ROLE OF THE FAMILY IN THE FORMATION OF GOOSE FLOCKS

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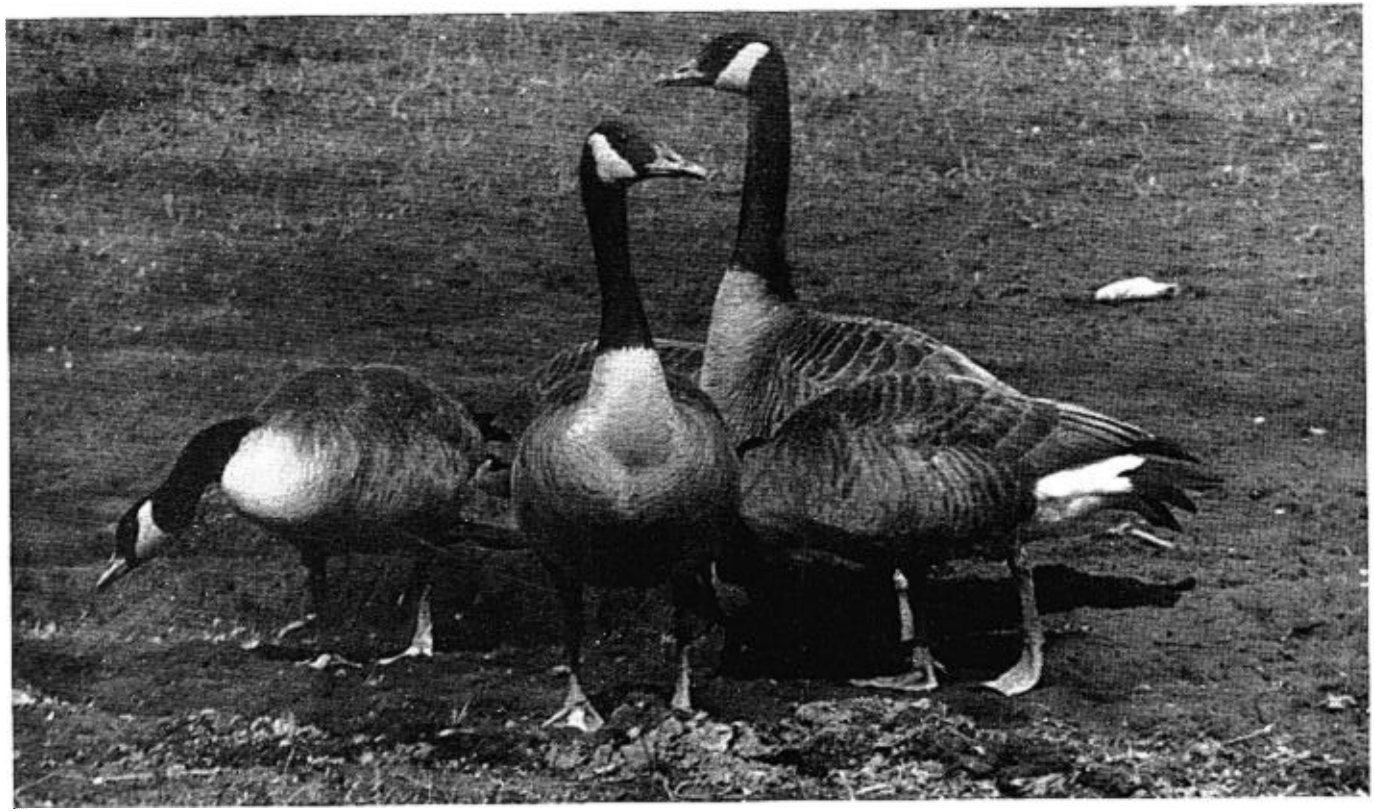
THE organization of birds into flocks must have intrigued man since time immemorial. One who sees a wedge of geese emerge from the gray murk of an early morning is impressed by the strength of the bond which holds the birds together. But the nature and meaning of that bond has not yet been thoroughly explored.

Our purpose in this paper is not only to draw together the scattered bits of evidence concerning the nature of the bond holding the members of a goose flock together but also to add our own observations indicating that the flock is a family. We wish to point out how this information may possibly be used as an index of annual fluctuations in productivity. Finally, we wish to explore the possibility of using counts of small flocks of geese, made after the open season, as a measure of the hunting pressure sustained by the population. This study was suggested by Arthur S. Hawkins. To Aldo Leopold we are indebted for generosity with his data and for the stimulation of his advice. Part of the data we gathered while the senior author was an employee of the Illinois State Natural History Survey.

