be possible to state with precision the flyways utilized by this and other species. The longest flight thus far reported for a small nongame, perching bird is for a robin banded in midsummer at Crystal Bay, Minn., and taken a year and a half later at Pachuca, Hidalgo, Mexico.

LIFE HISTORY

While migration is admittedly a most important part of the life histories of birds, it has been found necessary for the purpose of analyzing data to treat it as a separate subject, and the term "life history" is therefore restricted to the study of the habits of a species through a series of individuals, in which bird banding has its chief interest for the station operator. Such investigations, from the viewpoint of the increase of knowledge, are of great importance, as they will bring to light many facts that heretofore have been unknown or, at best, merely suspected. In the final analysis, bird banding depends for its results upon quantity production, so it follows naturally that those species that yield most easily to the present technique of the method are those concerning which the first contributions will be made. By the daily operation of their traps (pl. 9, fig. 2) station operators are acquiring a great fund of new information pertaining to individual birds.

Every student who has observed local birds throughout the year is aware that the distribution of the individuals, of even the so-called resident species, changes with the season. This is no doubt due to changes in food supply, environment, and probably to physical impulses. In short, the ecological conditions vary enough to force the individual birds to vary their habitat, while it is also true that the area under observation may receive a few additional individuals of the same species that may be migrants or merely wanderers from an adjoining area. Under the ordinary methods of study it is difficult or impossible for the observer to be sure that the same individuals are constantly under observation, in contrast to which the station operator, daily retrapping many of the local birds, can truthfully say that he knows the individual birds in the area contiguous to his station. He is accordingly able to record with accuracy the acts that each performs.

The accumulation of material of this character necessarily will be very slow, for each observation must be checked and rechecked at different points. In this respect two or more operators working together in the same general vicinity have many advantages that will expedite the development of their investigations. It also will be recalled that the majority of present-day bird banders are novices, and as such it is proper that they use every care to present only data that will bear the closest scrutiny. They are, however, learning rapidly, and the number of independent studies being undertaken is constantly increasing. It seems safe at this time to predict that these ornithologists, now in the making, will devote more and more attention to such subjects as the development of plumage in relation to the life cycle of the bird; body temperatures under different conditions and their relationship to weight and physical conditions; the effect of external parasites upon plumage and general health; heredity and the dominance of certain characters; and other matters that in the past have received but passing notice. Within the past year a circular letter addressed by the Biological Survey to all bird-banding cooperators, requesting information of the subjects that were of particular interest to them, brought in 187 replies, showing that at some stations three or four distinct studies were in progress, those above named having preference.

Every effort is made to counsel station operators against the error of premature publication, in the belief that it is desirable to carry a study to its logical conclusion from the standpoint of available facilities before making the results known in print. Accordingly, but little has appeared from the banding stations on these subjects, and it is not possible at this time to do more than refer briefly to work in progress.

Foremost among these investigations is the study of the house wren (*Troglodytes ædon*) that is being conducted by S. Prentiss Baldwin at his research laboratory near Cleveland, Ohio. This work, which has been carried on for five or six years, promises to be one of the most detailed studies ever made for a passerine bird. For the past two or three years Mr. Baldwin (1921) and his associates have published but little of the results that have been obtained, although the work has been greatly expanded and has involved the employment of special assistants and much delicate apparatus. The genealogies of the house wrens breeding in the vicinity have been worked out with much care, while many data have been collected relative to periods of courtship, nest building, intervals between deposition of eggs, incubation periods, activities of parents during incubation (Baldwin, 1927), length of time spent in nests by young birds, second broods, and other items.

Among the *Fringillidæ* are four or five species that merit special attention because of their quick response to the trapping methods generally employed. The song sparrow (*Melospiza melodia*) easily ranks first as shown by the fact that more than 13,000 have been banded. This species is plentiful in the regions where trapping stations are concentrated, thus facilitating cooperative work to determine the extent of local ranges and migratory movements. Through these activities it is learned that there is an interchange of individuals, the winter birds moving on and their places being taken by arrivals from other sections. Song sparrows repeat regularly, so a close check may be maintained on their actions. A statistical analysis of such data obtained at one station has been published by Rudyerd Boulton and John T. Nichols (1925).

