

GEOGRAPHICAL DISTRIBUTION IN RELATION TO
NUMBER OF EGGS

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Not many generations ago it was thought that the various species of plants and animals had been placed each in the habitat to which it was best adapted. As the sciences of botany and zoology developed, however, it was seen that both plants and animals transported to far-off countries, by man's agency, often thrived so well in their new environment that they even became pests to the agriculturist; also it was seen that a large proportion of the weeds with which the farmer had to contend were not natives but came from abroad. We in America have learned to our sorrow that some birds could be introduced here and multiply so as to drive away native birds; and we are aware that periodically some insect from a far distant clime threatens our fruits and vegetables. Consequently, as we continue our studies in the distribution of plants and animals, we become aware that the absence of a species from a given fauna or flora does not necessarily mean that it is not fitted for the environment of that region; it may mean simply that it has not happened to reach the region. Continued research has convinced us also that in many cases a species having acquired a range may not have been able to hold it.

The main factors in distribution over wide areas, beside adaptation to environment, must be time, means of dispersal, and fecundity. In considering birds we can only speculate as to time; but means of dispersal which is power of flight, and fecundity which is measured by the number of eggs laid, are within our scope. A few examples of distribution in relation to power of flight may help to explain.

If we select in any of our families of North American birds, as for example the vireos, those species having the most extensive distribution, and compare them with those of limited distribution, we shall find longer wing in relation to tarsus, to accompany greater distribution. Thus, Red-eyed, Philadelphia, Warbling, Yellow-throated, and Solitary vireos all reach northward into British provinces and have a wing length of four times or more that of the tarsus, while White-eyed, Gray, Hutton, Stephens, Bell, Least, and Black-capped vireos, all of southerly or southwesterly distribution, have the wing only about three times the length of tarsus. The differences in wing length are apparent to the eye; it is not necessary to measure. In the Tyrant Flycatchers we may select the long-winged Olive-sided Flycatcher and Wood Pewee, with its western race, as those having the most extensive distribution, both north and south, and east and west. In the same way the most widely distributed among the genus *Dendroica* have the greatest length of wing. While this correlation is due largely to the elimination of the unfit in the long migrations the birds have to make each year to and from their summer homes, it will be noted that the longer winged species also have a greater extent of range east and west. It is hard to believe that these physical proportions are due to climate or environment. If we are to understand geographical distribution we must take into account the means of dispersal, and not rely too much on fitness for a particular environment.

Coming now to the main point, let us start with the passerine birds. In the following accounts the name of the species is given first, then a brief indication of its range, followed by the minimum and maximum number of eggs, separated by a dash. It will be convenient to ignore the subspecies and also to note the existence of representative species in the Old World. The numbers of eggs are taken from the works of Chapman, Coues, Davie, Ridgway, and "Birds of America" in "Nature Lovers Library."

Among passerine birds of North America the kinglets seem to have the largest number of eggs: Ruby-crowned Kinglet, North America at large, 5-9; Golden-crowned Kinglet, North America at large and representing the Golden-crowned Kinglet of Europe, 6-10. These figures are much in excess of the usual 3-4 and 4-5 or 6, of passerine birds.

The Brown Creeper, eggs 5-8, is a bird of wide distribution in both Old and New worlds, the American bird not being specifically distinct from the European.

The nuthatches and titmice are two families with eggs in excess of the average, 4-7, 5-6, 5-8 being common figures for the first, and 5-9, 5-8 for the second. Both these families are represented by the holarctic genera *Sitta*, *Parus*, and *Lophophanes* (as formerly constituted), of wide distribution, although no species is common to both Nearctic and Palearctic regions.

The Winter Wren is regarded as "the strict representative of the European Wren" to quote Coues. It ranges North America at large; eggs 5-8.

It will be noticed that the ranges of these birds just mentioned include the ranges of the great majority of our passerines whose eggs are less in number. We cannot then ascribe the greater fecundity to temperature or climatic conditions. There is an interesting correlation that may help to explain; the smaller bird lays the most eggs.

The kinglets are among the smallest of our passerine birds, and their eggs as shown by their measurements are the smallest outside the hummingbird family. Their nesting and feeding habits are not apparently different from those of many other small birds, such as warblers and vireos. The Brown Creeper, Winter Wren, nuthatches, and titmice will be recognized as pygmies among birds without quoting any figures. Among the grebes the 3-5 eggs of the Western Grebe measure 2.50 by 1.54 inches, the 4-8 or 6-9 of the Pied-billed Grebe only 1.72 x 1.17 inches. Taking the woodland owls, and omitting the ground-nesting species so that we may be comparing birds of similar habits and environment, we have Great Gray Owl 2-4 eggs, 2.16 x 1.71 inches; Great Horned Owl, 2-3 eggs, 2.20 x 1.80; Barred Owl, 2-4 eggs, 2.0 x 1.65. The smaller species much exceed these in number of eggs; Screech Owl, 4-6 eggs, 1.55 x 1.22; Long-eared Owl, 3-6 eggs, 1.65 x 1.30; Richardson Owl, 3-7 eggs, 1.35 x 1.14; Saw-whet Owl, 3-5 eggs, 1.19 x 1.00; Hawk Owl, 3-7 eggs, 1.50 x 1.23.

