AERIAL SURVEY TECHNIQUES

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THE use of aerial survey in the census of wildfowl is new to Britain and techniques are, as yet, in an experimental stage. However, the system has been employed on a large scale in Canada and the United States for a number of years and routine methods have been evolved by the U.S. Fish and Wildlife Service which carries out the surveys.

The object of the aerial surveys in North America is to provide data from which shooting regulations may be drawn up, and as these regulations are made in advance, it is necessary to make a forecast of what the duck crop is likely to be. The success of a breeding season depends on many factors, not the least of which is the amount of water available. The duck breeding grounds in Canada are covered with small ponds or sloughs which fill up in the spring from the melting snow and their permanence depends on the subsequent rainfall. A wet spring means full sloughs in the summer for the young ducklings and is a harbinger of a good shooting season. Other important factors which obviously affect the success of a breeding season, are the number of birds which pair up after the spring migration and the number of young which are successfully reared. Thus, a forecast of next winter's duck population must take into account the amount of water available and the number of breeding pairs in the spring as well as the number and average size of the broods in the summer. From this information an index of the duck population is derived. In order to collect these data, a breeding population survey is flown in May and a production survey in July. For administrative reasons this information has to be submitted to headquarters by the end of July so that surveys cannot be continued later than about 25 July, when many broods are not yet hatched. The major duck breeding areas in North America are to be found in the Canadian provinces of Alberta, Saskatchewan and Manitoba. This is a vast area and as one obviously cannot hope to make a complete inventory, a sampling technique is necessary. The sampling procedures were determined by statistical methods outlined by Crissey in 1957. (Forecasting waterfowl harvest by flyways. *Trans. 22nd N. American Wildlife Conf.* pp. 256-268). The area to be sampled is divided into units of states or provinces and straight line transects are flown across them. The distance between each transect varies with the density of the population; in the prairie provinces, where the highest population densities occur, and from which the data are most variable, transects are flown at intervals of from 7 to about 20 miles. In northern areas with lower densities and less variability, an interval of 60 miles between transects is sufficient to reduce the sampling error to the required level of not more than 20%. Sampling error was determined from the variability imposed upon the data by sub-dividing transect lines into 18 mile segments and recording the data separately for each segment. The transects may extend up to 200 miles in length and altogether about 12,000 miles are flown in the May survey which takes six crews about 3 weeks to complete. The same transects are flown again in July but sometimes flying is not completed before the reports have to be submitted. An aerial survey crew consists of a pilot-biologist and an observer. The aircraft belong to the U.S. Fish and Wildlife Service and are flown by the Service pilots, but the observer is frequently a member of the Canadian

Wildlife Service. Light aircraft are generally used, high winged monoplanes being best because of the good visibility from this type of machine. For the Arctic surveys an amphibious twin engined aeroplane is preferred, either a Grumman Widgeon or the larger Grumman Goose. Although used primarily as land planes these have the advantage of being able to come down on one of the many lakes in case of engine trouble over wooded country. The surveys are flown at a height of about 100 ft. and at an air speed of 100 miles per hour. In all aspects of the procedure, great attention is paid to uniformity and as far as possible the same crew is used to fly the same transects each year.

Each member of the crew records the number and sex of each species seen on his side of the aircraft, using a dictaphone for the purpose. Because of his preoccupation with flying the machine, the pilot tends to see fewer birds than the observer, but tests have shown that the difference is not more than 20% and in any case the difference is immaterial in deriving an index of birds present provided the same pilot is used each time. In addition the observer notes the number of wet sloughs. In the spring the birds are recorded as pairs or as lone drakes, which are presumed to have mates remaining on the nest. Groups of birds are omitted if it is thought that these are transients. Only wildfowl within 220 yards of the aircraft are considered, hence the transect comprises a strip $\frac{1}{4}$ mile wide across the territory. For the July surveys great detail is attempted in the data. Because of this and of the greater difficulty in seeing the birds below leaf cover, the transect width is reduced to $\frac{1}{8}$ mile. The information collected consists of:

1. Number of broods
2. Age class of broods (using the abbreviated I, II, III classification)
3. Number of ducklings in the Class II and III broods
4. Number and species of adults without broods when these are single ducks of either sex or in pairs.
5. Number of water areas (recorded by observer only).

