BIRD-BANDING

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BLACK DUCK BANDINGS AT THE AUSTIN ORNITHOLOGICAL RESEARCH STATION ON CAPE COD, MASSACHUSETTS

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FOREWORD

IT IS my purpose, in this and several succeeding papers, to examine the data which have accumulated from nearly two decades of Black Duck banding in Massachusetts. It is particularly my purpose to see what light these bandings throw on the practical management of the species in the northeastern portion of its range.

At least eight individual banders or banding stations have trapped ducks in the state. While the Austin Ornithological Research Station at North Eastham was not the first of these, its records are exceptionally well adapted to serve as a foundation for the whole study. In explanation of this fact, it seems appropriate to review the banding program at the Station, and to note the ways in which its Black Duck bandings have been influenced by the techniques developed in connection with its even more extensive tern bandings.

The Austin Station is known primarily for its tern studies. It is seventeen years now since O. L. Austin, Jr., undertook the first general banding of adult terns in the Cape Cod breeding colonies. The Station was established soon afterward, and during all the intervening time has not only carried on the largest banding operations in the New England states, but by any of the usual criteria has stood among the top-ranking banding stations of the North American continent.

Its work has fallen into three general categories which dovetailed conveniently as to season. The tern studies have always been first; field work in the breeding colonies has extended from late May through July,

[1]Contribution No. 41 by the Austin Ornithological Research Station.

with tabulation and analysis of the data running on into the fall and early winter. Filling in before and after the terns, trapping and netting of miscellaneous passerines have been carried on in March and April, and of shorebirds and passerines from August to mid-November. Waterfowl banding has been the important winter activity, beginning with moderate volume in late July or August and coming to a peak from December to February.

The tern bandings at the Station have been organized upon a scale which makes them unique. Other bird-banders have turned out studies which were comparable in quality to the Austin work on terns, but I believe none have focussed the data from such great numbers of banded birds upon objectives which were so specific. The broad purpose from the beginning has been to discover the mechanics of population maintenance in a species with strongly developed colonial nesting habits—habits which imply a considerable subordination of the individual to the structure and reactions of the community.

The Cape Cod group of terns numbers some 30,000 birds. To make possible an adequate study of this community, chicks and adults have been systematically banded year after year. More than 70,000 adult terns alone have been individually trapped. The average content of banded birds in the population in any year is now better than 50%, which is to say that more than 15,000, of the 30,000 total population, wear bands. Of these banded birds, an average of about 3,000 each year are retrapped as breeding adults on the nest—an annual sample of 10% of the whole adult population.

These figures clearly outline the magnitude of the tern investigation at the Station, but only the experienced bander will appreciate all their secondary implications. The field work, of itself, has called for imaginative planning and a very unusual amount of energy and drive. In addition it has been necessary to devise, and unfailingly maintain, a system of records which would arrange and preserve the data without bogging down in rush seasons. Both O. L. Austin, Jr., who began the study, and Dr. Oliver L. Austin, who has carried it on during recent years, have been keenly aware of this necessity, and have given it close personal attention. The measure of their success is apparent in their reports, which build up a detailed analysis of community behavior in terns from the carefully sorted evidence of literally thousands of adult returns.

It is only natural that this major activity at the Austin Station should have influenced, and to some extent guided the development of, the other activities. The Black Duck project has benefited from the tern study in two important particulars:—it has had the same imaginative planning, and its files are equally complete and accurate.

Quantitatively, it has been of somewhat the same order; it will be shown later that with due allowance for the difference in objectives, the annual samples of the population have been large. Trapping these samples in the right places at the right time often meant hard work in dirty weather. Its accomplishment stemmed directly from lessons learned in the tern investigation. The personnel became accustomed to working with birds in great numbers, and when these numbers were not forthcoming from traps at a fixed location, they felt the necessity of extending their operations. This urge for adequate samples has characterized all the Austin work; in the Black Duck project it opened the way to some of the most significant findings with respect to local winter distribution.

As for the records, I cannot more effectively indicate their worth than by mentioning the personal satisfaction I have derived from studying them off and on over nearly seven years. My impression, on the day when Dr. Austin first showed me what they covered and how they worked, was that here lay definite answers to many of the most pressing questions of successful waterfowl management in New England. Since then, I have scanned and tabulated the record of every duck banded by the Station. I have never yet found an inaccuracy which could not be sufficiently cleared by a cross-reference, or any evidence of a serious failure to keep abreast of the field work. The total number of entries is well over 100,000.

There is one point to which the Station records bear eloquent testimony—that whatever truths may appear in this Black Duck study are the work of many heads and hands. It happens that the writing of the report has fallen to me, but only as the last link in a chain. To O. L. Austin, Jr., is due credit for the original plan, the basic methods, the bandings of the early years, and much keen advice in later years. Maurice Broun, Seth H. Low, L. J. Brewer alone, and then Brewer and E. A. Benchley, Jr., together, have in turn picked up the responsibility of daily trapping and recording, carried it well through days which were sometimes cold and tedious, and passed it on to others. The files show, by hundreds of entries, how each of them has contributed some part of his own enthusiasm to the work, and a proportionate share of information to the sum total.

PART I

GENERAL DESCRIPTION OF BANDINGS

Bird-banding records are sometimes dry stuff, sometimes extremely fascinating. In my own experience, they begin to be interesting when I have enough information to visualize clearly the circumstances of the original bandings, and when the returns or recoveries are sufficiently numerous to form the first dim outlines of a distribution pattern.

This section of my report is intended to satisfy the first requirement. It answers under various headings the questions which come up most commonly when a visitor opens the Black Duck files at the Station, looks through them at random, and feels an impulse to orient himself before going further.

GEOGRAPHICAL RELATIONS OF CAPE COD

A narrow peninsula thrusting straight out into the sea for thirty miles, then turning sharply north to run parallel with the mainland shore for another twenty miles—that is Cape Cod. Geologically, it is the great semi-circle of terminal and lateral moraines left by the lobes of glacial ice which once lay along the eastern coast of Massachusetts. Down the center of its basal portion runs a long ridge of rather high, scrub-covered hills, like a backbone, but when you have turned north at the elbow, the country is nearly flat. Actually, you do not notice the land so much as you do the water.

Everywhere you turn, there is water. Take any road, and within a few miles it will have carried you along the shore of some wide-spreading lake, past a dozen ponds covered with lily-pads, and across an inlet from the sea. In the middle distance there is always a great marsh with salt creeks meandering through it, or a broad bay bordered by a line of low dunes. And when the road climbs some elevation from which you look out across the marshes and the dunes, the whole background is water and more water, stretching away to the horizon—Massachusetts Bay on the north and west, the open Atlantic to the east, Nantucket Sound to the south.