Studies of the development of plumages constitute a phase of the work that has a direct appeal to many operators. The first of these to be undertaken was by Michael J. Magee, who has already published (1924) a preliminary report of his observations on the plumage of the purple finch (*Carpodacus p. purpureus*). In his study of this species, more than 4,000 individuals have been banded which have yielded 250 returns at his own station, together with thousands of repeat records. His notes definitely trace the plumage from the juvenile stage through the changes up to adults 3 or 4 years old. It has been found that most, if not all, males of this species do not acquire the full crimson plumage until they are 2 years old, and even then it is not the richly colored plumage of the old male, which is apparently not acquired by birds less than 4 years old.

Pacific coast stations are making similar investigations concerning the plumage of the house finch (*Carpodacus m. frontalis*) and the Gambel sparrow (*Zonotrichia l. gambeli*), while others in Eastern

States are conducting studies on the Junco (*Junco hyemalis*) and goldfinch (*Astragalinus tristis*).

The diseases affecting wild birds and their possible relation to species under domestication are occasionally of such importance as to call for work by trained specialists, all of whom deplore the lack of data on the subject which causes the loss of valuable time for preliminary work. Admittedly, this is a subject too difficult for the average bird bander, but it is a pleasure to record that among the active cooperators of the Biological Survey there are several physicians who are applying their skill and general knowledge to studies of avian ailments. Among the more common of these affections is one which causes injuries and deformities to the feet and legs of birds. It has been detected on chipping sparrows, Juncos, bronzed grackles, red-winged blackbirds, and others. Some success has already been attained in treating the disease, while experimentation is still in progress.

The study of avian parasitology is abundantly aided through the activities of trapping stations. This is particularly true regarding the "bird flies" *Hippoboscidae*, insects that are difficult to collect as they will almost immediately desert their host upon its death. At a few banding stations special equipment has been installed for the capture of these insects and many have been obtained, some being taken from hosts not previously recorded. The importance of such work will be apparent when it is remembered that biting flies are frequently responsible for the transmission of disease from an animal that acts only as a carrier to one that may be violently susceptible. Other parasitic insects also may be involved, and arrangements are being perfected whereby the services of specialists will be made available for the examination of infected birds obtained from banding stations.

Baldwin (1922), Whittle (1923), and L. B. Fletcher (1924) have contributed interesting information concerning what is termed "the group habit." From the evidence obtained it appears that certain groups or small flocks of such species as tree sparrows, juncos, and white-throated sparrows retain their identity throughout a season and even maintain basically the same organization in successive seasons. As Mr. Whittle says (loc. cit.), "There is * * * some evidence that there exists something like orderly procedure in such migrating bodies and that there may be definite groups having perhaps family or neighborhood relations which constitute migratory units." This theory, if satisfactorily demonstrated and followed to its ultimate conclusion, might throw important light upon the evolution of geographic races.

Longevity of birds in a state of nature and the mortality rate of young birds are subjects that frequently are given much discussion.

John T. Nichols, of the American Museum of Natural History (1927), gives good expression to a theory governing the normal span of life of birds, which he states as "a high death rate prior to gaining full adult strength and vigor, then comparative safety until the decline with age begins, then almost immediate elimination." As Mr. Nichols states, this implies "a fairly definite normal age limit at or slightly beyond the point where physical decline sets in," and "accumulating data * * * on longevity from banded birds would approach the limit, but rarely exceed it." Since, however, prompt elimination almost certainly takes place when the physical decline is begun, it would appear that a sufficient quantity of long-time records for banded birds of any species should furnish a reasonable average for the normal life of that species. Obviously, the time element in this problem is such as to make it a continuing project subject to frequent revision upon the acquisition of additional data.