The significance of the organization of birds into flocks has been questioned and discussed by many writers, among them Huxley (1916), Allee (1923, 1931: 342), Sherman (1924), Leopold (1933: 119), and Darling (1938a: 81). Trowbridge (1914) has postulated survival significance for the echelon flight pattern shown by migrating flocks.

The question, "Is the flock a family?" has brought comment from many observers, especially those interested in waterfowl. Alpheraky (1905: 2) states categorically, "Geese pair for life, i.e., they are genuine monogamists, and both parents show equal solicitude for their progeny . . . from individual pairs or families of geese (broods) are usually formed considerable flocks, the members of which carry out their wanderings and migrations together." One wishes that the nature of the evidence had been explained. But Alpheraky's statements have been confirmed in part for the genera *Anser* and *Casarca* by Heinroth (1911) and Lorenz (1935). When Pike (1902) killed 5 from a flock of 6 Bean Geese he found them to be an adult pair with 3 young. Darling (1938b: 28), speaking of a large flock of Barnacle Geese, makes the following statement: "The birds rose in a cloud into the gold of the dying sun, and we could see through our binoculars that the string formation of what I believe are separate families, was kept within that great concourse." Witherby (1939: 181) reported that Grey Lag Geese also appeared to be still in family groups



A FAMILY-SIZED FLOCK OF CANADA GEESE

in spring. In passerine birds, flocks of some species may retain families as entities (Whittle, 1926), while in other species, followed by means of colored bands (Butts, 1931, Odum, 1942), flocks were found not to be composed of families.

On the North American continent we have a splendid opportunity to watch flock organization, for in several of our species of waterfowl the young may be clearly distinguished by their plumage. McAtee (1924) mentioned that he had seen hundreds of families of swans, their composition being easily distinguished —2 white-necked birds accompanied by 2 to 5 gray-necked ones. Bailey (1928), in observing Lesser Snow Geese (*Chen h. hyperborea*) on the wintering ground in Louisiana, found that each huge flock seemed to be made up of family groups, "... instead of a great band of individuals, it was composed of hundreds of groups of 3, 4, 5, ..." Again, Bailey and Wright (1931) noted that in dense flocks observed in the same region "... the dark colored young were numerous (in fact, the big flocks appeared to be formed of family groupings)..." Rowan (*in litt.*) has noticed the same phenomenon in this species in Alberta. The same groupings have been observed in the Greater Snow Goose (*C. h. atlantica*) by Howard (1940), while McIlhenny (1932) has given us a careful description of the behavior of family groups in Blue Geese, strongly indicating that parental care and defense of young are maintained on the wintering ground.

In the genus *Branta*, young of the year cannot be distinguished by their plumage unless the bird is in the hand (Elder 1946a); consequently, evidence concerning the persistence of the family group is more difficult to obtain in this genus. Most of our general works on birds state that Canada Geese (*B. canadensis*) mate for life, that the young migrate with their parents, and that the flock is invariably led by an old gander; but none, as far as I have discovered, presents any supporting evidence except what could be adduced from captive birds.

Occasional statements by early ornithologists give evidence of family groups in wild Canada Geese as shown by their behavior. Mackay (1896) says that when a flock alights on a pond it breaks up into families at once, "each gander and goose with their young keeping together, the gander leading." Bishop (1901), Phillips (1910, 1922), Miner (1923: 114–115, 121), McAtee (1924), and Trautman (1940: 96) have witnessed similar behavior. One who spends much time watching geese sees convincing examples of family bonds persisting in winter. Once we watched 4 Canada Geese feeding together and moving slowly through a large, loose flock of the same species resting in a winter wheat field. Two of the 4 birds carried our colored bands, showing that one was an adult gander, the other a juvenile goose. As the group passed very near to other geese they received the usual postural and vocal challenges. The red-banded juvenile and what was assumed to be her sibling invariably gave way to any

challenger, while the other 2 birds, one of which was the banded adult gander, advanced to meet the challenger in every instance.

On 2 occasions while we were stationed at Horseshoe Lake Refuge in southern Illinois, small groups of geese wandered into deer traps operated on the island. In each case cloacal examination (Elder, 1946a) proved that the group trapped together consisted of an old pair and 2 or 3 young. More than once Phillips (1916) observed the killing of an entire small flock of Canada Geese at a shooting stand in Massachusetts. Here again, the flock was found to consist of an adult pair with several young. Jack Miner (1923: 121) cites an instance of a small flock of geese caught and banded by him in one group, and later shot in one group, the bands all being returned to him.

