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Migration of Birds

Routes of Migration

General Considerations

While certain flight directions are consistently followed by migratory birds, it is well to remember that the term "migration route" is a generalization, a concept referring to the general movements of a species, rather than an exact course followed by individual birds or a path followed by a species characterized by specific geographic or ecological boundaries. Even the records of banded birds usually show no more than the places of banding and recovery, and the details of the route actually traversed between the two points is interpolated. In determining migration routes, one must also constantly guard against the false assumption that localities with many grounded migrants are on the main path of migration and localities where no migrants are observed are off the main path.

There is also considerable variation in the routes chosen by different species. Differences in distance traveled, time of starting, speed of flight, latitudes of breeding and wintering grounds, all contribute to this great variation of migration routes among species. For example, waterfowl banding data not only indicate species differences, but also indicate considerable diversity in direction of movement by different breeding populations within a species as well as between individuals in the same population. Nevertheless, there are certain factors that serve to guide individuals or groups of individuals along more or less regular paths, and it is possible to define such lines of migration for many species.

Flyways and Corridors

Through plotting accumulated banding data obtained in the 1930's, investigators became impressed by what appeared to be four broad, relatively exclusive flyway belts in North America. This concept, based upon analyses of the several thousand records of migratory waterfowl recoveries then available, led Fred Lincoln to conclude that, ". . . because of the great attachment of migratory birds for their ancestral flyways, it would be possible practically to exterminate the ducks of the West without seriously interfering with the supply of birds of the same species in the Atlantic and Mississippi flyways, and that the birds of these species using the eastern flyways would be slow to overflow and repopulate the devastated areas of the West, even though environmental conditions might be so altered as to be entirely favorable." Since 1948, this model has served as the basis for administrative action by the Fish and Wildlife Service in setting annual migratory waterfowl hunting regulations.

The notion of bird populations being confined to four fairly definite and distinct migration "flyways" is probably most applicable to those birds that migrate in family groups, namely geese, swans, and cranes, but does not appear to be very helpful in understanding the movements of the more widely dispersing ducks or most other groups of birds. Young geese will tend to return to breed in the area in which they were hatched, even though competition might be less in goose populations breeding in another flyway. Mating in many ducks occurs on the winter range and even though a male had come south on one flyway, it will return with the female, perhaps on a different flyway. Consequently, vacant breeding areas are more rapidly repopulated by ducks than by geese.

Although Lincoln's analysis was confined to ducks and geese, some thought that it applied to other groups of birds as well. Everyone now realizes that the concept of four flyways, designated as the Atlantic, Mississippi, Central, and Pacific Flyways, was an oversimplification of an extremely complex situation involving crisscrossing of migration routes that vary from species to species. Flyways can be considered meaningful only in a very general way, even for waterfowl, and not generally applicable to other groups of birds. By determining relative abundances of dabbling ducks east of the Rocky Mountains, Frank Bellrose of the Illinois Natural History Survey presented a more realistic picture (Figure 13). Yet the four "Flyway" areas have been useful in regionalizing the harvest of waterfowl for areas of different vulnerability to hunting pressure. Bellrose also mapped the corridors for the diving ducks and showed heavy traffic similar to that of dabbling species through the Great Plains and relatively heavily used corridors from these central arteries eastward across the Great Lakes area to the Atlantic coast, terminating particularly in the vicinity of Chesapeake Bay. A fairly well-used corridor also extends along the Atlantic coast.

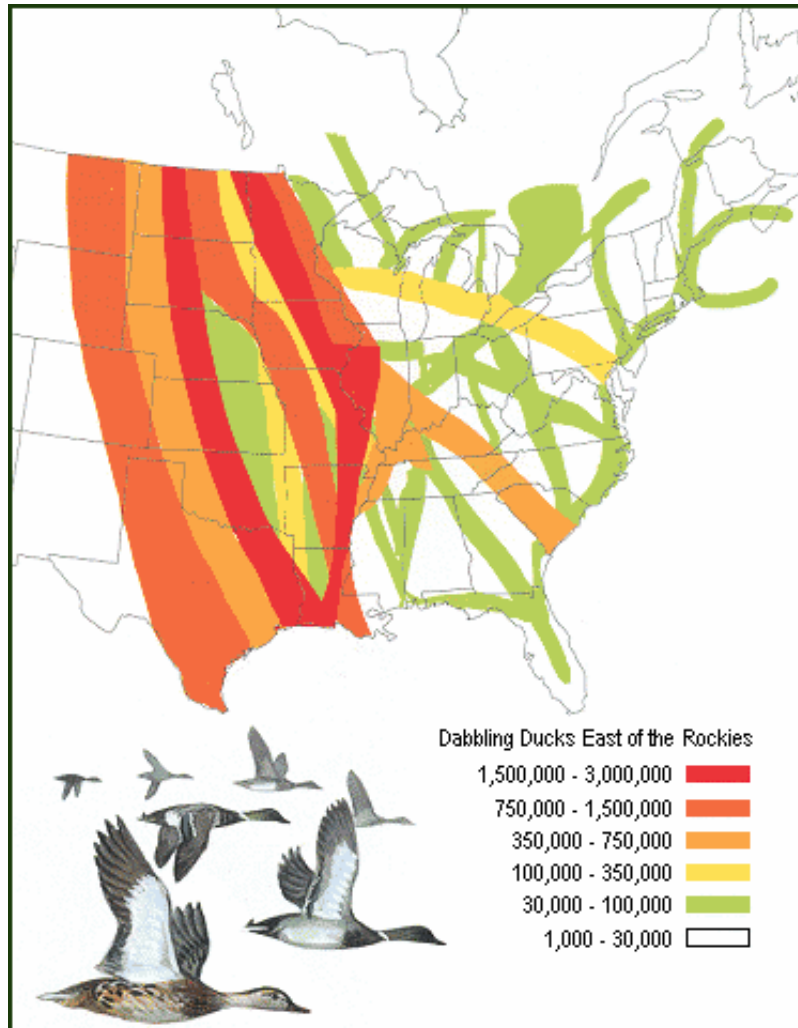


Figure 13. *Migration corridors used by dabbling ducks east of the Rocky Mountains during their fall migration (after Bellrose 1968).*

With our present knowledge of bird migration, recognizing distinct broad belts of migration down the North American continent encompassing groups of distinct populations or species is not realistic. About all we can say for sure now is that birds travel between certain breeding areas in the North and certain wintering areas in the South; that a few heavily traveled corridors are used by certain species; and that more generalized are routes followed by other species.

Narrow Routes

Some species exhibit extremely narrow routes of travel. The Red Knot and Purple Sandpiper, for example, are normally found only along the coasts because they are limited on one side by the broad waters of the ocean, and on the other by land and fresh water; neither of these habitat furnish conditions attractive to these species.

