

changes in vitamin A activity. As the changes in butter color produced by feed changes, and also the accompanying changes in vitamin A activity, are so much larger than the breed differences which are not an index of vitamin A activity, the natural yellow color of the milk fat is, in general, a fairly good rough index of its vitamin A activity.

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WATERFOWL Breeding Grounds of Far North Now Poorly Tenanted

While everything possible is being done to restore unwisely drained and cultivated areas in the United States to waterfowl, it must not be forgotten that far to the north there are extensive nurseries to which an adequate breeding stock of the birds must annually be returned.

Investigations conducted by the Bureau of Biological Survey afford many specific instances of excellent breeding grounds that are poorly tenanted, and indicate that this condition prevails over immense areas. The breeding population is relatively sparse over the Canadian and Alaskan ranges of several species of waterfowl that are important by reason of their former abundance and their wide distribution in the United States during their migrating and wintering. Observers of the southward waterfowl flight of 1934 reported the returning flocks from northern nesting grounds as the smallest on record.

Sportsmen and naturalists in the fall of that year were prepared to expect only meager returns from the few nesting grounds that still remain in the drought-parched areas of our northern plains, both in the United States and the Prairie Provinces; but farther north there are still suitable breeding grounds that afford hope for the future—if an adequate seed stock is maintained.

Beyond the northern boundary of the section most affected by the great drought—a curving line that crosses central Canada between Lake Winnipeg and the Rocky Mountains, an area stretching from Hudson Bay to the Rockies and from the Saskatchewan Valley north to the Arctic Ocean—lies a region aggregating upwards of a million and a half square miles that would seem to have been prepared by Nature especially for a waterfowl nursery. Its inherent productivity is the result of a series of great geologic and climatic processes, the most important of which were exerted by the vast ice fields of the glacial period and the readjustments that followed their disappearance. Practically the entire area was then ground and scoured, violent shifts of the soil took place, the drainage systems underwent drastic changes, and myriads of new lakes were formed.

After the recession of the ice many thousands of years passed while Nature clothed the bare rocks with lichens and mosses, fertilized the sterile soil with the products of decayed vegetation, and finally covered the terrain with forests and lesser plants. Through the slow process of encroachment by vegetation, thousands of lakes became marshes and eventually solid ground. Other thousands are still in the process of being filled.

The lichens and mosses, which have so effective a role in first clothing a newly born land, still form an important part of the vegetative cover and make much of the area a vast sponge that receives moisture avidly, but dispenses it with reluctance. Other classes of plants, spread by wind and water and encouraged by the almost con-

tinuous sunlight of the long summers, have helped through the ages to build up a varied and prolific invertebrate and vertebrate fauna, a teeming biota whose members are mutually interdependent. Of this great aggregation the waterfowl are a part.

Vast Number of Lakes and Marshes

Over this vast area of a million and a half square miles, the lakes probably average one to the mile, despite the fact that a few are 200 or 300 miles long. Thus, by a conservative estimate, there are in this region more than a million lakes and marshes virtually unmodified by man's presence, where drought is unknown, and where the food and shelter for waterfowl are ample. Distribution and migration studies show that a large proportion of the waterfowl species most important to wildfowlers not only of the Mississippi Valley but also of both the Pacific- and Atlantic-coast regions, nest naturally in this great area.

From November to mid-April this region is fast frozen, but with the melting of the snow and ice the eager waterfowl return to their ancestral homes there, the earliest following closely the retreating ice. Among the first are the swans, which subsist largely at this season on the roots of the broadleaved cattail (*Typha latifolia*). Shortly afterward follow the Canada goose (*Branta canadensis*), the snow goose (*Chen hyperborea*), Ross's goose (*C. rossii*), and the white-fronted goose (*Anser albifrons*). All these gather at first in the larger marshes and the deltas, where they rest and feed on the sprouting heads and the roots of *Equisetum*, locally called goosegrass, a very abundant plant. Later these geese, as they work their way northward, have recourse to the overwintered berries of a number of trailing upland shrubs, whose fruit is available in spring, when some of the waters are still icebound.