You look across the water and see no lands, but lands are there. Directly east they are too far away to matter, but in other directions they are only a few hours as the birds fly. Beginning in the east-northeast and swinging westward through an arc of 85 degrees, you may see them in your imagination—shores rising from the far rim of the water, marshes and bays folded among the hills, the nesting grounds and gathering places from which Black Ducks come to the Cape in the

fall, and to which they return in the spring. Turning then directly west, and swinging slowly southward a full 90 degrees, you may look toward other marshes and bays where some of the ducks pass on to spend the winter. A dozen-odd reference points will fix the relations in mind:—

North 55° East: at 245 miles across open water, the southern coast of Nova Scotia; at 800 miles, eastern Newfoundland.
North 45° East: at 430 miles, Prince Edward Island.
North 35° East: at 360 miles, the Grand Lake region of New Brunswick.
North 25° East: at 480 miles, Baie Chaleur, New Brunswick; at 1000 miles, the coast of Labrador.
North 5° East: at 160 miles, still across open water, Merrymeeting Bay, Maine; at 1250 miles, Ungava Bay.
North 30° West: at 80 miles, Newburyport Harbor, Massachusetts; at 825 miles, southern James Bay, Ontario.
North 75° West: at 33 miles, Duxbury Bay on the mainland of Massachusetts.
South 70° West: at 120 miles, eastern Long Island.
South 50° West: at 30 miles, Martha's Vineyard; at 400 miles, Chincoteague Bay, in Maryland and Virginia.
Straight South: at 30 miles, Nantucket.

AUSTIN ORNITHOLOGICAL RESEARCH STATION

The Austin Research Station is about halfway up from the bend of the Cape toward the tip, on the inner side. The country through here is a slightly rolling plain or moor, elevated somewhat above the marshes and bays which cut in from either side, and sloping gently from east to west. You turn off the main road to the left among the pitch-pines, come out of the pines into open fields, and the Station buildings are ahead. You stop on the low grassy bluff which marks the westerly edge of the moor, and the site of the principal Black Duck bandings is before you.

At the foot of the bank, and stretching off to the right as far as the flats and open water of an arm of Wellfleet Harbor, is a hundred-acre salt marsh. Two drumlin islands break its surface, one of them large enough to carry a low growth of oaks and shrubbery. A narrow creek, its outlines half hidden by the tall waving thatch-grass of late summer, winds up through the marsh between you and the islands, and just to your left, divides into two branches of which one turns abruptly east. A dike with a roadway across it shuts off this branch, and with its upper side, holds back a narrow fresh-water pond.

Across the pond is a rounded sandy ridge covered with pitch-pine woods. It thrusts out to the west around the head of the marsh, the pine woods thinning out to scattered clumps, and then gradually changes direction to the north and east, hooking around more and more, flattening as it goes, until it comes to the level of the salt meadow almost across from you. Within the bend of it, there was once a scant two acres of

dry upper marsh drained by the second branch of the creek, but a low dike was thrown across from the point of upland back toward its base, and now there is another pond. From your present elevation you look across to it—a sheltered, shallow pond of the sort that birds like, a group of old flat-topped oak-trees shading part of its north shore, two or three sand-bars running out into it, the rolling, vine-covered hills shutting it in on three sides. This is the Dike Meadow, the base duck-trapping station since 1931.

Come now into the "bird-room" of the Station—the workshop where the records are kept. From its windows you look across the hills which shut in the Dike Meadow, and see what lies beyond. Northwest and west is the broad sweep of Wellfleet Harbor, bounded by Great Island, Jeremy's Point, and Billingsgate. Beyond them is Cape Cod Bay, thirty miles wide to the mainland shore. Between south-southwest and south lies the great bend of the Bay which becomes, when the tide is out, the Brewster flats, wintering ground of geese, brant, and Black Ducks.

Spread out a map of Cape Cod on the central table, and locate the bays and marshes where supplementary trapping operations have been carried on by the Austin Station and others:—

South 55° West: at 20 miles, the Barnstable marshes.
South 20° West: at 10 miles, Long Pond, Harwich, where James J. Storrow banded Black Ducks from 1928 to 1942.
Straight South: at 3 miles, Great Pond in Eastham.
South 5° East: at 18 miles, upper Monomoy Island.
South 15° East: at 8 miles, the head of Pleasant Bay.
South 30° East: at 3½ miles, Nauset Marsh.

BLACK DUCKS: SEASONAL POPULATIONS AND ROUTINE HABITS

There are always Black Ducks on Cape Cod, but in the early summer they are neither numerous nor conspicuous. They are back in the brooks, the cranberry reservoirs, and the fresh-water swamps, nesting and molting. If you quietly follow up some creek past the point where thatch-grass grows, and get into the zone of plants which tolerate only an occasional dose of salinity, you may come across a mother duck with her brood of ducklings, or disturb a group of half-grown flappers. For a moment there is wild confusion as the birds spatter across the surface to the nearest cover, and then it is as quiet as before.

By late July some of the Blacks have their new wings, and begin to be seen more commonly. In the early evening family parties of four to eight birds circle the Dike Meadow once or twice, and then drop in on set wings to light among the decoy ducks, and dabble with them for corn. In a week or two there may be thirty or forty of them using the pond, and going out in the morning with a great rush of wings and much loud quacking at the first sign of movement around the house. They scatter

about in the overgrown creeks north of the station, and keep coming back by pairs and threes during the day, to reconnoitre.

September brings the first noticeable accessions from off the Cape. Now there are enough birds so that you find them more generally. Many still spend the day in the bogs and fresh-water swamps, but others are settling down in the wider salt-marshes, where they poke about at high tide feeding on the thatch-grass seed. As the tide goes out they swim down the ditches in little files, and pull up on some grassy bank to loaf in the sun. At dusk good-sized bunches of them are silhouetted against the western sky as they fly out to feed on the flats. By the end of the month you may see more than a hundred at once in the Dike Meadow or on the marsh north of the Station, and three or four hundred in Nauset Marsh.

In October the shooting season begins. At once the Blacks change their routine, all getting up from the meadows and the creeks at the first graying of the eastern sky, and going out on the Bay to idle away the daylight hours beyond gunshot from the shore. They gather in loose rafts, and doze with heads beneath their wings, and if a boat comes too close, get up and drop in again a mile away. Each day, almost, the rafts are larger, and when the birds pour back into the marshes after dark to feed, their wings make sweet music to the gunners homeward-bound.

November passes and December comes. There are rough days now—days when the Bay is too choppy for comfort, particularly when the flying spray freezes where it falls. Many ducks come inside at high water, and shooting looks up for the more experienced gunners. The winter Blacks have nearly all arrived, and every morning the Dike Meadow traps are loaded with them—heavy, smooth-feathered, red-legged, and strong. Toss up the new birds one by one as Len passes them to you from the little doorway, and the sun gleams momentarily on each bright new band before the leg is drawn up close to the body. Bird after bird scales away to leeward, skimming the meadow until it is clear of the land and then climbing higher and higher as it comes about into the wind and goes off over the Bay with fast-beating wings.

And now comes the first hard freeze-up. It may be before the gunning season ends, or it may be delayed a week or two after. The fresh-water ponds are closed tight, the upper meadows skim over, the creek-banks are temporarily cased in ice, and on the bayside a cold northwest wind begins to pile along the beach the floes of mushy slob-ice which are forming offshore. By morning the Bay is frozen as far as you can see, and only the tidal inlets, where the current runs strong, are still open. Here the ducks are concentrated, and here they will remain,

shifting about only as they are actually forced to by the exigencies of weather, until the break-up in February. You can make a rough count of them today, and if you recount them a month from now under similar circumstances, the total is not likely to be very different. They will feed on the flats as the tide goes out, and loaf and sleep not very far away when it comes in. On good days they will sit in the sun; on bad, they will huddle in the lee of any available shelter.

It is not hard to count the Blacks on day high tides when the moon is new or full, for then the water comes over every foot of the meadow and floats the birds into sight. You can cover the whole study-area from Wellfleet to the lower end of Pleasant Bay in two days, and re-check it on the next run of high tides two weeks later.