The Ipswich race of the Savannah Sparrow likewise has a very restricted migration range. It is known to breed only on tiny Sable Island, Nova Scotia, and it winters from that island south along the Atlantic coast to Georgia. It is rarely more than a quarter of a mile from the outer beach and is entirely at home among the sand dunes with sparse covering of coarse grass.

The Harris' Sparrow provides an interesting example of a moderately narrow migration route in the interior of the country (Figure 14). This handsome sparrow is known to breed only in the narrow belt of stunted timber and brush along the northern limit of trees from the vicinity of Churchill, on the west shore of Hudson Bay, to the Mackenzie Delta 1,600 miles to the northwest. When this sparrow reaches the United States on its southward migration, it is most numerous in a belt about 500 miles wide between Montana and central Minnesota south through a relatively narrow path in the central part of the continent. Its winter range lies primarily from southeastern Nebraska and northwestern Missouri, across eastern Kansas and Oklahoma, and through a 150 miles-wide section of eastern Texas. The habitat preference of Harris' Sparrows for the coniferous forest-tundra transition on its breeding range also characterizes the structure of its habitat choice of shrubby patches within grasslands on its wintering range. Consequently its narrow migratory pathway is west of the eastern deciduous forest, and even with deforestation the species has not widened its wintering area.

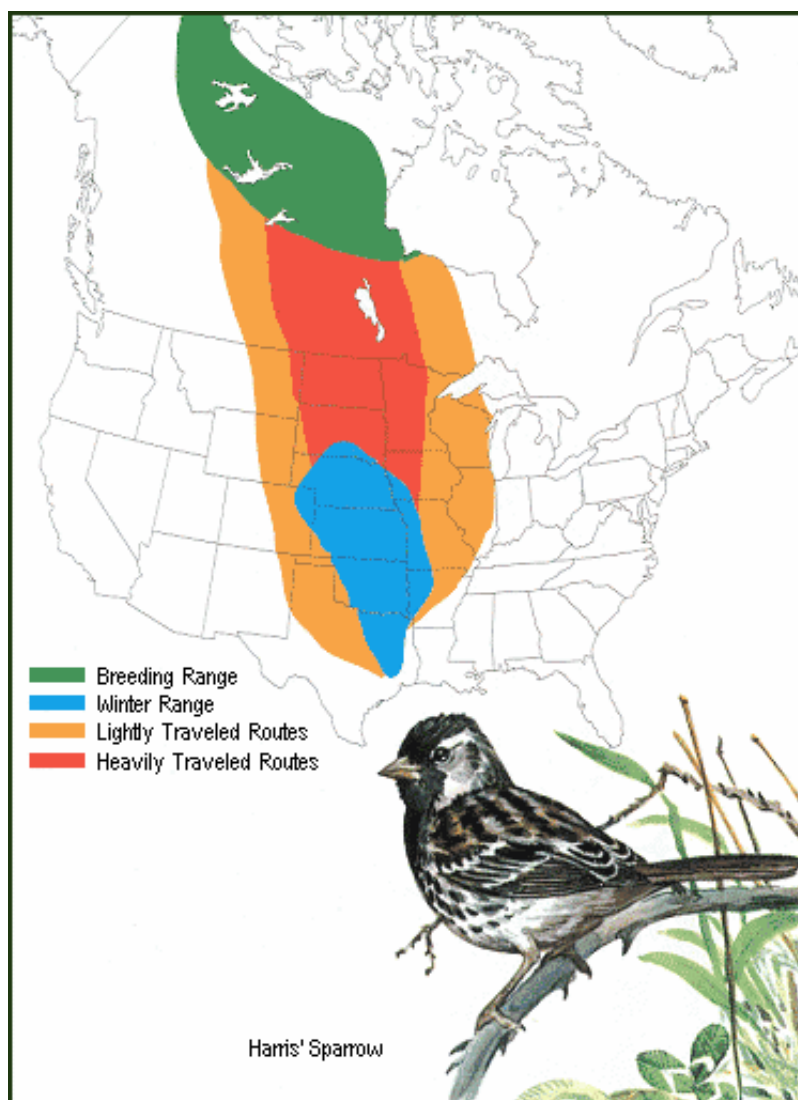


Figure 14. *Distribution and migration of Harris' Sparrow. This is an example of a narrow migration*

route through the interior of the country.

Converging Routes

When birds start their southward migration, the movement necessarily involves the full width of the breeding range. Later, in the case of landbirds with extensive breeding ranges, there is a convergence of the lines of flight taken by individual birds owing, in part, to the conformation of the land mass and in part to the east-west restriction of habitats suitable to certain species. An example of this is provided by the Eastern Kingbird, which breeds in a summer range 2,800 miles wide from Newfoundland to British Columbia. On migration, however, the area traversed by the species becomes constricted until in the southern part of the United States the occupied area extends from Florida to the mouth of the Rio Grande, a distance of only 900 miles. Still farther south the migration path continues to converge and, at the latitude of Yucatan, it is not more than 400 miles wide. The great bulk of the species probably moves in a belt less than half this width.

The Scarlet Tanager presents another extreme case of a narrowly converging migration route starting from its 1,900 mile-wide breeding range in the eastern deciduous forest between New Brunswick and Saskatchewan (Figure 15). As the birds move southward in the fall, their path of migration becomes more and more constricted until, at the time they leave the United States, all are included in the 600-mile belt from eastern Texas to the Florida peninsula. The boundaries continue to converge to less than 100 miles through Honduras and Costa Rica. The species winters in the heavily forested areas of northwestern South America including parts of Colombia, Ecuador, and Peru.

