ABUNDANCE AND ACTIVITY OF STARLINGS IN WINTER IN NORTHERN UTAH

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Starlings (*Sturnus vulgaris*) were first observed in Utah in the winter of 1939 (Lockerbie, 1939). It was 10 years before they reached sufficient numbers to become a nuisance to feedlot operators and fruit growers. During the 1950's Starlings in Utah increased tremendously. By 1960 feedlot operators in 16 counties were complaining of damage during winter feeding operations, and in Washington County in the southern part of the state the County Agricultural Agent reported that Starlings were the major agricultural problem.

Starlings in Utah are now concentrating in winter flocks estimated to be as large as 100,000, and complaints of damage are increasing. Starlings will probably continue to increase in Utah during the 1960's, causing increased economic loss to the state's feedlot and orchard industry. Thus some control action appears justifiable. Previous studies of agricultural pests have demonstrated that effective control is not possible until the ecology of the species is known. Information regarding distribution, abundance, and movements during winter would indicate whether a stable winter population or a mobile, nomadic population is responsible for the loss to ranchers.

The study area was near Tremonton, Box Elder County, northern Utah. The area is at 4500-feet altitude and is flat except for the meandering Bear and Malad rivers. The region is covered largely by grain and sugar beet fields. Many cattle feedlots and silage pits are scattered over the area, and flocks of sheep are present in some fields at certain times of the year.

The climate is semiarid with cold winters and hot summers. Average annual precipitation is about 13 inches, and the annual mean temperature is 56°F. Snow rarely remains on the ground for more than a few days after a storm. Spring is the wettest season of the year; nearly 40 per cent of the average annual precipitation falls in March, April, and May.

METHODS

To correlate population fluctuations with daily and seasonal weather changes, I observed starlings on a standardized census route about twice a week between 1400 and 1600. The 16.2-mile route sampled a rectangular area of about 4 square miles. Between 5 October 1961 and 31 May 1962 I drove the same route 97 times at an average speed of 25 miles per hour. By counting all birds within 10 chains (660 feet) on each side of the road, I censused one acre on each side of the road for every chain (66 feet) driven. The distance of 10 chains was paced at numerous landmarks along the census route. These reference points, such as barns, trees, and fence rows, made it possible to identify the limits of the sample area. Starlings seen during the census were classified in the following categories of activity and so marked on the census map: loafing or roosting, flying, feeding in fields away from feedlots, and feeding at feedlots. The following weather data were recorded for each census: maximum and minimum temperature, precipitation, wind velocity, sky condition, and the depth of snow cover.

RESULTS AND DISCUSSION

Monthly variation in activity and population as measured by standardized censuses. Population variations on successive days were often extensive (fig. 1). The

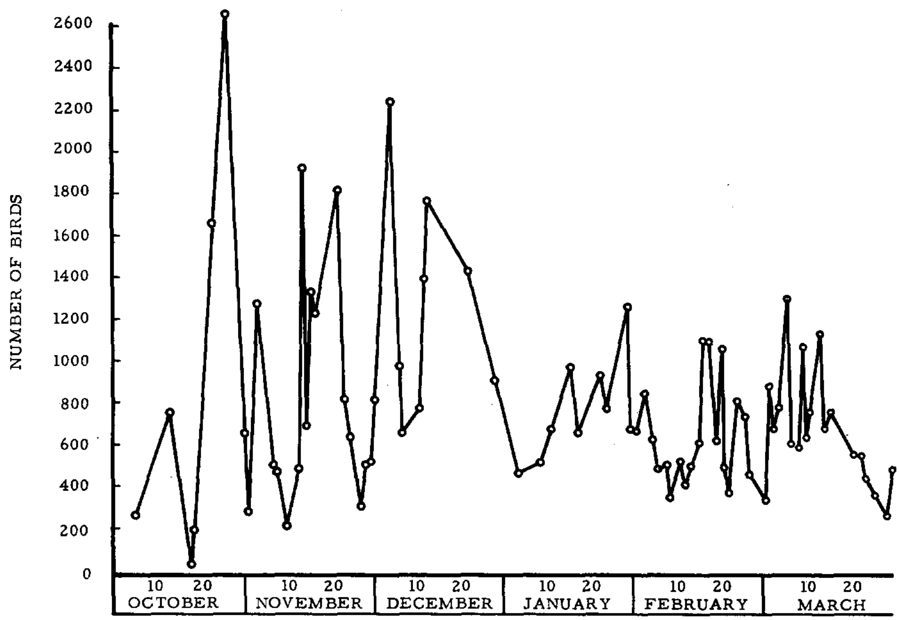

Figure 1. Starling population from October 1961 to March 1962.

population changes in the fall were much more drastic than in winter. This probably was due to the irregular arrival and departure of fall migrants. During fall the local resident population was undoubtedly periodically augmented by transient flocks en route to wintering areas. If the fall migratory directions of Starlings in Utah are similar to those in the eastern United States, these transient flocks migrated southward and southwestward (Kessel, 1953). Diurnal movements also accounted for some population fluctuations throughout the fall and winter, as some flocks surely repeatedly entered and left the study area undetected. While migration accounted for the seasonal fluctuations in the population, changes in weather conditions were primarily responsible for the day-to-day variations in Starling numbers.