The TOTAL WINTER POPULATION is fairly constant from year to year. A normal figure when the Blacks are up is 7500-8000. During peak years it may approach 10,000; in very bad years like 1934-35 it may drop below 3000. It will be shown later that the total fall and winter population is greater than the winter population, alone, only by the approximate number of birds shot; the percentage of birds which migrate through the Cape on their way south is comparatively small.

FLUCTUATIONS IN TOTAL POPULATION, when they do occur, may be abrupt. Black Ducks appear to have a rather short life expectancy. Longevity will be discussed at greater length in a following paper, but the general situation should be indicated here by three facts. The three oldest recoveries in the Station files are respectively 11 years 7 months, 11 years 6 months, and 10 years 6 months. In normal years the percentage of birds-of-the-year either trapped or shot is well over 50. During and following low years the percentage of 1-year and 2-year returns may fall very low.

The DISTRIBUTION OF THE WINTER POPULATION varies much more from year to year than its total numbers. This, too, will be discussed at a later time, but should be introduced here as part of the background. The normal winter population within a 3-mile radius of the Station is probably about 600 birds, but it may go as high as 1800, or in seasons of severe icing, may drop to nearly zero. The figures for Pleasant Bay are the most even from year to year, running from 3000 to 4500 in the five years 1938-42.

Summing up the population picture, it may be reasonably estimated that the birds trapped annually at the Station have been taken from fall and winter totals of 600 to 1500; the birds trapped in Nauset Marsh and Pleasant Bay from winter totals of 4000-5500; and all trapped birds together from an average regional population of about 7000.

METHODS OF TRAPPING

In the years that Black Duck banding has gone on at the Austin Station, the staff have experimented with a great number of different traps, and all the available baits. From this experience have come four general rules:—big traps built in place, funnel entrances properly adjusted, sand floors whenever possible, whole corn for bait.

The simplest, safest, and most effective trap used in recent years requires a dozen slender poles 7-8 feet long (usually pitch-pine of 2 inch diameter), a piece of heavy-gauge, 1 inch mesh, hexagonal chicken-wire 5 or 6 feet wide and 22-23 feet long, and a piece of the same or lighter-gauge wire 6 feet square to cover the top. The poles are driven into the ground to form a circle about 6 feet in diameter, the interval between poles being about 1½ feet except on the side toward the water where a gap of 3 feet leaves space for the entrance. The long netting is then placed around the circle, wired to the poles and pegged to the ground, the loose ends at the opening turning in toward the centre. These ends are wired together from about a foot above the ground up to the top, two additional poles are driven in to brace the curve of the resulting funnel-sides, and the top-netting is wired on. An opening is cut in one side or the top, and a light wire-covered door rigged over it to facilitate entrance by the attendant. The open V of the funnel at the bottom is then adjusted by bending the wire-ends until the aperture without pressure is 2-4 inches wide according to circumstances, and the trap is ready for baiting. It is rigid enough for all practical purposes, large enough to hold a big catch of ducks, has no sharp corners where they can crowd and trample each other, and the funnel entrance both catches and holds them. Its headroom is a great convenience to the operator who unloads it; he goes inside, catches each bird with a short-handled net, and releases, or passes it out to a helper, through a slit at the top of the door.

A trap of this type has been used at the Station pond on a broad sandy point in the northwest corner, where it stands 15 feet from the water's edge. Across the pond, and well out from shore on a low sand-bar, is a large drop-door goose-trap made of pipe and wire-netting. On either side of this trap are duck-traps of the same fundamental design as the above, and opening from the back wall on the inside is still another. With this rig, ducks are taken automatically night after night regardless of whether the goose-trap is sprung or not.

Trapping on the salt inlets and marshes is more difficult than at the Dike Meadow or any other site with a fixed water-level, for the mean tidal fluctuation at Wellfleet is ten feet, in Nauset Marsh six feet, and in addition to the lunar tide-cycles, there are daily ups and downs caused

by the winds. If the traps are on top of the meadow the water reaches them so irregularly that the ducks never form a habit of coming to the corn; built on the flats, a high tide may drown the captive birds. Yet the bulk of the population is on tide-water, particularly in winter, and must be sampled.

The problem has been met by selecting locations on banks, preferably sandy, with a slope of 20-25 degrees from the horizontal, and then building each trap with modifications to fit the exact circumstances. One successful trap was four or five times the normal size and built around a fresh-water seepage partway up the slope; the V-entrance, instead of operating only at ground level, was made continuous from bottom to top so that birds could enter at any height of tide. When the tide was down, they worked up the trickle of water from the spring, and so into the trap; at high water they swam in. Another productive trap consisted of two chambers connected by a runway:—the lower chamber on a sandy flat near low-water mark, the upper on the beach above high water. The ducks entered the lower pen at low tide, and as the water rose, went up the runway to the upper enclosure where they stayed, dry and warm, until taken out in the morning.

Floating ice is a further complication in mid-winter, particularly when it is pushed along shore by the wind and comes up against the traps with a shearing motion. The best offset is the type of construction in the trap itself; the driven poles withstand moderate pressure without damage, and if the ice is heavy enough to crush the trap it may be quickly and inexpensively rebuilt when conditions improve.

The biggest one-day catches of waterfowl by the Austin Station have been at Pleasant Bay and Nauset Inlet during mid-winter cold spells:—January 23, 1940—303 Black Ducks and 73 Canada Geese; January 20, 1941—395 Blacks, 5 Canada Geese; February 5 and 6, 1941—440 and 441 Blacks.

The biggest haul of ducks in a single trap was on February 5, 1941:—388 Blacks on a biting cold morning when reading and recording the bands was a task which long outlasted the excitement of the catch.

SEASONAL DISTRIBUTION OF ORIGINAL BANDINGS

The first step in solving any particular question with banding data is the sifting of the material to determine what portions of it are applicable. To state the same general idea from another point of view, the broader and more diversified the data, the more questions they will answer. It is appropriate, then, to consider the mass and distribution of the Austin data before proceeding to specific problems.

A BANDING SEASON in this report is arbitrarily defined as beginning on June 1 and ending the following May 31. The reasoning is:—any possible northward migration of Black Ducks off the Cape is concluded by the last of May, the number seen during June and early July is minimum, and there is no other break so well defined, and therefore so convenient. The population curve rises smoothly from late July to early December, stands nearly stationary through early February, and then declines rather quickly to a low in early April.

The first Blacks were banded at the Austin Station in the spring of 1931. Large-scale trapping began in November of the same year and continued through the spring of 1942. Shortage of corn and labor caused by the War brought about curtailment during the fall of 1942, followed by suspension in January, 1943. The ensuing three and a half years have brought in the bulk of the expectable recoveries from the bandings of the later years, so that the records are now approximately complete.

The AGGREGATE TOTAL of all original bandings during these thirteen seasons was 10,371. Of these about 5500 were trapped at the Station itself, about 4200 at Pleasant Bay and Nauset Inlet during a special study of winter distribution during the years 1939-1941, and the remainder in three small operations at Eastham Great Pond and Pleasant Bay. Table I supplies the totals, by months, for the whole number. Chiefly, this table gives a broad picture of the seasonal distribution of bandings at the Station proper, upon which two or three comments are in order.