The number of Coot broods are also noted as this species is an important game bird in the States. Groups of two or more drakes and groups of three or more adult birds of mixed sexes are not recorded as they do not provide information on production. The number of water areas counted by the observer are those in the 1/16 mile stretch that he is searching.

In all cases the survey flights are made in the early morning, usually between 6 and 10 a.m., for the following reasons. First, it has been clearly established from many experimental flights that more birds are out on open water at this time of day than at any other time. Secondly, in the early morning the strong wind which is a feature of the prairie during the day has not developed. Calm air conditions are desirable as wavelets on the water surface reduce visibility and tend to drive the birds under cover and it is generally considered impracticable to fly surveys in winds above 20 m.p.h. The ideal weather conditions for optimum visibility are considered to be a light overcast with a slight wind, sufficient to keep ponds from appearing glassy. It is desirable that all flights should be standardised at the same time of day for the diurnal movements of wildfowl might otherwise obscure the picture. This is a factor reducing the value of ground surveys which, of necessity, have to be continued throughout the day.

In addition to these production surveys, autumn and winter inventories are carried out and are of greatest use with species which form very large aggregations in a limited number of localities at some time during their annual migrations. These are best surveyed photographically from high flying aircraft. Greatest success is found with those birds, such as Snow Geese, which contrast most with their background.

The accuracy of the aerial surveys in North America is examined by comparing results from air and ground coverage of selected study areas which are extensively worked from the ground. This is an invaluable technique which has shown that, under standard conditions, a significantly constant proportion of the birds is seen from the air. The visibility of all species is not the same: for example, Mallard are more easily seen than Teal, and some method of applying a correction factor to the number is being investigated.

If the American survey regions are related to British conditions the most notable difference is found in the homogeneity of the habitat. While it is possible in Canada to fly for one or even two hundred miles over the same type of country, it is very unlikely that one would be able to fly very far in this country without encountering a major ecological change in the countryside. Hence a large scale transect system would not be appropriate here because the transects would not be sampling a uniform population. In any case in an overcrowded country like Britain it would be very difficult to plan straight line transects which would avoid towns and built-up areas. Navigation would present a problem too, for here there are no long straight mile roads which are used as navigational aids in Canada. Finally, weather conditions are such as to render it likely that a 200 mile flight across England would lead one through frontal conditions. Photographic inventories of geese are not as easily effected in this country as in America, chiefly because we have no very large concentrations in a few localities and because our grey geese do not contrast as sharply with stubble and grass background as do Snow Geese on water. With these considerations in mind we can detail some of the techniques which are being developed by the Trust for the aerial survey of wildfowl in Britain. These surveys can be broadly classified into those concerned with geese and those concerned with ducks and swans; the principal difference being that the former are usually found on land and the latter on water. Geese surveys are of necessity restricted to the winter months and so far very little summer flying has been done although it is hoped to carry out experimental surveys of breeding ducks in the spring and summer of 1959. The geese that have been surveyed to date include two ' black ' and two ' grey ' species, each presenting its own particular problems. A survey of Barnacle Geese in the Hebrides and Western Scotland in 1957 by Boyd and Radford showed that such flights by light aircraft in this part of the world are possible in winter, but the uncertain weather conditions and the lack of detailed weather forecasting facilities render this type of survey somewhat hazardous. The use of a more suitable aircraft might make further flights too expensive but as there is no other way in which a survey can be carried out this possibility must be considered. The other ' black ' goose that has been investigated is the Brent, which occurs primarily along the coast between the Thames Estuary and the Wash. This is a species which lends itself to aerial survey for it lives largely between the tidemarks and is therefore quite simple to find, provided the tide is not too low. Such coastal birds are very difficult to see and count from the shore

and aerial survey can make an important contribution to our knowledge of the status of these birds. Interest in the status of these two geese is acute as both have shown signs of serious decline in recent years and have been afforded a trial period of protection. English Brents are of special interest in that the east coast forms the meeting point of the light and dark bellied races.