Another convincing line of evidence supporting the belief that goose families remain intact during migration is supplied by the many instances of badly shot up flocks circling and returning to the spot where their companions had fallen to the guns. Bishop (1901), speaking of Canada Geese in North Carolina, states ". . . if both old birds are shot the young will return to decoys, but if 1 old bird escapes it will guide the young to safety." Phillips (1916) records the same behavior of Canada Geese in Massachusetts and believes that the return of the remaining birds in the flock is due to sudden loss of leadership with the death of the parents in the first volley. This behavior often enables the gunners to bag an entire small flock of geese. Bent (1925: 219) records the same behavior in Canada Geese, Black Brant and Emperor Geese.

The evolutionary significance of the flock as a family unit is brilliantly discussed by Mayr (1942: 242). Basing his conclusions upon the work of Heinroth (1911) with *Anser* and the unpublished notes of James Moffitt, Mayr states: "Geese are among the very few birds in which the family does not break up at the end of the breeding season, but parents and the young stay together for nearly a year. They migrate together to the winter quarters, they spend the entire winter together, and they do not separate until after the return to their nesting area." He goes on to point out that as a result of this social segregation and geographic isolation there is extreme inbreeding of small populations, concluding that "No other arctic or subarctic bird breaks up into so many pronounced races as the geese."

Since Canada Geese tend to move in much smaller flocks than do Blue and Snow Geese, it is easy to make accurate counts of the birds seen. One of us counted while the other recorded every small flock that passed; we thus tabulated flocks both in migration and in local feeding flights. One group of counts of flocks engaged in local flights at Horseshoe Lake Refuge in Illinois was made before the opening of the hunting season, another after its close. Counts for each period were tabulated separately so that the percentage of flocks of each size could be plotted graphically (Figs. 1 and 2).

Upon a more thorough perusal of the literature we found that Phillips

(1916) had gathered similar data for the same purpose some 30 years earlier. Because his paper was not cited by any of the authors mentioned in our review of the literature above, it seems apparent that the title of his paper, "Two Problems in the Migration of Waterfowl," so obscured its content that it had been overlooked. We therefore take this opportunity to present his data again (Fig. 1). In all graphs, flocks numbering more than 20 birds have been excluded because of the difficulty in getting accurate counts of larger flocks.

Of nearly 300 flocks of Canada Geese counted by Phillips (Fig. 1) as they

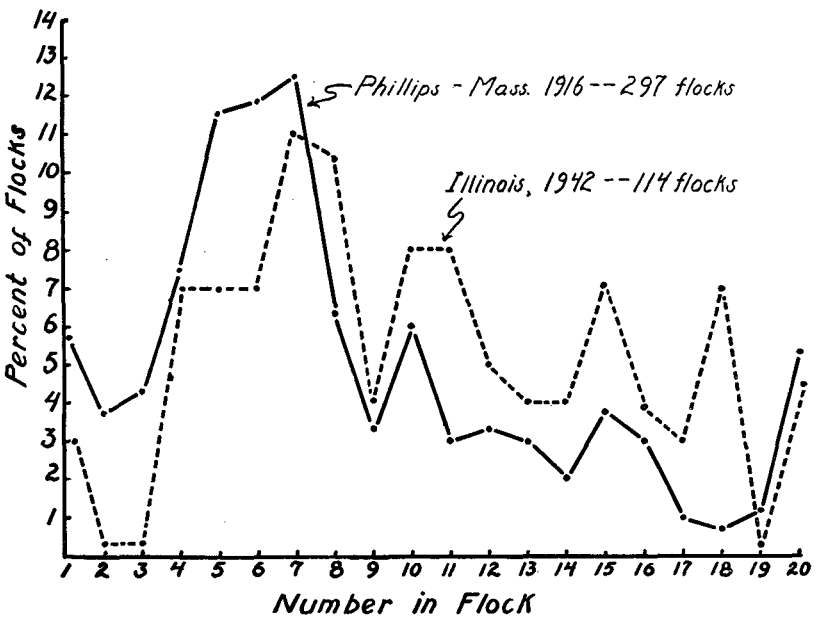


FIG. 1. Size of Flocks of Canada Geese in fall migration.

passed over his shooting stand in Wenham, Massachusetts, by far the greatest number were small groups of 5, 6, or 7 birds or approximate multiples of these numbers. Hundreds of brood counts made by Williams and Marshall (1938) establish that the mean size of a clutch in this species is between 4 and 5. This fact supports Phillips' conclusion that "It is hardly necessary to state that the apex of this curve at 6 or 7 represents the average size of a family of Canada geese. . ."