At the present time the oldest American banded bird that has been reported was a pintail (*Dafla a. tzitzihoa*) banded by Dr. Alexander Wetmore on September 16, 1914, at the mouth of Bear River, Utah, and which was killed near Brawley, Calif., either on October 16 or 17, 1926. This bird was adult when banded and so was at least 1 and probably 2 or 3 years old, thus making its age at death at least 13 years. Among smaller species there are available several records for individuals 4, 5, and 6 years old, and a few that were at least 7, 8, and 9, when last reported.

Such investigations can be multiplied almost endlessly, so that the application of the banding method permits both professional and amateur students of birds to render important contributions to science through studies conducted with living birds.

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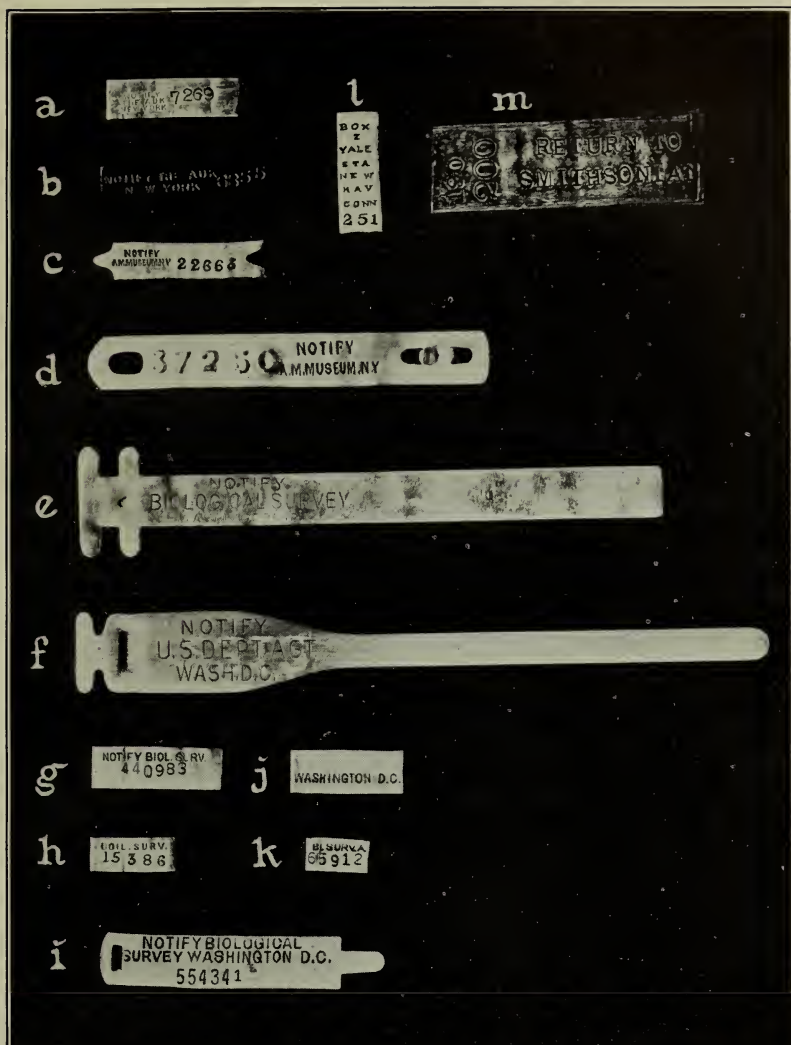
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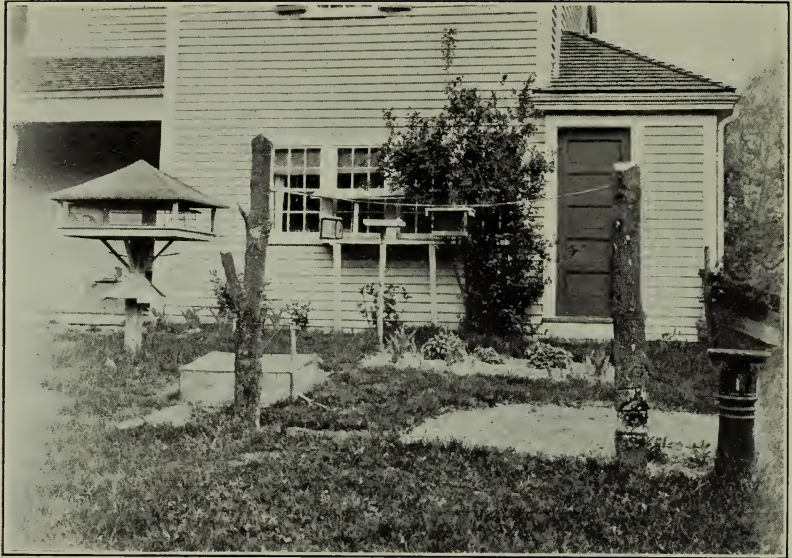
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BANDS USED IN MARKING NORTH AMERICAN BIRDS