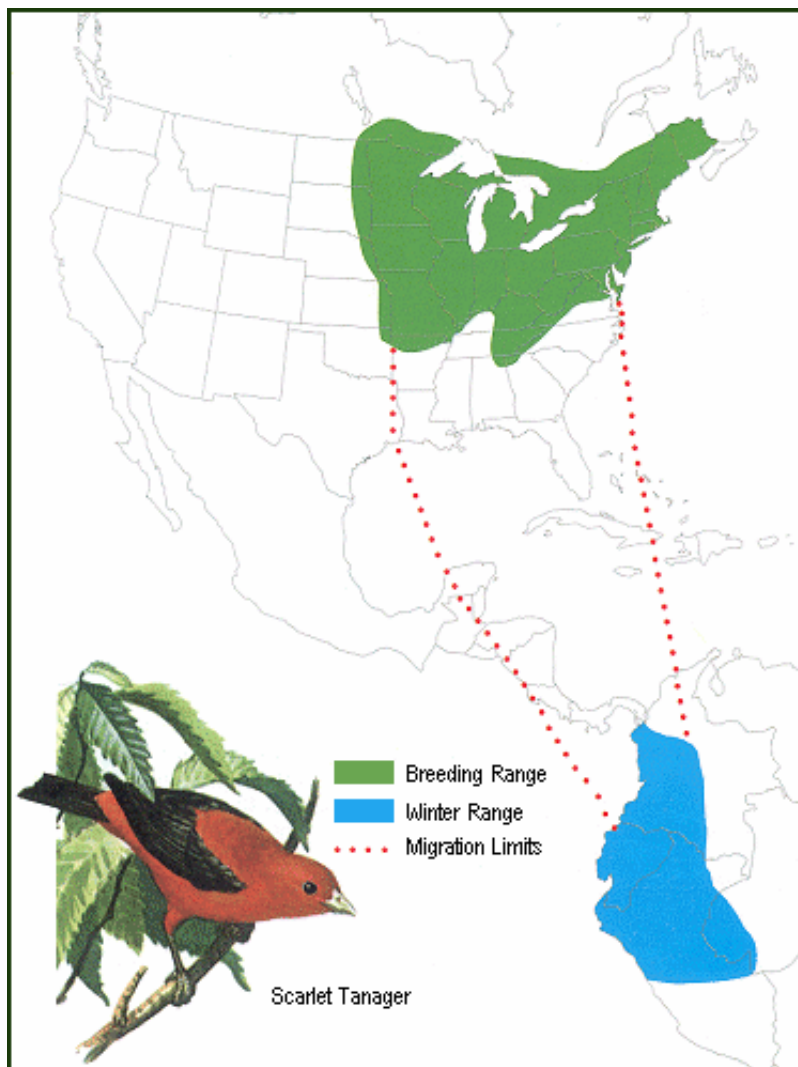


Figure 15. Distribution and migration of the Scarlet Tanager. During the breeding season individual tanagers

may be 1,500 miles apart in an east-and-west line across the breeding range. In migration, however, the lines gradually converge until in South America they are about 500 miles apart.

The Rose-breasted Grosbeak also leaves the United States through the 600-mile stretch from eastern Texas to Apalachicola Bay, but thereafter this grosbeak crosses the Gulf of Mexico and enters the northern part of its winter quarters in southern Mexico and these lines do not converge. However, the pathway of those individuals that continue to South America is considerably constricted by the narrowing of land through Central America (Figure 16). Although the cases cited represent extremes of convergence, a narrowing of migratory paths is the rule for the majority of North American birds. Both the shape of the continent and major habitat belts tend to constrict southward movement so that the width of the migration route in the latitude of the Gulf of Mexico is much less than in the breeding range. The American Redstart represents a case of a wide migration route, but even in the southern United States this path is still much narrower than the breeding range (Figure 17). These birds, however, cross all of the Gulf of Mexico and pass from Florida to Cuba and Haiti by way of the Bahamas, so that here their route is about 2,500 miles wide.

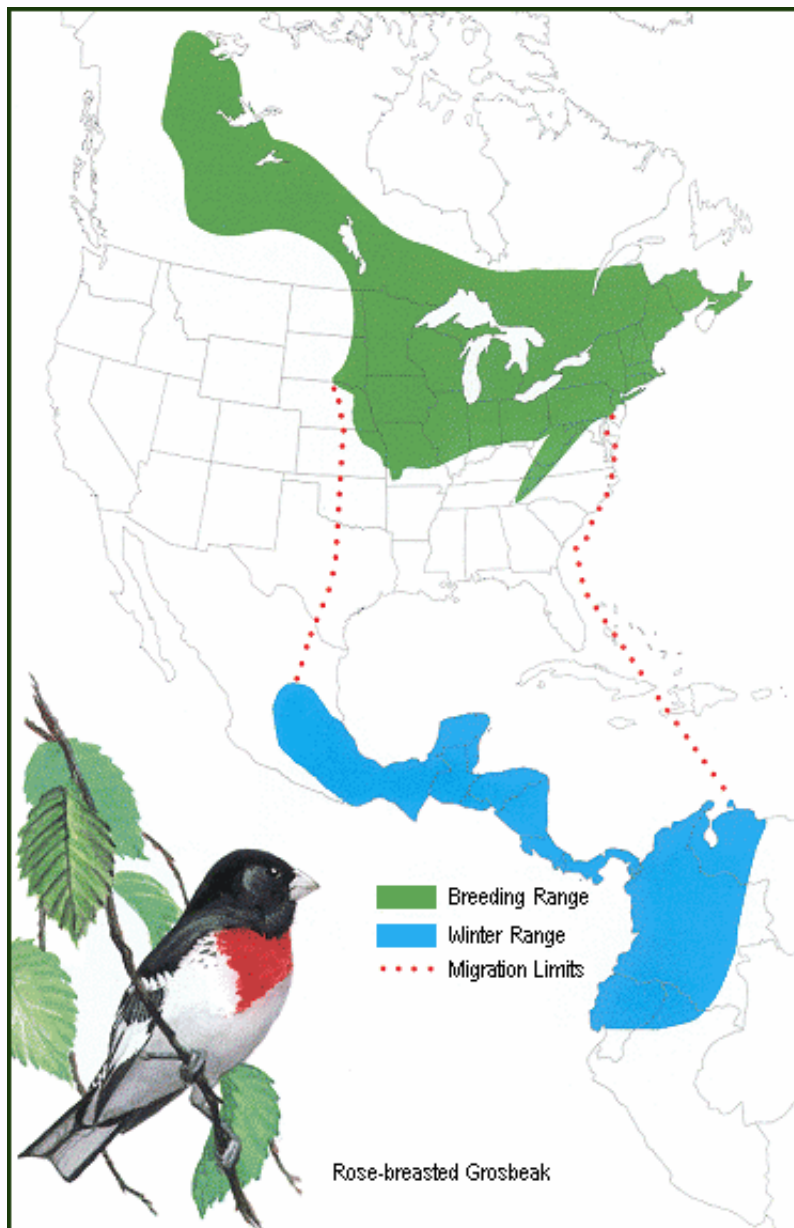


Figure 16. Distribution and migration of the Rose-breasted Grosbeak. Though the width of the breeding range is about 2,500 miles, the migratory lines

converge until the boundaries are only about 1,000 miles apart when the birds leave the United States.