The two grey geese which have been investigated so far are the Pink-footed and the Greylag Goose. The Pinkfoot was the more difficult bird to survey owing to its habit of feeding far from its roosts. It was necessary systematically to quarter large areas of arable land before the birds could be found, although from prior knowledge only limited regions needed to be searched. The Greylag feeds nearer to its roost and consequently the searching time was much reduced. All species were counted from a height of about 4-500 ft. Visual estimates are made of large flocks by counting the birds, on a hand tally, in units of 10 or 50, depending on the size of the flock. Photographic techniques are being explored as these are potentially greatly superior in that there is no question of the accuracy of a good photographic count. Two K20 aerial cameras have been obtained, using Kodak Super XX aerial film. However, under the poor lighting conditions of a winter survey and with the lack of contrast between birds and background, a photographic record cannot be relied upon and the visual counts will continue to be necessary. In this respect it is desirable that the same crew is used each time so that the individual tendency to under-for—or over-estimate numbers will be a constant factor.

Aerial surveys of ducks have been made on reservoirs, gravel pits, rivers, flood water and along the coast. For these surveys it is necessary to fly at about 100 ft. in order to identify the birds. The flocks on large reservoirs are extremely difficult to count as the approach of the aircraft scatters the birds, mixing those that have been counted with the uncounted ones. It is also a formidable problem to count the separate species when these are mixed up together. Such difficulties do not arise on small ponds and gravel pits or on rivers where only small concentrations of ducks are encountered. Flights along rivers seem to be fruitful and ' replicate flights ' along the same routes are being made to test the consistency of the observations. These flights are usually made at a cruising speed of about 90 m.p.h. Data are recorded on a Minifon wire recorder which has the advantage over notebook and pencil in that notes may be made without taking one's eye off the birds. The only coastal duck that has received attention is the Shelduck in Bridgwater Bay, which is the only known moulting area for this bird in the British Isles, and several flights were made last summer and autumn to determine the number of moulting birds.

Swans are easily seen and counted both on reservoirs and rivers and experience has shown that a single pilot-observer can make an adequate census of these birds. It is possible from the air to distinguish juveniles from adults and information on brood size and adult/juvenile ratios is being collected.

Most of the surveys have been made with Auster aircraft, which are high-wing monoplanes similar in design to the aircraft used by the U.S. Fish and Wildlife Service. A Miles Messenger, which is a low-wing monoplane, was used for surveys in Scotland when an Auster was not available and the visibility was found to be better than anticipated, although, of course, inferior

to that from the Auster. The disadvantage of the poor visibility from low-wing aircraft may be offset by the observer being able to see out of both sides of the aeroplane, at least in those with tandem seating. However, the Auster is preferred because it is cheap, manoeuverable and has good slow-flying characteristics.

The advantages of aerial survey should now be apparent. First, with an aircraft all birds are accessible. Second, aerial survey is " instantaneous " within a particular area and there is little danger of counting the same birds twice (this probably happens not infrequently when ground counters are out at various times of the day). The use of the same observer each time is a great advantage when comparing annual fluctuations, for the changes are not likely to be a reflection of differing abilities to assess numbers as might be the case with a number of ground counters.

Aerial survey has, however, its limitations. Perhaps the greatest of these, in the winter at least, is the weather. Fog and low cloud will prevent flying altogether while high winds make it somewhat dangerous to fly too near the ground. The long sequence of foggy days in November and December 1958 seriously curtailed our flying programme. Aircraft availability has in general been good although the locally hired Auster is not available at weekends or on summer evenings, and for flights away from base, special arrangements have to be made. Flying restrictions have proved less irksome than was anticipated except that five areas dangerous to flying (firing ranges) are located within the Brent regions on the east coast. Airfield availability leaves much to be desired and re-fuelling problems are often serious in Scotland where the geese may sometimes be found more than an hour's flying time away from the nearest airfield with fuel. It is not anticipated that aerial survey will replace ground counts but it is hoped that the method will be of value in supplementing ground observations, especially in areas where few counters are available. When once the limitations and the possibilities of the method have been evaluated it should be possible to design flying programmes that will be of considerable assistance in the general problems of wildlife conservation.