Lettering from top to bottom they are: *a*, split-ring band, made and issued by P. A. Taverner; *l*, seamless band, first issue of the New Haven Bird Club; *b*, flat strip band, second issue of the New Haven Bird Club, the one shown being made of thin brass; *c* and *d*, ring bands of the American Bird Banding Association; *e* and *f*, flat strip bands, the first used by the Biological Survey; *g*, *h*, *i*, *j*, and *k*, the present split-ring bands of the Biological Survey; *g* and *j* show the outer and inner surfaces; *h* shows the misprint on one lot whereby "Biol. Surv." was made to read "Boil. Surv."; *k* shows the smallest band with legend abbreviated to "Bi. Surv." followed by the series letter, and the number restricted to five figures; *i* shows a lock band with complete legend, the type used on waterfowl and other large birds; *m*, bands used by Dr. Paul Bartsch, bearing name of the Smithsonian Institution. (Photograph from Biological Survey)



1.—AN EFFECTIVE BACKYARD TRAPPING STATION

Several traps are in use, including a protected feeding station trap on elevated platform, a collapsible drop trap on the ground, and small window feeding shelf traps. (Photograph by Charles L. Whittle)



2.—PURPLE FINCHES AND JUNCOS FEEDING UNDER AND AROUND A DROP TRAP

Most of these birds are banded so the records of recapture here would be "repeats." (Photograph by Charles L. Whittle)



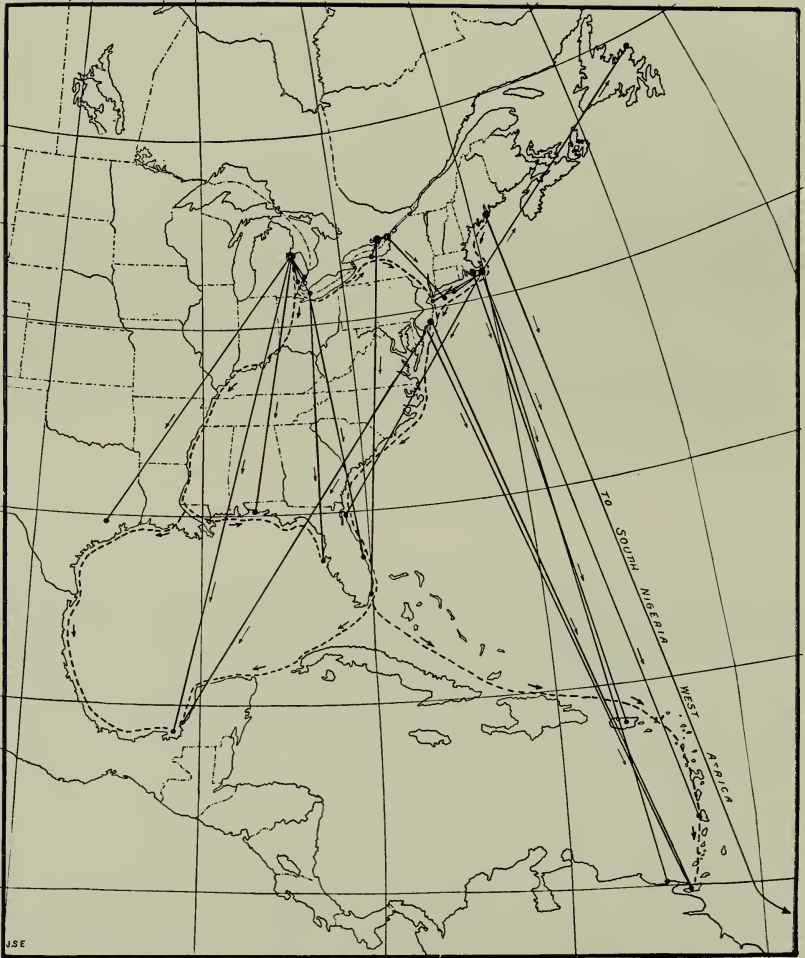
1.—MORE THAN 700 FLEDGLING CASPIAN TERNS, IMPOUNDED IN A CORRAL FOR BANDING, AT A COLONY IN NORTHERN LAKE MICHIGAN