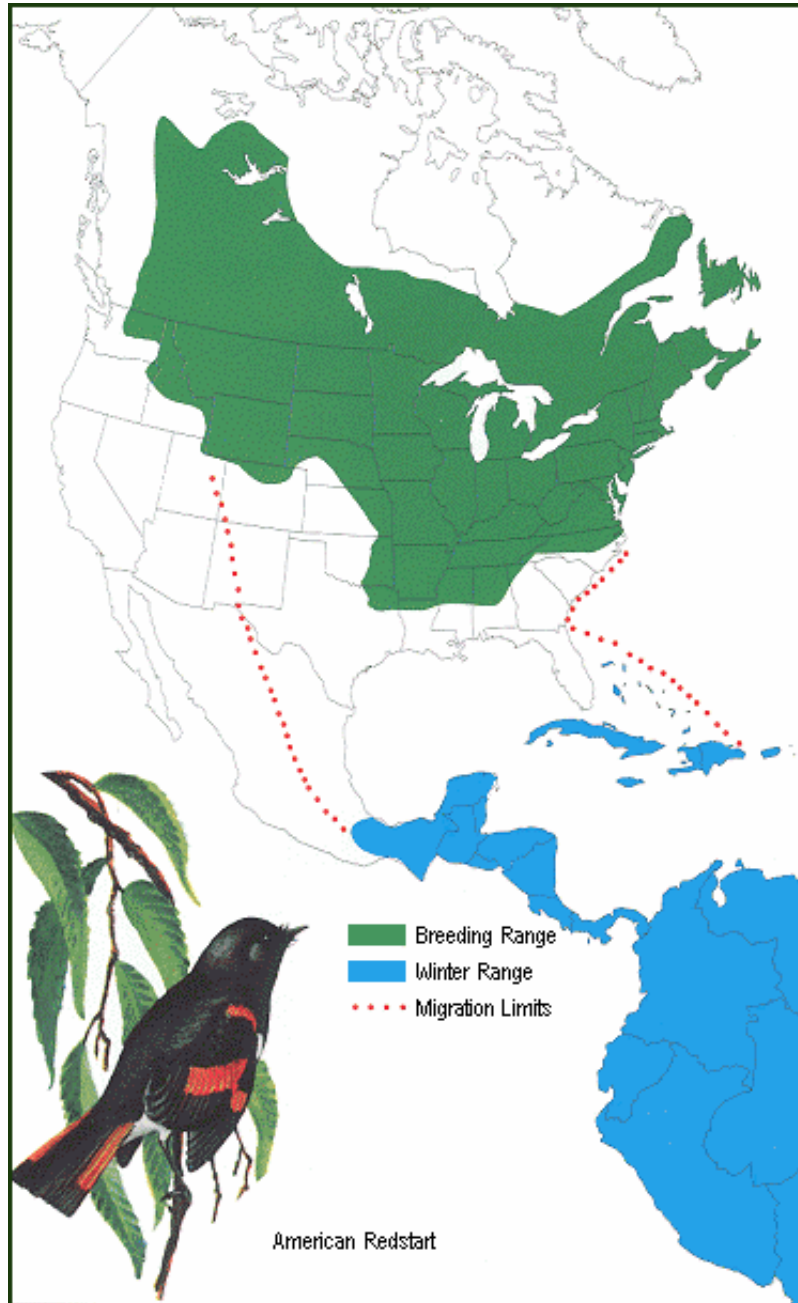


Figure 17. *Distribution and migration of the Redstart. An example of a wide to migration route, birds of this species cross all parts of the Gulf of Mexico, or may travel from Florida to Cuba and through the Bahamas. Their route has an east-and-west width of more than 2,000 miles.*

Principal Routes From North America

W.W. Cook identified seven generalized routes for birds leaving the United States on their way to various wintering grounds (Figure 18). The routes by which birds return northward in the spring are not as well known.

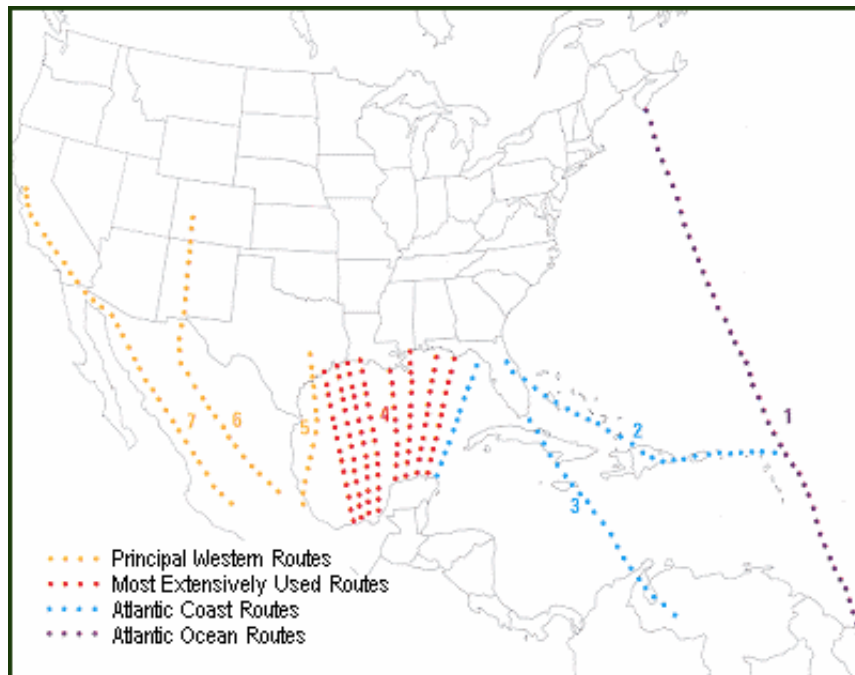


Figure 18. *Principal migration routes used by birds in passing from North America to winter quarters in the West Indies, Central America, and South America. Route 4 is the one used most extensively while only a few species make the 2,400 mile flight down Route 1 from Nova Scotia to South America.*

Atlantic Oceanic Route

Route No. 1 (Figure 18) is primarily oceanic and passes directly over the Atlantic Ocean from Labrador and Nova Scotia to the Lesser Antilles, then through this group of small islands to the mainland of South America. Most of the adult American Golden-Plovers and some other shorebirds use this as their fall route. These plovers may accomplish the whole 2,400 miles without pause, and in fair weather the flocks pass Bermuda and sometimes even the islands of the Antilles without stopping. As mentioned previously, radar has indicated strong fall movements of warblers from the New England coast out over the Atlantic to points south along this route. One of these, the Blackpoll Warbler has evolved a high level metabolic efficiency in order to make this extended overwater passage. This species loses only 0.06% of its weight per hour (essentially water and fat) compared to thrushes, warblers, and sparrows on overland routes which lose 1.2% of their weight per hour of flight. Since this route lies almost entirely over the sea, it is definitely known only at its terminals and from occasional observations made on Bermuda and other islands along its course. Some of the shorebirds that breed on the arctic tundra of the District of Mackenzie (Northwest Territories) and Alaska fly southeastward across Canada to the Atlantic coast and finally follow this oceanic route to the mainland of South America. Although most birds make their migratory flights either by day or by night, birds using this route fly both day and night.