When we plotted the counts of the 114 small flocks which we saw in migration in Illinois (Fig. 1), we found a surprising similarity between Phillips' curve and our own, not only in the peaks representing the one-family size flock but also, apparently in the rest of the curve. Whether or not the other

peaks have real significance we cannot say; but it seems highly probable that they represent aggregates of 2 or more families. If this is true, the smaller the flock (say, 5) the more likely it is to join or accept union with another flock—hence accounting for the peaks at 10 and 15.

To discover whether the extreme hunting pressure and unusually heavy kill of geese at Horseshoe Lake, previously reported (Elder 1946b), were reflected in family or flock size, we made a large number of counts before and after the

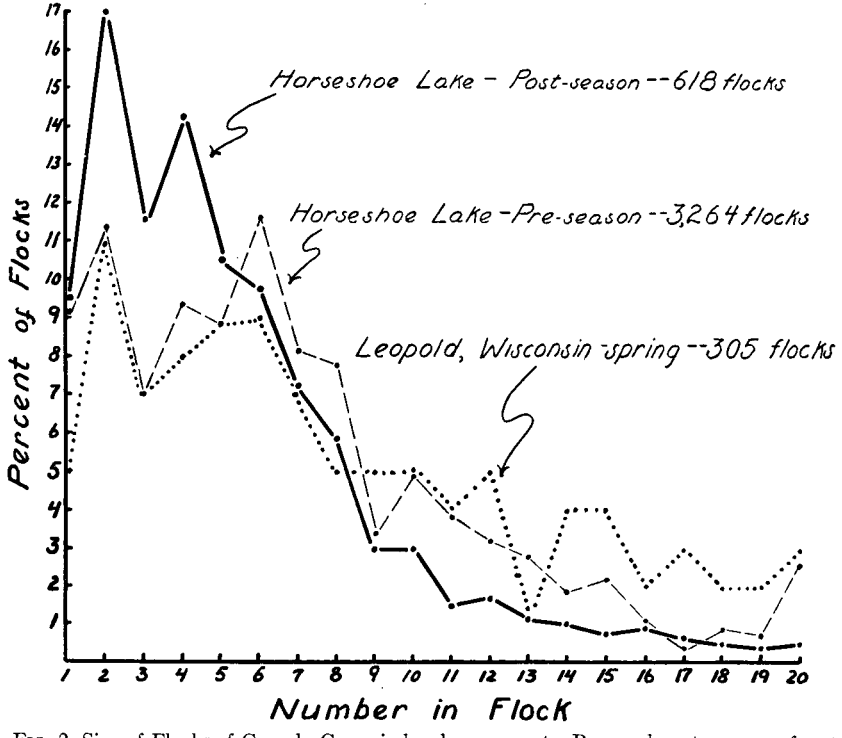


FIG. 2. Size of Flocks of Canada Geese in local movements. Pre- and post-season refers to counts made before and after the hunting season, October 15 to December 13, 1942.

shooting season. The broken line in Fig. 2 shows the distribution of more than 3,200 flocks counted before the season opened. Again, a sharp peak is found at the family-size flock of 6.

In the 618 flocks counted after the close of the shooting season (Fig. 2) we see that the family-size peak has shifted from 6 to 4. That this change indicated a great loss of young geese due to shooting was confirmed by a bag-sample of 761 birds containing 5 juveniles per adult pair. In contrast, among the 1,028 geese we trapped and banded, mostly after the hunting season had closed, there were only 3 juvenile birds per adult pair. (These adults undoubtedly

included some 2-year old geese as yet unmated and with no young—*cf.* Elder 1946a).

Another distinct difference in the curves presenting pre- and post-hunting season flock counts is the sharp increase in the number of pairs seen. We do not believe that this is due to pair formation prior to the spring migration, but rather to an increase in number of pairs that had lost all of their young during the fall season of heavy kill.

After 1925, when Jack Miner (1932) first began banding Canada Geese in fall as well as in spring, his returns showed that the geese nesting on the west coast of James Bay, passing through his sanctuary in fall to winter in southern Illinois and Missouri, returned to the north in spring not through his sanctuary but more to the west, in Michigan and Wisconsin. This was confirmed by returns from our own banding. The difference in the spring and fall routes is easily seen in Wisconsin where goose flocks are scarce in fall but numerous in the spring flight. It is very probable that the counts made by Aldo Leopold (unpublished) at his hunting shack on the Wisconsin River were actually of the same population that we studied at Horseshoe Lake Refuge. In any case, the flock-size distribution plotted from his data (Fig. 2) shows the same curve as do the pre-hunting season data from Illinois.