(Photograph from Biological Survey)



2.—COMMON TERN BANNED ON THE COAST OF NEW JERSEY AND RECOVERED NEAR CARMEN, SOUTHERN MEXICO

The specimen in a mummified condition is preserved in a glass jar, as "No. 767" of the collection of "El Caos," Carmen, Campeche. (Photograph by Jose Jesus Cervera)



FLIGHTS MADE BY BANDED COMMON TERNS

The straight lines connect points of banding and recovery while the broken lines indicate theoretical routes that probably were followed. (Photograph from Biological Survey)



1.—THE AUTHOR IN A LARGE DUCK TRAP, SUCCESSFULLY OPERATED IN THE MARSHES OF THE ILLINOIS RIVER

Note the captured mallards gathered in the rear end of the trap. (Photograph from Biological Survey)



2.—DUCK TRAPPING STATION AT LAKE MERRITT, OAKLAND, CALIF.

Large numbers of pintails have been banded at this station. (Photograph by E. W. Ehmann)



1.—BANDED YOUNG BLACK-CROWNED NIGHT HERON

Returns from these birds have demonstrated many interesting features in connection with their migratory flights. (Photograph by W. B. Purdy)



2.—A BROOD OF BANDED SPARROW HAWKS

Several birds of this species, banded in Massachusetts, have been retaken in Maryland and Virginia. (Photograph by H. P. Ijams)