The Arctic Tern follows the Atlantic Ocean route chiefly along the eastern side of the ocean in the eastern hemisphere. Likewise, vast numbers of seabirds such as auks, murres, guillemots, phalaropes, jaegers, petrels, and shearwaters follow this over-water route from breeding sites along coasts and on islands in the Northern and Southern Hemispheres.

Atlantic Coast Route and Tributaries

The Atlantic coast is a regular avenue of travel, and is well known for many famous locations for observing both land and water birds. About 50 different kinds of landbirds that breed in New England follow the coast southward to Florida and travel thence by island and mainland to South America (Figure 18, route 2). The map indicates a natural and convenient highway through the Bahamas, Cuba,

Hispaniola, Puerto Rico, and the Lesser Antilles to the South American coast. Resting places are provided at convenient intervals, and at no time are these aerial travelers out of sight of land. It is not, however, the favored highway; only about 25 species of birds go beyond Cuba to Puerto Rico along this route to their winter quarters, while only six species are known to travel to South America by way of the Lesser Antilles. Many thousands of American Coots and American Wigeons, Northern Pintails, Blue-winged Teals, and other waterfowl as well as shorebirds, regularly spend the winter season in the coastal marshes, inland lakes, and ponds of Cuba, Hispaniola, and Puerto Rico.

Route No. 3 (Figure 18) is a direct line of travel for Atlantic coast migrants enroute to South America, although it involves much longer flights. It is used almost entirely by landbirds. After taking off from the coast of Florida, there are only two intermediate land masses where migrants might pause for rest and food. Nevertheless, tens of thousands of birds of about 60 species cross the 150 miles from Florida to Cuba where many remain for the winter months. The others negotiate the 90 miles between Cuba and Jamaica but, from that point to the South American coast, there is a stretch of islandless ocean 500 miles across. The Bobolink so far outnumbers all other birds using this path that this route could be designated the "Bobolink route" (Figure 19). As traveling companions along this route, the Bobolink may meet vireos, kingbirds, and Common Nighthawks from Florida, Chuck-will's-widows from the Southeastern States, Black-billed and Yellow-billed cuckoos from New England, Gray-cheeked Thrushes from Quebec, Bank Swallows from Labrador, and Blackpoll Warblers from Alaska. Sometimes this scattered assemblage will be joined by a tanager or a Wood Thrush, but the "Bobolink route" is not used by the greatest number of migrants. Formerly, it was thought most North America landbirds migrated to Central America via the Florida coast, then crossed to Cuba, and finally made the short flight from the western tip of Cuba to Yucatan. A glance at the map would suggest this as a most natural route but, as a matter of fact, it is practically deserted except for a few swallows and shorebirds or an occasional landbird storm-driven from its normal course. What actually happens in the fall is that many of the birds breeding east of the Appalachian Mountains travel parallel to the seacoast in a more or less southwesterly direction and, maintaining this same general course from northwestern Florida, cross the Gulf of Mexico to the coastal regions of eastern Mexico. They thus join migrants from farther inland in using route No. 4 (Figure 18).

Routes used by Brant in eastern North America merit some detail because their flight paths were long misunderstood. These birds winter on the Atlantic coast, chiefly at Barnegat Bay, New Jersey, but depending upon the severity of the season and the food available, many winter south to North Carolina. Their breeding ground are in the Canadian arctic archipelago and on the coasts of Greenland. Careful studies have shown that the main body travels northward in spring along the coast to the Bay of Fundy, overland to Northumberland Strait, which separates Prince Edward Island from mainland New Brunswick and Nova Scotia. A minor route appears to lead northward from Long Island Sound by way of the Housatonic and Connecticut River valleys to the St. Lawrence River. After spending the entire month of May feeding and resting in the Gulf St. Lawrence, the eastern segment of the Brant population resumes its journey by departing overland from the Bay of Seven Islands area, flying almost due north to Ungava Bay and from there to nesting grounds, probably on Baffin Island and Greenland. A smaller segment travels a route slightly north of west to the flocks take a more northwesterly course by descending the Fort George River to reach the eastern shore of James Bay. Upon their arrival at either of these two points on James Bay, the Brants of this western segment turn northward and proceed along eastern Hudson Bay to their breeding grounds in the Canadian Arctic.

The fall migration of Brant follows the routes utilized in the spring. During this season, the eastern population appears only on the western and southern shores of Ungava Bay before continuing their southward journey to the Gulf of St. Lawrence and beyond. Most of the birds of the western segment, instead of following the eastern shores of Hudson and James bays, turn southwestward across the former, by way of the Belcher Islands, to Cape Henrietta Maria, and from there south along the western shore of James Bay by way of Akimiski and Charlton Islands. At the southern end of James Bay, they are joined by those that have taken the more direct route along the east coasts of the bays and all then fly overland 570 miles to the estuary of the St. Lawrence River.

The Atlantic coast wintering area receives waterfowl from three or four interior migration paths, one of which is of primary importance, as it includes great flocks of Canvasbacks, Redheads, Greater and Lesser scaup, Canada Geese, and many American Black Ducks that winter in the waters and marshes of

the coastal region south of Delaware Bay. The Canvasbacks, Redheads, and scaup coming from breeding grounds on the great northern plains of central Canada follow the general southeasterly trend of the Great Lakes, cross Pennsylvania over the mountains, and reach the Atlantic coast in the vicinity of Delaware and Chesapeake Bays. American Black Ducks, Mallards, and Blue-winged Teals that have gathered in southern Ontario during the fall leave these feeding grounds and proceed southwest. Many continue this route down the Ohio Valley, but others, upon reaching the vicinity of the St. Clair Flats between Michigan and Ontario, swing abruptly to the southeast and cross the mountains to reach the Atlantic coast south of New Jersey. This route, with its Mississippi Valley branch, has been fully documented by the recovery records of ducks banded at Lake Scugog, Ontario.