The monthly bandings afford some interesting comparisons from year to year, but they must be considered suggestive rather than conclusive, for they involve several unmeasured variables. In the first place, the number of ducks trapped before mid-September, which fluctuated widely over the years, depended not only on breeding-season success in the very limited local region, and on the rather erratic distribution of Blacks in late summer when the habitat offers them the widest possible choice of feeding and loafing grounds, but on somewhat irregular operation of the traps by Station personnel due to pressure of other work. Again, the numbers trapped after late December were materially affected by ice conditions; in a severe winter the Station waters are frozen tight where in milder winters they remain partly open. Finally, from 1939 to 1941, winter trapping at the Station was curtailed in order to give more time to the larger operations at Pleasant Bay and Nauset.

On the other hand, both the effort applied to trapping and the effect of natural conditions on the take were fairly uniform in October, November, and December, so that the combined figures for those months offer some indication of population trends.

TABLE I

Original Bandings of Black Ducks by Austin Station

	Banded season of	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total bandings for season	Total original bandings, all seasons
Birds Banded at Austin Station, South Wellfleet	1930-31										6	2		8	
	31-32	3					148	216	137	41	55	13		613	
	32-33			2	47	241	274	252	87	52	31	29		1015	
	33-34			13	69	116	138	202	52	48	24	28		690	
	34-35			63	9	13	10	5	12	13	5			130	
	35-36		3	53	38	39	9	15	19	38	2	4		220	
	36-37		33	93	45	29	53	31	14	21	21	14		354	
	37-38		36	62	44	112	49	41	49	26	34			453	
	38-39		1	19	16	41	110	43	47	32	17			326	
	39-40			41	43	36	47	44	129					340	
	40-41		4	9	47	102	82	400	34	13	8			699	
	41-42			138	64	73	53	137	12	24	11			512	
	42-43		2			11	60	44	38					155	
Totals by months		3	79	493	422	813	1033	1430	630	308	214	90			5515
Bandings at Great Pond and Nauset Marsh, Eastham, and at Pleasant Bay, Orleans.	1932-33						30	132	52	12	39	43	26	334	
	34-35									170				170	
	35-36									130				130	
	38-39								358	43				401	
	39-40							772	1414	373				2559	
	40-41								1050	212				1262	
Totals by months							30	904	2874	940	39	43	26		4856
Aggregate total of all original bandings															10,371

Making due allowance for the disparities noted above, the SEASON TOTALS with the October-December totals checked against them fall into a pattern which probably has some significance. It will be noted that bandings were above normal in '31-'32, reached their highest point in '32-'33, and held up fairly well through December of 1933, when they suddenly slumped. There is much corroboratory evidence in the files that this period was actually the turning point to the extreme low of the following year, when only 67 Blacks were trapped during the whole season after August. Thereafter there was a slow recovery for three seasons, a minor recession for two, followed by full recovery in 1940-41 to a point comparable with '31-'32 and '32-'33. The fall of 1941 brought a peak banding of local-raised birds in August, followed by recession in late fall. In a rough way, this history probably follows the trends of the regional population during the years of banding.

The MONTHLY TOTALS for the whole 12-year operation at the Station proper show an excellent distribution of bandings over the ten months when Blacks are on the Cape in numbers, and this distribution is further emphasized in Table II, which reduces the figures to percentages and then groups them by seasons. Particular attention is called to the fact that more than 10% of the whole number of birds (575 out of 5515) were banded before the end of August, and that more than half were banded before December 1.

SEASONAL DISTRIBUTION OF REPEATS AND RETURNS

One more table completes the general description of Black Duck bandings at the Austin Station.

Repeats and returns of banded birds are of great importance in working out local movements. By persistent and flexible trapping opera-

TABLE II

DISTRIBUTION OF BANDINGS BY MONTHS AND SEASONS

Month	Number Banded	% of Total Bandings	Distribution by Seasons
June and July	82	1.4	18% (997) during season when most birds trapped are probably local-raised.
August	493	8.9	
September	422	7.7	
October	813	14.7	34% (1846) during season of arrival and possible further migration southward.
November	1033	18.8	
December	1430	26.0	37% (2060) during season when birds are mostly static.
January	630	11.4	
February	308	5.6	11% (612) after start of spring migration.
March	214	3.9	
April	90	1.6	
Totals	5515	100.0%	100% (5515)

TABLE III

Total Trappings of Black Ducks by Austin Station

	Trapped season of	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total trappings for season	Total trappings, all seasons
	1930-31										11	3		14	
	31-32	3					162	386	275	88	177	31		1122	
Birds	32-33			2	106	453	702	1296	1788	1681	1458	464		7950	
Trapped	33-34			18	204	188	413	836	602	893	381	214		3749	
at	34-35			153	62	21	20	11	25	54	16			362	
	35-36		3	204	414	431	79	63	138	120	16			1468	
Austin	36-37		52	289	444	362	374	287	82	112	196	115		2313	
	37-38		40	247	216	573	732	576	297	268	263			3212	
Station,	38-39		1	40	31	369	723	486	263	195	72			2180	
South	39-40			54	79	115	120	228	492					1088	
	40-41		4	10	73	325	221	1870	646	169	141			3459	
Wellfleet	41-42			394	524	328	446	1236	682	397	178			4185	
	42-43		2			14	129	186	235					566	
Totals by months		3	102	1411	2153	3179	4121	7461	5525	3977	2909	827			31,668
Trappings	1932-33						41	244	501	229	361	683	676	2735	
at Great Pond	34-35									723				723	
and Nauset Marsh,	35-36									551				551	
Eastham, and	38-39								478	74				552	
at Pleasant	39-40							1198	3450	1098				5746	
Bay, Orleans.	40-41								3407	1528				4935	
Totals by months							41	1442	7836	4203	361	683	676		15,242
														Aggregate total of all trappings	46,910

tions, the Austins have built up a mass of recapture records which must be nearly unique for any single species of waterfowl. Table III, summarizing the seasonal distribution of total trappings (new birds, repeats, and returns), supplies the means of measuring these retrappings.

Subtraction from any item in Table III of the corresponding item from Table I gives the total of repeats and returns for the given period. Thus for the Station proper, total trappings of 31,668 (Table III) minus total original bandings of 5515 (Table I) leave a total for repeats and returns of 26,153. Dividing this total by the number of original bandings gives the average number of repeats and returns per duck banded.

For every duck originally banded at the Station proper, there have been 4.7 repeats and returns.

This is an average figure; since many hundreds of birds were caught only once, the actual retrappings of the remainder were very much more numerous. The files are full of cases in which an individual duck was trapped again and again, not only in one season, but during successive seasons. Thirty birds banded in the 1932-33 season were in the traps 1680 times, an average of 56 times apiece. One bird was trapped 23 times in six seasons, another 42 times in nine seasons, a third 92 times in eight seasons, a fourth 121 times in four seasons. More important are the records of ducks which were caught less often, but at significant times and places. Among them are birds which were found fall or spring at the Station itself, but were unrecorded in winter until traps in new locations at Nauset turned them up, and then caught them again the following winter. One group of birds was trapped regularly at the Station until a severe freeze-up; within a few days they were showing up in the Nauset traps, and then returned to the Station when the ice went out again. A single bird, by repeats and returns, established a consistent pattern of appearance at the Station over four years, and then was recovered 300 miles away just before the time when it might have been expected to return for the fifth year.