Why do the larger birds lay fewer eggs? It is not difficult to name one reason. The Barred Owl, for example, has 2-4 eggs, the Long-eared Owl 4-6. It appears at first thought that the Barred Owl, having fewer mouths to supply, has an easier task in feeding its young than the Long-eared, but this is not so; for, the eggs being similar in shape, their content is in ratio of the cube of a similar diameter. The egg of the Barred Owl is as already stated, 2.0 x 1.65, that of the Long-eared Owl, 1.65 x 1.30. Cubing either diameter and comparing we find the content of the larger egg to be nearly twice that of the smaller. As the chick fills up the egg in either case, if the eggs of the two birds were the same in number the Barred Owl would have nearly twice the bulk of young to feed—nearly twice the amount of tissue to nourish. In the same way if we compare the egg of a kinglet with a bird of similar habits and environment, a Blackpoll Warbler, for example, we find with an equal number of eggs the warbler would have nearly twice the bulk of young to feed. Moreover the young of the larger bird have to be fed for a longer time. To appreciate the labor of the adult birds it must be remembered that the young in the nest consume each day at least their weight in food, and that the adults also have to feed themselves.

We can apply this reasoning to birds of similar habits whether they belong to the same family or not; for instance, if the Loon had as many young to feed as a Western Grebe it would have more than twice the bulk to nourish; as it is the Loon has but two young. It is true the young of grebes and loons leave the nest soon after hatching, but they are attended and fed by the parents for some time. No doubt it takes time for the little ones to acquire the ability to take their food by diving. In "The Secrets of the Eagle," Gilbert and Brook, is a photograph of two adult Black-throated Divers each carrying a tiny fish in its beak to the young. In all these examples, if the smaller bird is busy in feeding its young, the larger bird, if the number of young were equal, would be overworked and the young undernourished. In some cases it may be that the larger bird can get a different kind of food and thus lighten its labor. A crow or a grackle, for example, can raise as many young as most passerine birds, much of its food being of a different nature.

Other examples of correlation of size and number of eggs are the Black Swift, of very large size for its family, and of very limited distribution in the western United States. It lays one egg, while the Vaux Swift and the Chimney Swift, very small in comparison, have 4-6 eggs. In the genus *Sula*, the gannet of the North Atlantic has one egg, while the much smaller booby, a tropical bird, has two. The three eiders breeding in the arctic regions, distinguished by their very large egg have 4-6 or 7 (Chapman), about half the number laid by the smaller ducks. Although there is a tendency for northern birds to lay more eggs than their representatives in the south, this may be overcome if the northern bird is much larger, as in the gannets and eiders. To the rule that the larger bird in a group of similar habits and environment lays fewer eggs, the Purple Martin is an exception, as it does not have fewer eggs than some of its smaller relatives.

There is a group of boreal birds that are holarctic, which may not have a greater number of eggs than most northern passerine birds, but certainly have less than the kinglets, wrens, titmice, creepers, and nuthatches. These are shore larks, pine grosbeaks, crossbills, redpolls, Snow Bunting, longspurs, Bohemian Waxwing, Northern Shrike and Titlark. But all of these are birds with good power of flight, as we may see in the field, or may surmise from the long, pointed form of wing possessed by all but the shrike and grosbeak. The means of dispersal, that is the power of flight, is superior to that of the tiny birds of the first group. To this list must be added the Bank Swallow, of Boreal and other zones, which has wide range in the Northern Hemisphere. The eggs are but 4-6, but the bird, like all its family, is a tireless flier.

We now come to cases where the number of eggs is less than the normal. The Redstart of the Canadian, Transition, and Upper Austral zones in eastern North America has 4-5, the Painted Redstart in the same genus, mainly of Arizona and New Mexico, has but 3. In the genus *Pipilo*, the Oregon Towhee, ranging in the coast districts from southern British Columbia to California, has 4-5, the Towhee of the eastern United States and adjoining British Provinces, 4; but the Cañon Towhee of New Mexico and Arizona has 3, rarely 4, and the Abert Towhee of the southwestern United States, 2-4. The Brown Thrasher of eastern North America north to British Provinces and west to the Rocky Mountains, 4-5, but the Crissal Thrasher of limited southwestern distribution has not more than 3, and some other thrashers of that region have less than the Brown Thrasher. *Phainopepla nitens* of the western parts of the United States from Utah, Nevada and Colorado southward, 2-3, and *Pyrrhuloxia sinuata* of southwestern United States and Mexico, 3. Probably there is a similar deficiency in the number of eggs of the southwestern

orioles (*Icterus*) as compared with the more widely distributed Baltimore and Orchard orioles. So much for examples in the west and southwest. We now come to some in the south.