With the geese come ducks of more than a dozen species, and these seek first the larvae, and probably the eggs, of toads and frogs, and the snails of two genera, *Limnaea* and *Planorbis*, that develop by myriads in the waters. Insect life is enormously abundant, and the larval forms of those that develop in the water are especially important. These include May flies (Ephemeroidea, both nymphs and adults); dragonflies (nymphs); water bugs and water beetles; and the young of many other smaller insects. Even the thronging larvae of mosquitoes are eaten by the young ducks. As the season progresses the marshes are filled with many plants that furnish food and shelter, including the large reed *Phragmites phragmites*, sedges (*Carex utriculata* and *C. aquatilis*), great bulrush (*Scirpus lacustris*), common pondweed (*Potamogeton natlans*), fennel-leaved pondweed (*P. pectinatus*), white-stemmed pondweed (*P. praelongus*), clasping-leaved pondweed (*P. perfoliatus*), and northern pondweed (*P. alpinus*). Sweet flag (*Acorus calamus*), yellow pond lily (*Nymphaea advena*), water persicaria (*Polygonum amphibium*) and other smartweeds, and the broad-leaved sagittaria (*Sagittaria latifolia*) also abound in suitable places.

That this great region no longer harbors a reasonable share of the teeming waterfowl population that bred there in the early days is most discouraging to conservationists. Old residents testify to a reduction of 75 percent in the past 20 years. Today, with no change in the physical environment, and with a food supply that would still suffice for the former unparalleled wealth of bird life, these myriad swamps and lakes are occupied by scarcely a tenth of their potential waterfowl

population. We have not yet exterminated any of the thirty-odd species that formerly graced this great waterfowl paradise, but we have allowed several of our most beautiful and useful species to be reduced to a pitiful remnant.

Although about 75 percent of the waterfowl shot in North America are taken in the United States, an overwhelming majority of these birds (about 85 percent) are produced in Canada and Alaska, and if the time ever comes when certain of the species are no longer represented in the flocks that come from the far-northern breeding grounds, we shall know that they are gone forever. We have already lost the Labrador duck and several other North American birds whose tremendous populations seemed to early observers to insure their perpetuation, and it is none too soon to take thought of the danger suggested by the rapid diminution of any species that is subject to special pursuit.

The Lesson of the Passenger Pigeon

The folly of relying alone on the presence of extensive breeding areas to perpetuate a threatened species is well illustrated by the story of the extermination of the passenger pigeon. In 1860 a legislative committee of Ohio declared:

The passenger pigeon needs no protection. Wonderfully prolific, having the vast forests of the north as its breeding grounds, traveling hundreds of miles in search of food, it is here today and elsewhere tomorrow and no ordinary destruction can lessen them.

Ten years later this pigeon, which was numbered among the millions in the memory of many people now living, had become scarce. Within 30 years it was practically extinct, and the last known representative of its race died in a zoological park 20 years ago.

It is well, therefore, before it is too late, that we be warned by the rapid diminution of several of our waterfowl species, the numbers of which a generation ago recall today the scoffings of the last century regarding the passenger pigeon. Unless we take care of the stock that is needed to bring back to its maximum productivity the great northern breeding grounds of the wildfowl, our efforts to restore this great resource by other means will bear but small and bitter fruit, for we shall be without the breeding stock to populate these ancestral grounds.

If, on the other hand, the nature-minded people of North America really wish it, the waterfowl paradise of the North can again welcome to its marshes the hordes that were the wonder of former times. To this end, it is necessary to spare and send back each spring to these fertile nesting grounds a yearly increasing stock of the beautiful species that still carry on there.

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WATERFOWL Problems Clarified by Study of Gunning Practices With the alarming decrease in waterfowl numbers in North America in recent years, sportsmen and conservationists have been faced with a problem of national importance. The Bureau of Biological Survey, charged by the Migratory Bird Treaty Act with the custodianship of the waterfowl while they are in the United States, has made extensive