These cases need not be multiplied further to emphasize the volume of the Austin Black Duck bandings. It is clear enough, I think, that the material is inclusive and well proportioned within natural limits. Thoroughly analyzed, it should result in a clearer understanding of migratory movements, local ecology, and population maintenance.

This being so, we may proceed to the consideration of specific problems of distribution.

PART II

NORTHWARD RECOVERIES OF CAPE COD BLACK DUCKS

I suppose that few banders have released a trapped bird, the aluminum ring on its leg, without speculating at least idly on where it came from, whither bound. These queries are renewed when recovery cards come in; the typical reaction is to trace on a map the distance and direction of flight revealed by each recapture. It is the travels of birds which most frequently attract the interest of man.

The great bulk of Austin Black Duck recoveries off the Cape have come from eastern Canada. They have been numerous and regular. They suggest a direct and material connection between the Black populations of the two regions, and in fact indicate that the Maritime Provinces and Newfoundland are the chief sources of Cape Cod Black Ducks. It is appropriate, therefore, to examine first of all the distribution of these northward recoveries for the general purpose of determining how conclusive they really are.

DESCRIPTION OF DATA

Of the 10,371 Black Ducks banded by the Austin Station, 430 have been recovered north of Massachusetts. Fifteen of these were birds which were banded in late summer or fall, and recovered the same fall in Maine or eastern Canada. So far as Cape Cod is concerned they seem to constitute a problem of post-breeding-season dispersal rather than of source, and are therefore excluded from the present calculation. There remain 415 northward recoveries which are almost exactly 4% of the total bandings.

In Table IV these records are broken down as to place and season of original banding, and state or province in which recovered. The recoveries are then totalled by season and divided by total bandings in season to give (in the last column) the percentage of birds recovered from each season's banding.

A quick test of Table IV is in order, to determine both the upper and lower limits of its usefulness. Comparison of the recoveries by states and provinces shows wide fluctuation from year to year. Four-fifths of the Labrador recoveries, one-half of those from Ontario, were banded in two seasons. The ratio between recoveries in Quebec and in Nova Scotia is 8:2 for 1931-32 bandings; 1:8 for 1937-38. It already appears, then, that the body of the table, segregating recoveries by states and provinces alone, reveals no consistent pattern. Either the northward return of Cape Cod Blacks is somewhat erratic from year to year, which is quite possible; or the various uncertainties of both trapping and recovery operate unevenly over short periods of time, which is also possible and indeed highly probable.

TABLE IV

Northward Recoveries of Black Ducks Banded by Austin Station

	Birds banded season of	New Hampshire, Vermont and New York	Maine	New Brunswick	Ontario	Quebec	Prince Edward Island	Nova Scotia	Newfoundland	Labrador	Total recoveries in season	Total birds banded in season (from Table I)	% of banded birds recovered
Birds originally banded at Austin Station, South Wellfleet, and Great Pond, Eastham	1931-32		5	10	1	8	1	2	4		31	613	5.1
	32-33		6	8	4	12	1	11	5	4	51	1349	3.8
	33-34			2		6	2	9	3		22	690	3.2
	34-35			2				1			3	130	2.3
	35-36		1	4		4	1	5			15	220	6.8
	36-37		3	5		6	2	4			20	354	5.6
	37-38			2		1	2	8	2		15	453	3.3
	38-39		1	5	1	1	2	3	2		15	326	4.6
	39-40	1	2			1	1	3			8	340	2.4
	40-41		2	11		2	5	6	1		27	699	3.8
	41-42	1		2	1	1	3	5	1	1	15	512	2.9
	42-43	1			1			2			4	155	2.6
Totals by states and provinces		3	20	51	8	42	20	59	18	5	226	5849	Average
% of total recoveries		1%	9%	22%	4%	19%	9%	26%	8%	2%			3.9%
Birds originally banded at Nauset Marsh and Pleasant Bay	1934-35					2		1			3	170	1.8
	35-36		2	1		2				1	6	130	4.6
	38-39			4		2	4	8	1		19	401	4.8
	39-40		9	20	1	3	21	39	12	7	112	2559	4.4
	40-41		2	12	2	3	6	13	11		49	1262	3.9
Totals by states and provinces			13	37	3	12	31	61	24	8	189	4522	Average
% of total recoveries			7%	20%	2%	6%	16%	32%	13%	4%			4.2%

If now the individual entries of the table are totalled, their significance is more apparent. Added across, and converted into percentages of banded birds recovered, seventeen separate samples give results ranging from 1.8% to 6.8% Dropping the four extremes, two at either end, brings the range between 2.4% and 5.1%. Twelve annual samples from the Austin Station proper, many of the birds banded before and during the gunning season so that they suffered some loss from shooting during the fall, produce an average northward recovery of 3.9%. Five samples from Pleasant Bay and Nauset, all banded after the gunning season, give an average recovery of 4.2%. At this point it is evident that we are dealing with a comparatively dependable value—that annual samples of Black Ducks banded on Cape Cod will consistently produce northward recoveries of about 4 per cent.

We may also infer that if the rate of recovery is so consistent in spite of weather, length of gunning season, and innumerable other unmeasured factors, the distribution of recoveries will tend to be similarly consistent. This deduction is strengthened by totalling the vertical columns of Table IV:—it now appears that the fluctuations even out over a term of years, and the recoveries begin to group themselves along definite axes of migration, with significant differences in recovery between fall-trapped and winter-trapped birds. These trends are most readily studied on a map.

In plotting the northward recoveries on a map, I have broken down the data along different lines. The shorter the term of a recovery, the greater its value as an indicator of migration route. A Black Duck last in the traps on Cape Cod in March, and recovered in eastern Canada early in April, is almost sure to have been nowhere else during the interval. If the same duck is not recovered until fall, however, there is introduced the uncertainty as to where it spent the summer, and by the second spring, there is the added doubt as to whether it even re-wintered on the Cape. Separating recoveries according to elapsed time is a useful check; divergent patterns may call attention to significant factors not otherwise suspected, and convergent patterns are strongly corroboratory of each other.

Map I (insert) shows the 415 northward recoveries in four classes according to season of year when recovered, and elapsed time since last trapping on Cape. Numerically, this classification works out as follows:

Recovered before Sept. 1 of first summer (solid red)	64	15%
Recovered between Sept. 1 and Jan. 15 of first fall (solid black)	179	43%
Recovered in spring or summer more than 12 months after final record on Cape (red circle)	49	12%
Recovered in fall or early winter more than 18 months after final record (black circle)	123	30%
	415	100%

From these figures are derived average ratios of seasonal and elapsed-time recoveries which may be used in checking corresponding ratios in smaller areas:—

Fall and winter recoveries : spring and summer recoveries	=	3 : 1
First year fall and winter : all other fall and winter	=	1½ : 1
First year spring and summer : all other spring and summer	=	1¼ : 1

The map confirms at sight the deductions already drawn tentatively from the table. Recoveries are grouped significantly, and in general show converging and complementary patterns. At the same time there are minor divergencies which attract attention:—the high ratio of first-year fall recoveries in the Merrymeeting Bay region of Maine, and of first year spring records in eastern Newfoundland, for examples.

Since both table and map raise interesting questions of distribution, the next step is to analyze the recoveries step by step, filling in from the records the details which complete the story.