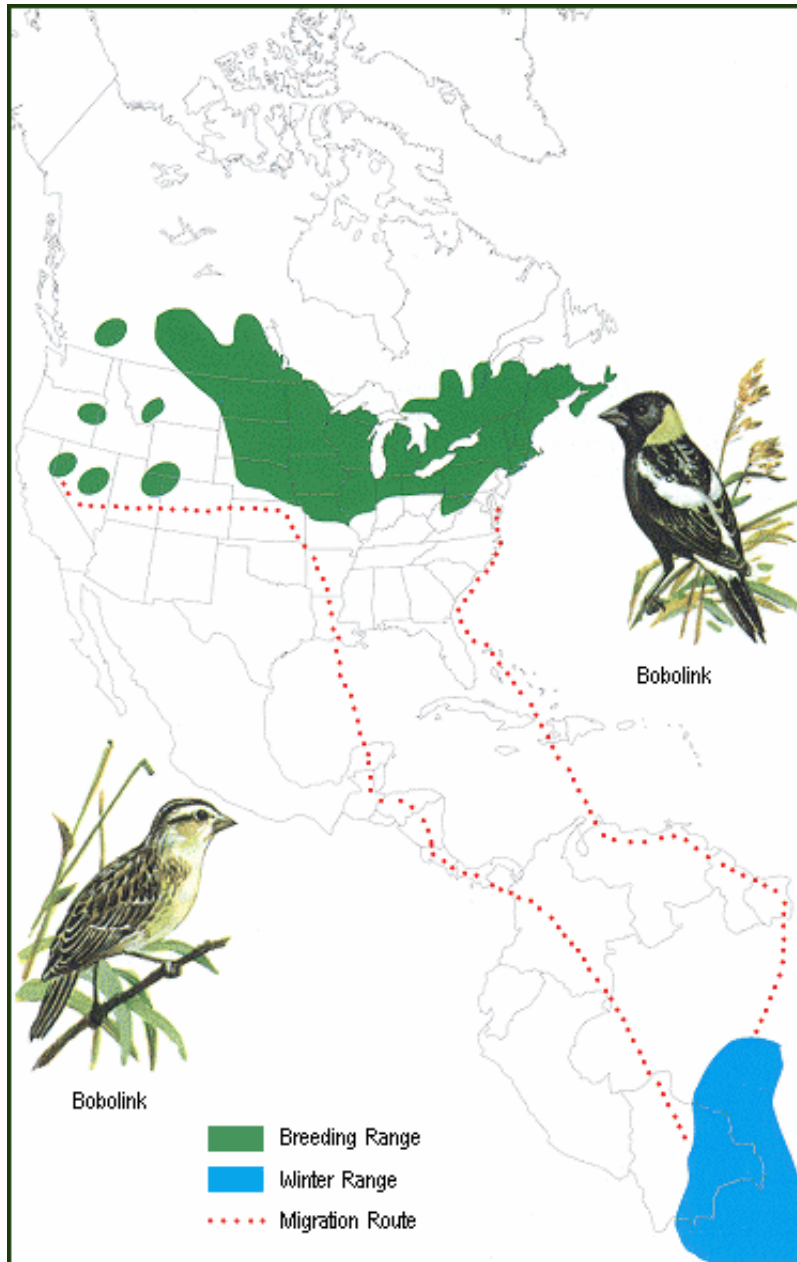


Figure 19. *Distribution and migration of the Bobolink. In crossing to South America, most of the Bobolinks use route 3 (Fig. 18), showing no hesitation in making the flight from Jamaica across an islandless stretch of ocean. It will be noted that colonies of these birds have established themselves in western areas, but in migration they adhere to the ancestral flyways and show no tendency to take the short cut across Arizona, New Mexico, and Texas.*

Canvasbacks migrate from the prairie pothole region of the central United States and Canada to many wintering areas in the United States. This duck has been the subject of careful study, and its principle migration routes based on recovery of banded birds have been shown. These principle routes travel from the major breeding area in the prairie provinces of Canada and the northern prairies of the United States southeastward through the southern Great Lakes area to Chesapeake Bay, the chief wintering area (Figure 20). Relatively few Canvasbacks proceed southward along the Atlantic seaboard. A less important route extends off from the main trunk in the southern Minnesota region and goes south along the Mississippi Valley to points along the river. Other individuals of the prairie breeding population fly southward on a broad front to the gulf coast of Texas and the interior of Mexico, while some proceed southwestward on a relatively broad path to the northern Pacific coast.

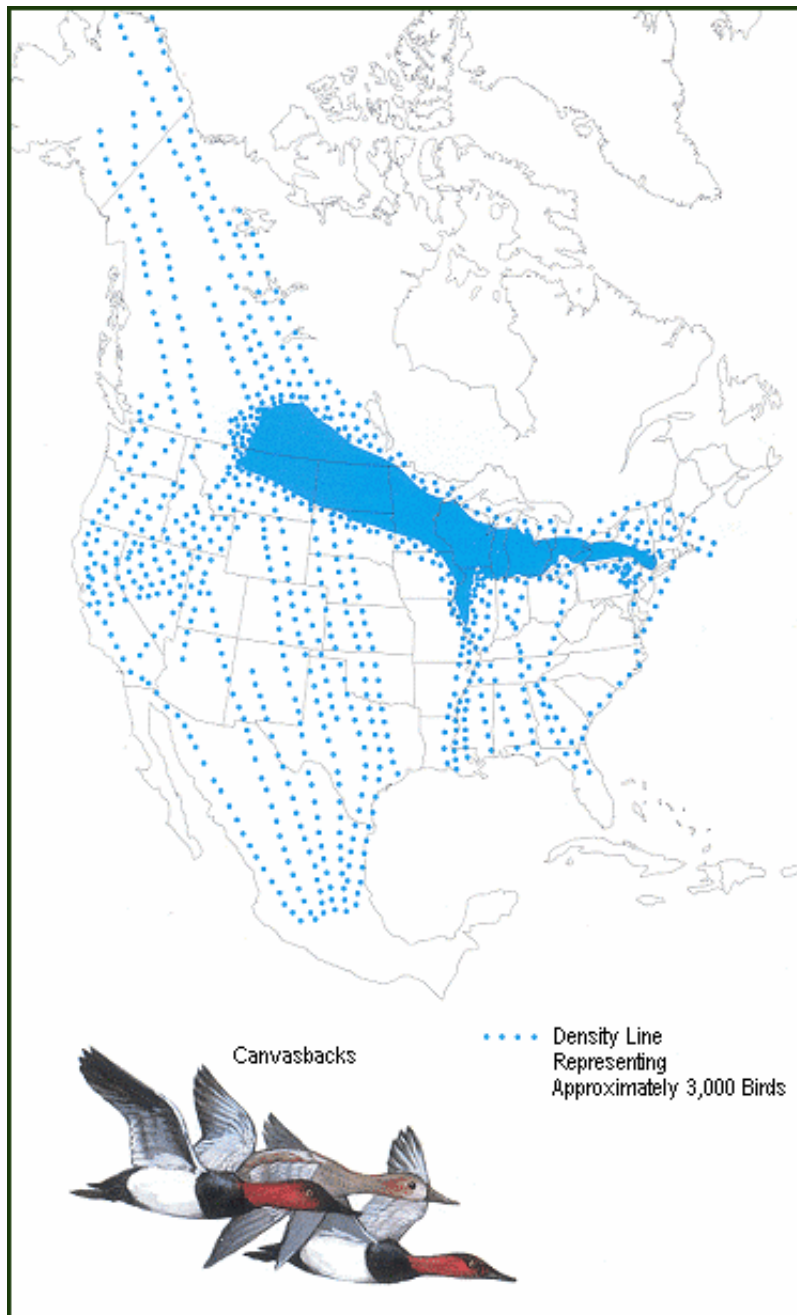


Figure 20. *Principal migratory routes of the Canvasback. The major route of travel extends from breeding areas in central Canada southeast across the Great Lakes and either south down the Mississippi River or east to Chesapeake Bay (After Stewart et al. 1958).*