In comparing the graph of flocks seen in migration (Fig. 1) with that of flocks engaged in short flights between loafing areas and feeding grounds (Fig. 2) one clear difference appears: there is a much greater percentage of ones, twos, and threes in local movements than in migratory flights. Seemingly geese may go to feed or gravel either alone or in twos or threes, but before starting migratory flights they join other flocks. The abundance of these small groups is undoubtedly due to the extreme shooting pressure on all sides of the Horseshoe Lake Refuge; the percentage of shot-up, fragmentary flocks may be even higher than the graph shows, for some undoubtedly may join family groups on their way to feed. This would explain why the peaks at multiples of family size (10 and 15) are so much more prominent in Fig. 1 than in Fig. 2—the former representing flocks not yet subjected to much shooting. Phillips (1916) believes that the existence of any migrating flock of 1, 2, 3, and probably 4, is the result of shooting.

Another factor possibly contributing to the abundance of pairs seen in local movements may be the habit which Jack Miner (1923: 122) describes—adult geese occasionally leaving their young "but seldom for more than an hour."

Due to the kindness of Dr. Harrison F. Lewis (*in litt.*) we present in Figure 3 data from another species, the Brant, *Branta bernicla*. This curve was drawn from counts of 83 small flocks seen by Dr. Lewis and Mr. C. Doire, May 24–June 14, 1935 at Seven Islands Bay, Saguenay County, Quebec. We again see in this curve 3 general peaks which may represent family size and multiples thereof.

Before concluding, we wish to suggest one more factor which may affect the curve of flock-size frequency distribution: the possibility that after the young are fledged the parents may readmit to the family circle the sub-adult, non-breeding young of the previous year's brood. This has been observed by Jenkins (1944) in crowded captive geese and by ourselves in captive Whooper Swans (*Cygnus cygnus*); but Sherman (1924) was of the opinion that in both geese and swans ". . . the bonds between parents and young are of very short duration, and that those between mated birds are of the most tenuous sort." However, all of these observations are from captive birds and it would be dubious at best to extrapolate to the wild for it has been our experience that the degree of crowding of captives markedly affects their social organization.

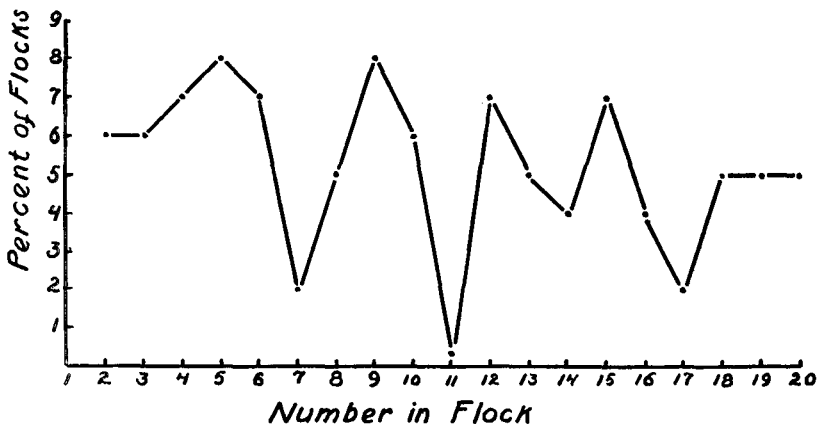


FIG. 3. Size of Flocks of Brant counted by Harrison F. Lewis and C. Doire, May 24 to June 14, 1935, Saguenay County, Quebec.

SUMMARY

We believe we may be certain that the small goose flock is usually a family and that larger flocks are frequently multiples of families rather than mere aggregations of individuals, as are flocks of ducks.

It seems likely that a count of several hundred small flocks arriving at a refuge in the fall might be a good index of the success of that year's hatch. Since the peaks in 4 of the curves presented correspond so closely, we think it likely that productivity in Canada Geese is very nearly constant from year to year. This is in sharp contrast to the productivity in Blue Geese, which in some years produce few or no young (McIlhenny 1932, Smith *in litt.*).

Finally, a comparison of the flock-size most frequently occurring before and after the shooting season may give a measure of the shooting pressure sustained by that population. It would indeed be interesting to see a frequency distribution curve for migrating *spring* flocks.

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