GENERAL DISTRIBUTION OF RECOVERIES

The most striking fact brought out by the map is the massing of recoveries in a northeasterly direction. As the eye moves back and forth across the page it is held briefly and in turn by the tight groups of dots centered about Merrymeeting Bay in Maine, Grand Lake in New Brunswick, the New Brunswick-Nova Scotia border, Minas Basin and the coast of Yarmouth County in Nova Scotia; but each time it moves on. These places are all famous ducking-grounds; it is to be expected that the ducks would be there, that the gunners would be there too, that the bands would come from there. Each time, attention returns to the comparative dearth of recoveries north of the Cape in Maine and Quebec, as compared with their abundance to the northeast in Nova Scotia, Prince Edward Island, and Newfoundland. Can this impression be reduced to some definite form?

The broken red lines on the map divide northern New England and eastern Canada into equal sectors, each 25 degrees in width. When the recoveries which fall within each sector are tabulated, the results are as follows:—

Sector 1. Nova Scotia, Newfoundland, Prince Edward Island, extreme eastern New Brunswick	255	61%
Sector 2. Eastern Maine, most of New Brunswick, eastern Quebec, southern Labrador	106	26%
Sector 3. Western Maine, central Quebec, northern Labrador	30	7%
Sector 4. New Hampshire, Vermont, western Quebec, James Bay	17	4%
Sector 5 and west. New York and southern Ontario	7	2%
	415	100%

It is not difficult to think of possible flaws in this tabulation; the ratio of recoveries to birds present in Newfoundland, for instance, is doubtless higher than in the interior of Labrador. Nevertheless, 87% of the

actual recoveries from Cape-banded birds have come from the two eastern sectors, over 92% from east of north. The trend is so strong and consistent that it must have substantial significance.

This opens the way to a further deduction. If the bulk of the recoveries are coming from the direction of Nova Scotia, it follows logically that the ducks are leaving and returning to Cape Cod by the direct route over water. In view of the complete absence of first year fall birds from eastern Maine, the handful of recoveries from any part of Maine, and the lone bird from coastal New Hampshire, it is difficult to think otherwise. The manner of arrival at the Cape, to be discussed later, supports the same conclusion.

SPRING AND SUMMER RECOVERIES

I have mentioned already that Black Ducks recovered to the north the first spring after banding furnish the most direct and dependable evidence of migratory movements.

There are few instances of recoveries soon enough to be counted in days. The method of recovery may partly account for this, but certainly a chief cause is that Blacks are much less regular in attendance at the traps on the Cape after early March, thus reducing the chance that a bird will have been recorded within a day or two of departure. Again, the bulk of them leave the Cape at a time when only the coasts of the Maritime Provinces are open; many of them must delay on the way. The shortest elapsed time was made by a duck banded at Great Pond, Eastham, on March 9, 1933, recaught eight times to the morning of April 16, and recovered in a muskrat trap at the head of Hermitage Bay, Newfoundland, on April 22, six days later. There are also records of 25 days and 34 days elapsed time to the St. Lawrence estuary in Quebec.

The Hermitage Bay record leads directly into an interesting aspect of spring and summer recoveries—the method of capture. Of the 113 spring and summer recoveries, 47 were reported as "caught in muskrat trap." A dozen more from the same localities and at corresponding dates were "captured," "taken," or "found dead," all of which terms are probably euphemisms for the first. Adding to these some part of the 27 birds for whose death no cause was given, it appears that upward of 70% of the spring recoveries were the result of muskrat trapping.

Some of these birds were released alive, and two of them lived long enough to arrive at more distant points on their routes. The first was banded at Great Pond, Eastham, on March 17, 1933, the hard year when so many Blacks failed to go north at the normal time. It was retrapped thirteen times to May 28, when the traps were closed. Three years later it was already in Northumberland County, New Brunswick, on May 8, when it was caught in a muskrat trap and released. During this same summer of 1936 it was shot by an Eskimo on the Whale River,

at the head of Ungava Bay, thus closing one of the most colorful careers of all the Austin-banded ducks.

The other of the two was banded at Salt Pond Channel on Pleasant Bay, Feb. 12, 1936, was released from a muskrat trap in Saguenay County, Quebec (north shore of the St. Lawrence), May 1, 1938, and was shot at the Ragged Islands on the Labrador coast north of Cape Harrison in August, 1939.

Muskrat traps catch the greatest number of Blacks, or at least are most frequently reported as catching Blacks, in New Brunswick (22 out of 27), Maine (6 out of 8), and Newfoundland (14 out of 28). In Newfoundland to some extent, and all through the interior of Labrador and northeastern Quebec, Blacks are hunted after their arrival in the spring and the bands are returned with the notation "shot." Coming at the start of the breeding season, either unintentional trapping or deliberate shooting must cause rather serious losses, but both practices are of long standing in that country. In Newfoundland, much more thickly settled than Labrador, shooting apparently accounts for the high ratio of first-spring recoveries.

Turning now to the distribution of spring and summer recoveries, there is an obvious difficulty in surmising whether a given bird has arrived at, or is only en route to, its breeding ground. The bulk of the recoveries in Maine and New Brunswick fall in the last half of April; in Newfoundland, Labrador, and Quebec they are in May. All the northern provinces and territories show scattering recoveries in June, July and August. Eastern Newfoundland has the greatest number of recoveries, most of which may be reasonably supposed to represent birds on their nesting grounds. To bring the rest of the picture into focus, let me comment briefly on other states and provinces with the full records before me.

Maine has eight recoveries, all but one of them east of the Penobscot, and in April. Some of them may have been nesting birds, but locality and time make it equally possible that they were following up the Penobscot and St. Croix valleys to the north-northeast. The complete absence of spring recoveries from northwestern Maine and New Hampshire must be significant; surely if the birds were there they were as likely to be recovered as along the north shore of the St. Lawrence.

New Brunswick is second only to Newfoundland in number of recoveries. Except for the Grand Lake region, they are rather conspicuously coastal; there are none in the western half of the province. More than half of them are in April, all but one of the rest in early May. I have already cited the case of the bird trapped on the Miramichi on May 8, killed in northernmost Ungava the same summer. The only definite breeding-season record for New Brunswick is on the Kennebe-

casis during July, and incidentally, a muskrat trap was the instrument of capture.

In Nova Scotia the low ratio of spring to fall recoveries suggests some difference in the season or methods of muskrat trapping rather than an absence of ducks. None of the ten records are definitely ascribed to trapping. Four of the eight were "found dead" in March, either in the Yarmouth-Pubnico region or in Minas Basin. These are both wintering grounds, and since all four birds had been unrecorded at the Cape for more than a year, they could have been winter casualties. No two were recovered in the same year. Early May records and one July record are on the coast; two late May records on fresh water, inland.

Prince Edward Island's two records are in early May and mid-August.

Quebec stands third in number of spring and summer recoveries. Quebec and Labrador together have thirty-four, six more than Newfoundland. Nine of them are on the Gaspé Peninsula, mostly coastal, in April, May, and June. One is on Anticosti, in April. Four more are west of the Saguenay River, and will be discussed later in connection with the Ontario records.