Mackenzie Valley-Great Lakes-Mississippi Valley Routes and Tributaries

The migration route extending from the Mackenzie Valley past the Great Lakes and down the Mississippi Valley is the longest of any in the Western Hemisphere. Its northern terminus is on the arctic coast in the regions of Kotzebue Sound, Alaska, and the mouth of the Mackenzie River, while its southern end lies in Argentina. For more than 3,000 miles, from the mouth of the Mackenzie to the delta of the Mississippi, this route is uninterrupted by mountains. In fact, the greatest elevation above sea level is less than 2,000 feet. Because it is well timbered and watered, the entire region affords ideal conditions for its great hosts of migrating birds. It is followed by such vast numbers of ducks, geese, shorebirds, blackbirds, sparrows, warblers, and thrushes that observers stationed at favorable points in the Mississippi Valley during the height of migration can see large numbers of many species.

When many of these species, including ducks, geese, American Robins, and Yellow-rumped Warblers, arrive at the Gulf coast, they spread out east and west for their winter sojourn. Others, despite the perils of a trip involving a flight of several hundred miles across the Gulf of Mexico, fly straight for Central and South America. This part of the route is a broad "boulevard" extending from northwestern Florida to eastern Texas and southward across the Gulf of Mexico to Yucatan and the Isthmus of Tehuantepec (Figure 18, route 4). This route appears to be preferred over the safer but more circuitous land or island routes by way of Texas or Florida. During the height of migration some of the islands off the coast of Louisiana are rewarding observation points for the student of birds, since the feathered travelers literally swarm over them.

Present detailed knowledge of the chief tributaries to the Mackenzie-Great Lakes-Mississippi Valley route relates primarily to waterfowl. Reference has been made already to the flight of American Black Ducks that reach the Mississippi Valley from southern Ontario. Some individuals of this species banded at Lake Scugog, Ontario, have been recaptured in succeeding seasons in Wisconsin and Manitoba, but the majority was retaken at points south of the junction of the Ohio River with the Mississippi indicating their main route of travel from southern Ontario.

A second route that joins the main artery on its eastern side is the one used by eastern populations of Snow Geese, including both blue and white phases, that breed mainly on Southampton Island and in the Fox Basin of Baffin Island. In the fall these geese work southward along the shores of Hudson Bay and, upon reaching the southern extremity of James Bay, take off on their flight to the great coastal marshes of Louisiana and Texas west of the Mississippi River delta.

Great Plains-Rocky Mountain Routes

This route also has its origin in the Mackenzie River delta and Alaska. The Sandhill Cranes, White-fronted Geese, and smaller races of the Canada Goose follow this route through the Great Plains from breeding areas in Alaska and western Canada. It is used chiefly by the Northern Pintails and American Wigeons that fly southward through eastern Alberta to western Montana. Some localities in this area, as for example, the National Bison Range at Moiese, Montana, normally furnish food in such abundance that these birds are induced to pause in their migratory movement. Some flocks of pintails and wigeons move from this area almost directly west across Idaho to the valley of the Columbia River, then south to the interior valleys of California. Others leave Montana by traveling southeastward across Wyoming and Colorado to join other flocks moving southward through the Great Plains.

Observations made in the vicinity of Corpus Christi, Texas have shown one of the short cuts (Figure 18, route 5) from the coastal bend of Texas to the shore of the Bay of Campeche that is part of the great artery of migration. Thousands of birds pass along the coast to the northern part of Veracruz, Mexico. Since coastal areas in Tamaulipas to the north are arid and unsuited for denizens of moist woodlands, it is probable that much, if not all, of this part of the route for these species is a short distance off shore. It is used by such woodland species as the Golden-winged, Worm-eating, and Kentucky warblers.

Pacific Coast Route

Although it does present features of unusual interest, the Pacific coast route is not as long or heavily traveled as some of the others described. Because of the equitable conditions that prevail, many species of birds breeding along the coast from the northwestern states to southeastern Alaska either

do not migrate or else make relatively short journeys. This route has its origin chiefly in western Alaska, around the Yukon River delta. Some of the scoters and other sea ducks of the north Pacific region as well as the diminutive Cackling Canada Goose of the Yukon River Delta use the coastal sea route for all or most of their southward flight. Large numbers of arctic-breeding shorebirds also use this route. The journey of the Canada Goose, as shown by return records from birds banded at Hooper Bay, Alaska, has been traced southward across the Alaskan Peninsula and apparently across the Gulf of Alaska to the Queen Charlotte Islands. The birds then follow the coast line south to near the mouth of the Columbia River, where the route swings toward the interior for a short distance before continuing south by way of the Willamette River Valley. The winter quarters of this subspecies of Canada Goose are chiefly in the vicinity of Tule Lake, on the Oregon-California line, and in the Sacramento Valley of California, although a few push on to the San Joaquin Valley. A tributary of this flyway is followed by Ross' Goose, which breeds in the Perry River district south of Queen Maud Gulf and other areas farther east on the central arctic coast of Canada (Figure 21). Its fall migration is southwest and south across the barren grounds to Great Slave and Athabaska Lakes, where it joins thousands of other waterfowl bound for winter homes along the eastern coast of the United States and the Gulf of Mexico. But when Ross' Geese have traveled south approximately to the northern boundary of Montana, most of them separate from their companions and turn southwest across the Rocky Mountains to winter in California. In recent years more Ross' Geese have been found wintering east of the Rocky Mountains along with flocks of Snow Geese, a change that may be correlated with an eastward extension of their breeding range.



Figure 21. *The breeding range, wintering range, and main migration route of Ross' Goose. This is the only species of which practically all members breed in the Arctic, migrate south through the Canadian prairie, and upon reaching the United States, turn to the southwest rather than the southeast. The southern part of this route, however, is followed by some mallards, pintails, wigeons, and other ducks.*

The southward route of long-distance migratory landbirds of the Pacific area extends chiefly through the interior of California to the mouth of the Colorado River and on to winter quarters in western Mexico (Figure 18, routes 6 and 7).