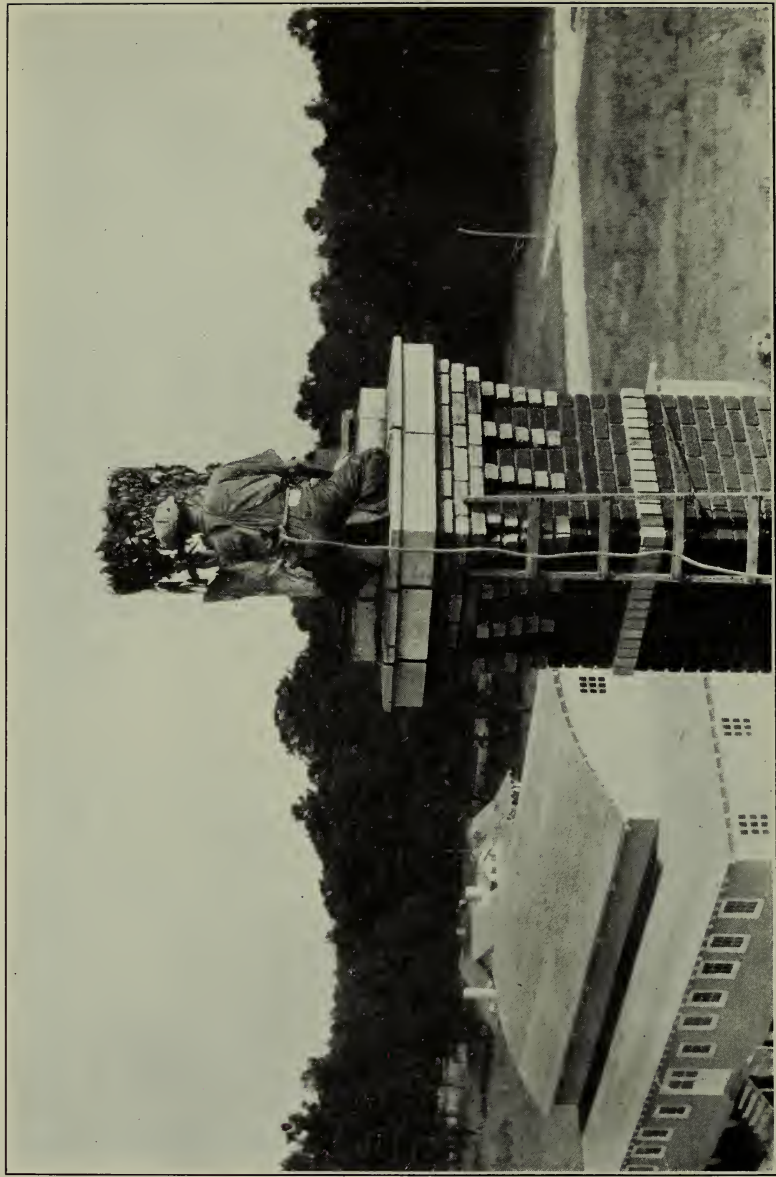
1.—BANDING A SNOWY OWL

Several of these Arctic visitors were marked with bands during the invasion of 1926-27. (Photograph by Frank J. Vejtasa)



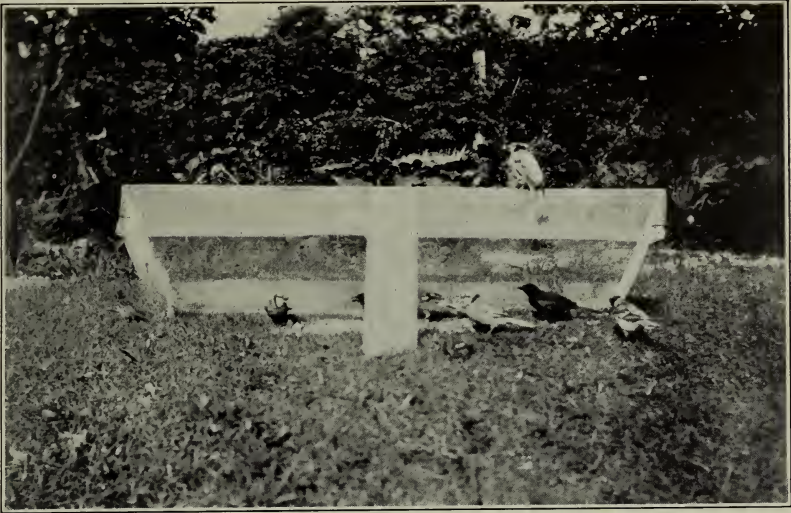
2.—SIX BANDED CHIMNEY SWIFTS

Many species of birds will lie on their backs for variable periods of time in seeming ignorance of their liberty. (Photograph by H. L. Stoddard)



TRAPPING CHIMNEY SWIFTS FOR BANDING

By means of specially constructed traps, thousands of these birds have been taken from chimneys where they gather before and after the nesting season. (Photograph by H. L. Stoddard)



1.—FIVE BLUE JAYS AND TWO BRONZED GRACKLES FEEDING AT A DROP TRAP

Both of these species are captured in large numbers, and important information is being obtained from banded individuals. (Photograph by E. C. Hoffman)



2.—A PRODUCTIVE WINDOW TRAPPING STATION

This station, operated at an upper window of a summer hotel, has been exceptionally successful. The birds are mostly purple finches with a ruby-throated hummingbird at the extreme right. (Photograph by Eleanora S. Morgan)