This leaves twenty spring and summer recoveries in all the great wilderness of eastern Quebec and Newfoundland Labrador. On the map they seem thinly scattered, but actually they are so grouped that their significance may be greater than their numbers. In point of fact, there are recoveries wherever there are people to make them, just as on Newfoundland the dots are concentrated in the settled eastern and north-central districts, and entirely lacking from the uninhabited centre of the island. Thus it is not likely that Cape Cod birds would be recovered at each little settlement along the north shore of the Gulf of St. Lawrence, and at Goose Bay and Northwest River west of Hamilton Inlet, and then at Cartwright and Hopedale and Davis Inlet on the Labrador coast, unless there were also Cape birds in the unexplored country lying between. It is particularly unlikely that four Blacks from the Austin Station would turn up in three different years at the tiny settlements of Fort Chimo and Whale River Post, near Ungava Bay, unless there were others in the same general vicinity and in the 500-mile stretch of wilderness to the south.

Taking now a broad look at these separate groups of spring and summer recoveries, how do they add up? They surely indicate that Newfoundland is an important source of the Black Ducks which come to Cape Cod, and they suggest that Labrador and eastern Quebec may be equally important. It is true that almost all Newfoundland and Labrador recoveries were banded on the Cape in December and January, thus representing chiefly the winter population, but the obvious explanation is that they arrive by way of maritime Nova Scotia, where the freeze-up

is late. Fewer Quebec recoveries were banded in mid-winter at the Cape, more in October and November. Together, Newfoundland, Labrador, and Quebec recoveries were banded in about the same monthly proportions as all recoveries; they represent an approximate cross-section of the whole Cape population. Maine, New Brunswick, Gaspé, and Nova Scotia probably supply minor rather than major fractions of the Cape Black Ducks, for many of the recoveries in these nearer regions must be migrants on their way north.

Clearly, the general trend of these spring and summer recoveries is northeast, and toward the further limits of the Black Duck's summer range.

FALL AND WINTER RECOVERIES

Fall and winter recoveries raise fewer questions, in proportion to their numbers, than those of spring and summer. Their salient aspects are at once apparent from the map and call for only brief comment.

In Newfoundland the distribution is interesting, with the fall recoveries lying in general to the southwest of summer records and toward the coast. The arrangement suggests departure from the extreme southwest corner, and this impression is strengthened by the massing of records on Prince Edward Island. There are fainter traces of the same sort of movement via Miquelon to Cape Breton Island, and from the easterly shore of Canadian Labrador across Anticosti, and down the coasts of Gaspé and New Brunswick. It is strongly apparent that the main axis of fall migration lies from Prince Edward Island down the west side of Nova Scotia.

The seasonal distribution of fall recoveries is also interesting. It shows, as would be expected, a progressive withdrawal from north to south, but it also reveals in rather striking fashion the effect of a maritime environment in retarding fall migration. Table V summarizes these data in monthly percentages of total fall recoveries.

It will be noted that each mainland region is cleared of Blacks decidedly earlier in the fall than the corresponding part of Newfoundland or Nova Scotia to the east. Quebec recoveries after early October are on the Gaspé coast and up the St. Lawrence. Interior New Brunswick is

TABLE V

MONTHLY DISTRIBUTION OF FALL AND WINTER RECOVERIES

	Sept.	Oct.	Nov.	Dec.	Jan.
Quebec	45%	35%	20%		
New Brunswick	38%	39%	19%	4%	
Maine		60%	40%		
Prince Edward Island	22%	44%	28%	4%	2%
Newfoundland	7%	73%	13%	7%	
Nova Scotia	4%	43%	28%	17%	8%

clear in October; later records are on or near the coast. Prince Edward Island is intermediate, as its position would imply. The strongest contrast of all is between Maine and Nova Scotia:—no recoveries after November in the one, 25% winter recoveries in the other.

Mid-winter recoveries of two categories emphasize the close relationship between Cape Cod and Nova Scotia. In the first place, there are twenty-one records of Blacks banded on the Cape in the winter months, and recovered in Nova Scotia during subsequent winters at dates after the normal season of migration. These birds almost certainly wintered in Nova Scotia after spending a previous winter on Cape Cod. There are no similar cases to the northward of the Cape except one on Prince Edward Island, and surprisingly few south or west. These recoveries have usually been in the three southernmost counties, or in the vicinity of Chedabucto Bay at the southeast corner of Cape Breton Island. The latter records suggest a Newfoundland origin for these delayed migrants.

Five of the most interesting examples of winter recoveries are appended, the first of which could have been, but probably was not, a very early transient:—

BANDED:		RECOVERED:	
Station	16 Dec. '32, 27 repeats to April 28	Guysborough Co.	16 Feb. '34
Pleasant Bay	8 Jan. '34, 21 repeats to April 12	Chedabucto Bay	10 Jan. '36
Pleasant Bay	29 Dec. '39	Yarmouth County	5 Jan. '42
Pleasant Bay	4 Jan. '40	Yarmouth County	15 Jan. '43
Station	5 Dec. '40, 5 repeats to March 22	Yarmouth County	23 Dec. '43

In addition to the above, there are three records of birds which were trapped on Cape Cod in the fall and were then recovered in Nova Scotia the same winter, having thus performed a reverse migration. The first of these was caught and banded at the Station on November 24, 1931. The next year it was in the traps first on November 18, and repeated four times to December 27. Just two weeks later, on January 10, 1933, it was recovered in Yarmouth County, Nova Scotia. The second bird was banded at the Station October 25, 1932, and was recovered January 15, 1933, in Shelburne County. This was five days after the first bird was recovered; the two might well have made the crossing in company. The third bird was banded November 5, 1938, and was recovered in Yarmouth County December 27.

The only real anomaly in the distribution of fall recoveries is the 7 : 1 ratio of 1-year birds (five times the normal) killed around Merrymeeting and Casco Bays in Maine. The full records do not supply any obvious clue. Three of the fourteen were banded at the Cape in August,


MAP I - Northward Recoveries of Black Ducks Banded on Cape Cod
first summer after banding
first fall after banding
summers later than first
falls later than first
0
50
100
SCALE
1 inch = 95 miles
5 records James Bay
4 records Ungava Bay
3 records Ontario
1 record
QUEBEC
LABRADOR
GASPÉ
ANTICOSTI
NEW BRUNSWICK
PRINCE EDWARD ISLAND
NOVA SCOTIA
NEWFOUNDLAND
MAINE
VERMONT
NEW HAMPSHIRE
MASSACHUSETTS
AUSTIN STATION
OLD MAP DIAGONALLY,
THIS CORNER
DOWN

and two of these were last in the traps on the same day in November and were shot not far apart in Maine on the same day in October the following year. Four other recoveries were banded at the Station in one season, and thus are somewhat out of proportion to the total. Otherwise the bandings were well distributed, at normal dates from late October to mid-January, and in every way indistinguishable from the average. If the preponderance of 1-year birds is more than accidental, it is due to some factor as yet obscure.

Summing up the evidence of these fall and winter recoveries, their trend is again northeast. There is no offset to the surprising fact that Maine, the nearest landfall north of Cape Cod, greater in area than Nova Scotia and fifteen times as large as Prince Edward Island, has less than a quarter as many recoveries as the one, less than half as many as the other.

RECOVERIES TO THE NORTHWEST

I have already called attention to the very few recoveries of Cape Cod Black Ducks from points west of north. They make up only 7% of any seasonal grouping of records, or of all records combined. It is unlikely, therefore, that they have great significance from the standpoint of management. At the same time, they inevitably invite speculation as to the circumstances under which they were made, and until they are examined in detail, there is always the possibility that they mean more than appears on the surface.