The movements of the Western Tanager show a migration route that is in some ways remarkable. The species breeds in the mountains from the northern part of Baja California and western Texas north to northern British Columbia and the southwestern headwaters of the Mackenzie River. Its winter range is in two discontinuous areas - southern Baja California and eastern and southwestern Mexico south to Guatemala (Figure 22). During spring migration the birds appear first in western Texas and the southern parts of New Mexico and Arizona about April 20 (Figure 23). By April 30 the vanguard has advanced evenly to an approximate east-west line across central New Mexico, Arizona, and southern California. By May 10 the easternmost birds have advanced only to southern Colorado, while those in the far west have reached northern Washington. Ten days later the northward advance of the species is shown as a great curve, extending northeastward from Vancouver Island to central Alberta and thence southeastward to northern Colorado. Since these tanagers do not reach northern Colorado until May

20, it is evident those present in Alberta on that date actually reached there by a route that carried them west of the Rockies to southern British Columbia and thence eastward across the still snowy northern Rocky Mountains.



Figure 22. *Breeding and wintering ranges of the Western Tanager. See Fig. 23 for the spring route taken by the birds breeding in the northern part of the range.*

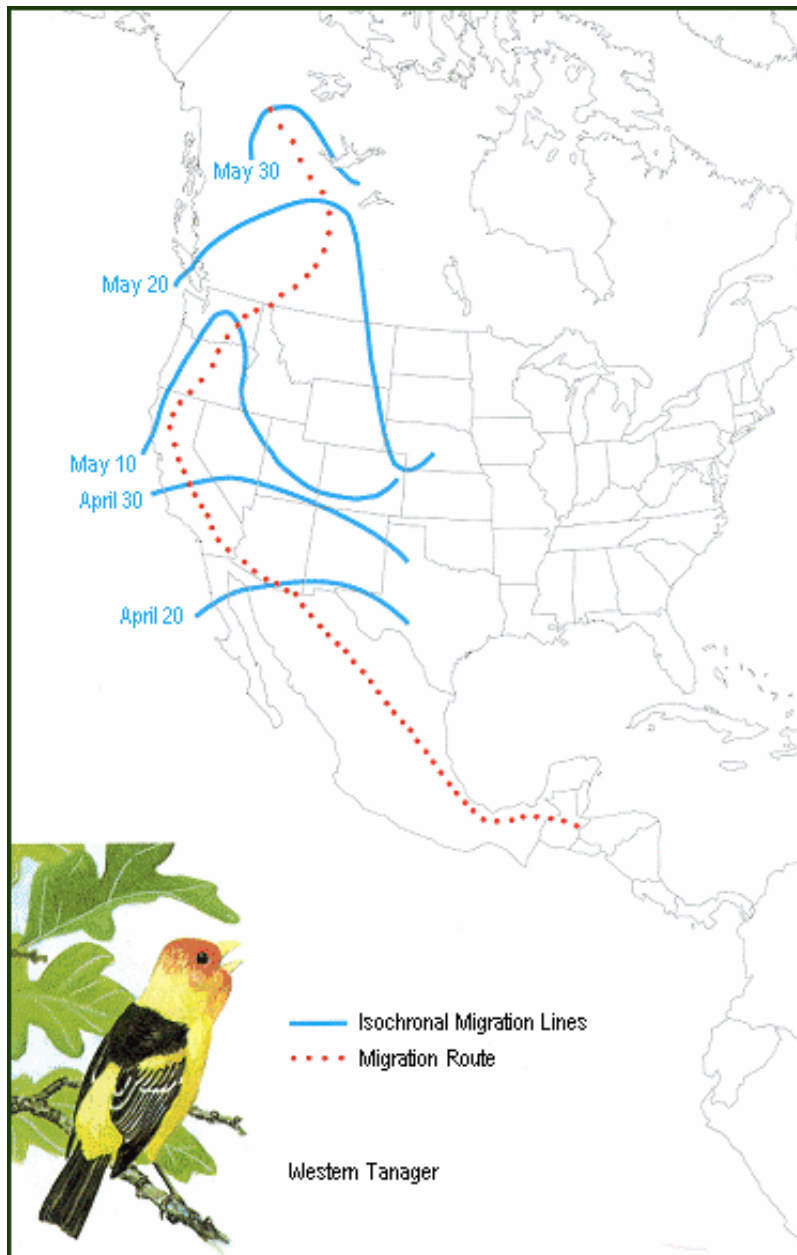


Figure 23. *Migration of the Western Tanager. The birds that arrive in eastern Alberta by May 20 do not travel northward along the eastern base of the Rocky Mountains, because the vanguard has then only reached northern Colorado. Instead the isochronal lines indicate that they migrate north through California, Oregon, and Washington and then cross the Rockies in British Columbia.*

Pacific Oceanic Route

The Pacific oceanic route is used by Pacific Golden-Plovers, Bristle-thighed Curlews, Ruddy Turnstones, Wandering Tattlers, and other shorebirds. The Ruddy Turnstones, migrating from the islands in the Bering Sea, have an elliptical route that takes them southward through the islands of the central Pacific and northward along the Asiatic coast. In addition, many seabirds that breed in the far northern coasts as well as on southern coasts and islands migrate across the Pacific well away from land except when the breeding season approaches. The Pacific Golden-Plover breeds chiefly along the arctic coast of Siberia and in limited areas of the Alaskan coast. Some of the birds probably migrate south through Asia to winter quarters in Japan, China, India, Australia, New Zealand, and the islands of Oceania. Others go

south across the Pacific to Hawaii and other islands in the central and southern Pacific. Migrating golden-plovers have been observed at sea on a line that extends from the Aleutian Islands to Hawaii. While it seems incredible that any birds could lay a course so accurately as to make landfall on these small, isolated, oceanic islands, 2,000 miles south of the Aleutians, 2,000 miles west of Baja California, and nearly 4,000 miles from Japan, year after year Pacific Golden-Plovers make this transoceanic round-trip.

Arctic Routes

Some arctic nesting birds retreat only a short distance south in winter. These species include the Red-legged Kittiwake, Ross' Gull, Emperor Goose, and eiders. This latter group of ducks winter well south of their nesting area, but nevertheless remain farther north than do other ducks. The routes followed by these birds are chiefly parallel to the coast and may be considered as being tributary either to the Atlantic or Pacific coast routes. The heavy passage of gulls, ducks, and Brants at Point Barrow and other points on the arctic coast has been noted by many observers. The best defined arctic route in North America follows the coast of Alaska. A migration route, therefore, may be anything from a narrow path closely adhering to a geographic feature, such as a river valley or coastline, to a broad avenue that leads in the desired direction and follows only the general pattern of the land mass. Oceanic routes appear to be special cases that are not fully understood. Also it must be remembered that all the main routes contain a multitude of tributary and separate minor routes. In fact, with the entire continent of North America crossed by migratory birds, the different groups or species frequently follow lines that may repeatedly intersect those taken by others of their own kind or by other species. The arterial or trunk routes, therefore, must be considered merely as indicating paths of migration on which concentration of birds is more noticeable.

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