We have already noticed the extensive distribution of the Winter Wren. If we list the whole wren family we have the following: Carolina Wren, north to Nebraska and Connecticut, west to the Rio Grande Valley, 4-6; Bewick Wren, eastern United States, Nebraska to Pennsylvania on the north, and west to the Pacific Coast, 4-6; House Wren, United States across the continent, 6-8; Winter Wren, Canadian Zone across the continent and represented in the Old World, 5-7 or 8; Short-billed Marsh Wren, Transition and Upper Austral zones, west to Kansas, 6-8; Long-billed Marsh Wren, Transition and Austral zones across the continent, 5-9. In this family we note the limited ranges of the Carolina and Bewick wrens corresponding to their limited fecundity.

The Acadian Flycatcher of eastern North America, whose breeding range does not extend northerly beyond New York and Connecticut on the east and Nebraska on the west, has the most limited range of its genus, *Empidonax*. Its eggs are 2-3, the remaining species 3-4 or 4-5. The Boat-tailed Grackle lays fewer eggs than the Purple and Bronzed grackles.

Among woodpeckers the Red-cockaded of the Austroriparian Fauna has 2-5, while the widely distributed Downy and Hairy have 4-6, and the Flicker, breeding from the tree limit in Alaska south to Florida and Texas, is credited with 5-9.

Birds of limited distribution, but with more than the usual number of eggs are Prothonotary Warbler and Rough-winged Swallow; perhaps the peculiar choice of nesting site has something to do with this. The Bush-tits and Fan-tailed Wrens, being very small birds, keep to the rule of an excess of eggs, but are of limited distribution in the west and southwest. Although the species of *Lophophanes*, Tufted Tit and others with an excess of eggs, are in North America of limited distribution, the genus is Holarctic.

That birds of temperate zones usually lay more eggs than their representatives in the tropics, is noted by Chapman (Handbook, 1932, p. 83), giving among other examples the Sooty Tern, Bridled Tern, and Noddy, as compared with the Arctic, Roseate, and Common terns, the first three having one egg, the others usually 3. These are large birds compared with small; nevertheless the law has to be reckoned with. Without going into the tropics the same tendency of the northern birds to lay more eggs than their southern representatives has already been noted. The western and southwestern examples, redstarts, towhees, thrashers, phainopepla, and pyrrhuloxia, are probably of southern origin and can be included in the same category with southern birds.

There may be some unknown physiological factor, but it is plain that the southern bird is at a disadvantage in feeding its young, because in the breeding season there are more hours of daylight as we pass from tropic to temperate or arctic regions, the northern bird having more time for feeding. Some of our Alaskan birds even have the "midnight sun." If we remember that each chick has to have at least its own weight in food each day, we realize what an effort it is on the part of the old birds to supply this, and that bird life in the breeding season is indeed a struggle.

We may sum up the distribution of North American passerine birds in relation to the number of eggs laid, in a formula:

1. Maximum 3; invariably of limited distribution in the south, southwest or west; not differing especially in size from their representatives in the north and east.
2. Maximum 4 to 6 rarely 7; includes the great bulk of passerine birds, but

none are Holarctic except about ten genera of long-winged boreal or arctic birds, three species common to Alaska and the Old World, the aquatic Dipper (*Cinclus*), and the Bank Swallow.

3. Maximum 7 to 10; a group of very small woodland birds, Holarctic and of extensive distribution, although of feeble flight, chiefly members of the following groups: kinglets, wrens, creepers, nuthatches, and titmice; in addition, the Magpie of western North America, similar to the Old World Magpie. Birds with an excess of eggs but of limited distribution, in the west and southwest, are bush-tits and fan-tailed wrens.

It is true that each species must have a number of young suitable to maintaining its population; but this is true only to a limited extent. There can be no perfect adjustment. A bird in relation to its food is one of a chain; a thrush, for example, has some bird preying upon it, and in turn it preys upon some insect which in turn depends upon vegetable food. Periodical fluctuations in numbers in any one link, which observation shows are constantly taking place, cause fluctuations in others of the chain, at times imperiling the existence of the bird. Unless we realize the continual struggle and continual change in our bird life, much of which takes place so slowly that we are apt to overlook it, we shall not be able to form a good conception of what has taken place or of what is taking place.

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