These recoveries to the northwest fall into three classes. Of greatest interest are three summer and two early fall recoveries on James Bay. In order of recovery, these are:—

BANDED:		RECOVERED:
Station	16 Oct. '32	Attawapiskat H. B. Post, before 16 Sept. '33
Station	21 Jan. '33, 6 repeats to April 5	
Station	2 Jan. '32	Moosonee, Spring of '38
Pleasant Bay	8 Jan. '41	30 mi. north of Moosonee, June '41
Station	20 Nov. '42, 4 repeats to Jan. 6	Cape Henrietta Maria, July '44

As is typical of far-northern records, the dates and exact points of recovery are indefinite, for most of these bands were brought into Hudson Bay Posts by natives who collected them possibly miles away and months before. The recovery of June '41, above, was marked "shot by Indian." The three localities named are all on the west side of James Bay:—Moosonee at the extreme southwestern corner, Cape Henrietta Maria at the extreme northwest (being the dividing line between James and Hudson Bays), and Attawapiskat about midway between. Note

that the Attawapiskat ducks were both on Cape Cod in the winter of 1932-33, though never in the traps at the same time, and they were almost surely together when recovered the next summer or fall, for the bands were turned in by the same man. Of the other three birds, the June '41 recovery was the first summer after banding, the 1944 and 1938 recoveries respectively one and six years after banding.

The second loosely defined class of northwestern recoveries is made up of six records in the triangle of lower Ontario bounded by the Ottawa River on the north, Georgian Bay on the west, and Lake Ontario to the south, plus a seventh across the lake in north central New York. In the northwest corner, a Black was killed at North Bay in January, 1934, after spending the whole previous winter at the Station, and another was caught in a muskrat trap at Vermilion Bay on April 21, 1942, fifteen months after banding at Nauset. Two birds banded in the Novembers of '32 and '38 were recovered near the north shore of Lake Ontario, at Kingston and Rice Lake, in the fifth and third Novembers afterward. Two birds banded in January '40 and March '42 were killed on the Ottawa River October 30, 1940, and November 1, 1942. The last of the seven was banded December 1, 1942, and killed at Rome, N. Y., on October 31 of the next fall. This is a rather diverse group as regards either point or time of recovery.

The third group of northwesterly recoveries consists of the fourteen records which may, by their position, furnish clues to the explanation of the preceding twelve. They are shown on the map:—mid-October records in coastal New Hampshire and at the northwesterly corner of Lake Champlain; a second-year mid-April recovery in Beauce County, Quebec; a scattering of fall records along the middle and upper St. Lawrence from Quebec City to Lake St. Louis; and finally, three first-spring recoveries west of Lake St. John, as follows:—

BANDED AT STATION:	RECOVERED:
27 Nov. '31, 1 repeat Nov. 29 (no banding until Nov. 21 that fall)	St. Maurice River (flows northwest from St. Lawrence in Portneuf Co.) 10 May '32
16 Oct. '32, 1 repeat Oct. 20	West shore Lake St. John (muskrat trap) 4 May '33
24 Oct. '35	Mistassini River (killed by Indian) May '36

These twenty-six records are the data at hand. They indicate that dispersion in the direction of James Bay, while minor, is more than accidental. Do they otherwise fall into any intelligible pattern?

Let us first test the obvious presumption that a direct route is followed. Draw a line on the map between the Cape and Moosonee. It is

manifest at once that there are no spring recoveries anywhere along the route. It also appears that the only fall records on the direct route are the two in New Hampshire and Vermont and two or three along the lower Ottawa River. The other Ontario records and the one in New York are displaced well to the west. Moreover, these latter birds were all killed in country where the trend of the main Black Duck flight in fall is more south than east—if they followed along with other Blacks down the river valleys, as ducks do, they would come out on the middle Atlantic coast.

The Vermont record, too—if enough Cape Cod Blacks were following the direct route to produce five recoveries in the wilderness of James Bay, 800 miles away, is it likely that only one bird would be killed on the heavily gunned marshes around the northern end of Lake Champlain, and none at all between there and the coast?

There is an alternate hypothesis which seems to explain the distribution of recoveries more fully than the foregoing, and is particularly supported by the homogeneous little group of records west of Lake St. John—all birds banded at about the same time of year on the Cape, all killed in early May. Suppose that a few Blacks, having arrived in the vicinity of Baie Chaleur in April, then crossed Gaspé to the northwest by following up one river valley and down another, as the spring records in Bonaventure and Matapedia Counties suggest they do. They would then be near the mouth of the Saguenay, and if they continued northwest, would reach Lake St. John. The Mistassini River flows north-northwest out of Lake St. John, and its headwaters are not far across the height of land from Lake Mistassini. From the northwest side of Lake Mistassini the Rupert River flows west into the southeastern corner of James Bay.

Having arrived in James Bay, quite possibly by chance, these birds would tend to mingle with a population of Blacks which must leave in fall largely in a southerly direction. If some of the Cape ducks followed this route, it would bring them to Georgian Bay and southeastern Ontario where in fact there have been recoveries, all more than nine months after leaving the Cape. If, on the other hand, some of them retraced the route to the east up the Nottaway or Rupert Rivers, it might well bring them to the lower Ottawa River or down the St. Maurice, where again there are actual fall recoveries from September 2 to October 16. These dates are consistent with the season of year when the Lake St. John birds were originally banded at the Cape.

It is equally possible that some of the early autumn recoveries along the upper St. Lawrence indicate a minor current of migration from quite another source. They may represent birds which come out of the northeastern interior to the river, and then follow the southwest trend of the valley as far as the known fall gathering grounds west of Quebec City.

From there they may continue southwest, or they may go cross-country to the vicinity of Merrymeeting Bay by a route through northern Maine which at the time of the spring migration is still locked in ice. A bit of evidence pointing in this direction is the fact that upper St. Lawrence River recoveries, like those from Merrymeeting and Casco Bays, run strongly to first-fall birds. The ratio is at least four times higher than along the main route through the Maritime Provinces.

All the foregoing possibilities having been mentioned, it is more than ever apparent that recoveries of Cape-banded Blacks to the northwest are not of major significance. The theory of a direct route to James Bay is untenable with so few recoveries in New Hampshire and Vermont. If the Saguenay River hypothesis has any merit, it leads only to the conclusion that recoveries in James Bay result somewhat fortuitously from the substantial spring movement into eastern Quebec.

Whatever the route, there is no evidence of more than incidental volume.

CONCLUSIONS

At this point we have finished consideration of northward recoveries of Black Ducks banded by the Austin Station on Cape Cod. We have sized up their general trend, and then studied and compared them group by group. What do they show?

The fact of prime importance about these recoveries is their northeasterly direction. Their mass lies that way either in whole or in section. Spring and summer records are numerous north of the St. Lawrence; fall records are concentrated in the Maritime Provinces. The axis of migration is northeast-southwest. Fall migration is earlier on the mainland, delayed in Nova Scotia. The bulk of the birds go back and forth between Cape Cod and Nova Scotia by the direct route over water.

For the purposes of management, these conclusions are useful in defining the scope and direction of the problem. If we would understand the status of Black Ducks on Cape Cod, and have studied the winter environment there, we must then look northeast. The number of wintering Blacks on the Cape is largely influenced by what takes place between spring and fall in Newfoundland, Labrador, and eastern Quebec, in New Brunswick, Prince Edward Island, and Nova Scotia.

(To Be Continued)

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