Most of the highest fall counts were made on windy or stormy days, while low numbers generally were seen during relatively warm, stable periods. Usually unstable weather temporarily grounds migrating birds, and they continue their journey when the weather becomes favorable. Thus the extreme fall population changes were probably real; unsettled weather presumably concentrated Starlings already in the study area and temporarily grounded migrants passing through. Also many Starlings terminated their migration in and around the study area, since the resident summer population was very low. After fall migration, which apparently ended in December, population fluctuations decreased considerably, for there was no effect of weather superimposed on both migrating and local birds. Thus the winter population variations were probably only apparent and merely reflected the concentration of birds at feedlots during unstable weather.

The largest count, 2660 birds, was made on 26 October. As figure 1 suggests, the greatest populations in the study area occurred during migration in late fall. Fall migration occurs from late September through November, but the actual dates of Starling migration vary somewhat from year to year and with geographic locality

TABLE 1

SEASONAL CHANGE IN ACTIVITY AND POPULATION SIZE IN STARLINGS

Month	Per cent of all birds				Starlings counted per day		
	In feedlots	Feeding	Roosting	Flying	Mean	Range	No. of counts
October	4	21	61	18	894	50–2660	7
November	21	67	19	14	811	215–1805	16
December	35	82	13	5	1211	665–2210	9
January	60	78	19	3	769	455–1265	9
February	41	75	22	3	650	425–1095	19
March	45	77	17	6	681	280–1145	19
April	16	76	14	10	69	17–190	13
May	5	53	12	35	27	19–46	5

(Kessel, 1953). According to Killpack and Crittenden (1952), Starlings do not arrive in the Uinta Basin of Utah until the first week of November, and the population peak comes in late December and January. After January the number of birds declines again. They attributed these population changes to continuous movements throughout the winter. Davis (1955) recorded the population changes in a communal roost in Maryland for three years. The number of roosting Starlings was highest in late September, decreased in November, rose again in January, and then rapidly decreased to a low in June.

After 15 March the population rapidly declined to a low in early May due to the dissipation of winter flocks and presumed migration to breeding areas. According to Kessel (1953) spring migration occurs from mid-February to the end of March. The counts after 10 April showed little variation and averaged about 27 birds; only a relatively few resident breeding pairs remained in the area. The population rose in late May because young birds were coming off nests.

The number of flocks and the mean flock size between October and March tended to rise and fall with the overall population. The average number of birds per flock between October and March was about 47. The average number of flocks per census day was 13 for the same period, and the modal flock size was usually between 11 and 25 birds. Flocks of more than 1000 birds were seen only in October, and flocks larger than 500 were never seen after January.

Table 1 presents the average number of birds observed per census day together with the lowest and highest counts for each of the eight months in which counts were taken. This table also shows the monthly average percentages of Starlings observed in feedlots, feeding in all areas, roosting or loafing, and on the wing.

As figure 1 suggested, the average number of birds per day was higher in the fall. The peak population was 1211 birds per census in December. Although bad weather caused some apparent population increases, I definitely believe that Starlings in and around the study area were most numerous in December. The fluctuations in figure 1 are too extreme to show a definite trend, although after December the average number of birds per day dropped each month with the exception of March. There is undoubtedly some population decline in winter due to increased mortality resulting primarily from severe weather. The slight increase in March may have been due partly to the temporary appearance of some early-spring migrants from points outside the study area. In the study area spring migration was not noticeable until late March. The average number of birds observed per day in February would have been con-

TABLE 2
THE EFFECT OF SNOW COVER ON USE OF FEEDLOTS BY STARLINGS
Per cent of birds using feedlots

Month	Ground bare	Ground snow covered[a]
October	4	–
November	20	27
December	23	55
January	30	64
February	39	47
March	43	49
April	16	–
May	5	–

[a] No snow in October, April, and May.

siderably higher except for a warm, nine-day rainy period. Snow melted and feedlots were flooded, causing Starlings to disperse over the countryside.

The general average per cent of birds observed feeding in feedlots, fields, gardens, and garbage dumps increased to a peak of 82 in December (table 1). Apparently feeding demand is greatest in December when days are shortest and mean temperatures are very low. After December the per cent of birds feeding dropped slightly except for a moderate increase in March. Note that the per cent feeding remained high during the nesting period, April and May. Gibb (1954) found the same trend in per cent feeding for titmice from October to March, although the monthly percentages were generally higher. Titmice are smaller birds and thus have higher metabolic rates than do Starlings. The per cent of time that Blue Tits (*Parus coeruleus*) spent feeding rose to 89 in December, the most critical month. The per cent of time spent feeding then declined in January and February and rose again in March before the breeding season.

The monthly average per cent of birds feeding at feedlots also rose until it reached a maximum of 60 in January. January is the coldest month, and snow remains on the ground for the longest durations. Starlings often largely depend on feedlots between December and March. Feedlot use was notably higher each month when there was snow on the ground (table 2). In December and January, the most critical months, feedlot use more than doubled when there was at least one-half inch of snow covering the ground. Dunnet (1956) noted that during severe winter weather Starlings became almost wholly dependent on man's artificial food sources.

The average per cent of birds roosting or loafing remained fairly low except for the high 61 per cent in October. The high per cent loafing in October was due partly to early communal preroosting activity. Generally the per cent loafing for a given month or day is the reciprocal of the per cent feeding during the same period. Hence the per cent loafing varies inversely with the per cent feeding for every month except April and May.

The average per cent of birds observed flying was highest in the fall and spring. Perhaps this was associated with increased movement during spring and fall migration.

Daily population and activity variations in relation to weather factors. Temperature had a strong influence on the distribution, abundance, and activity of Starlings. Generally both daily maximum and minimum temperatures correlated with census results in about the same fashion.

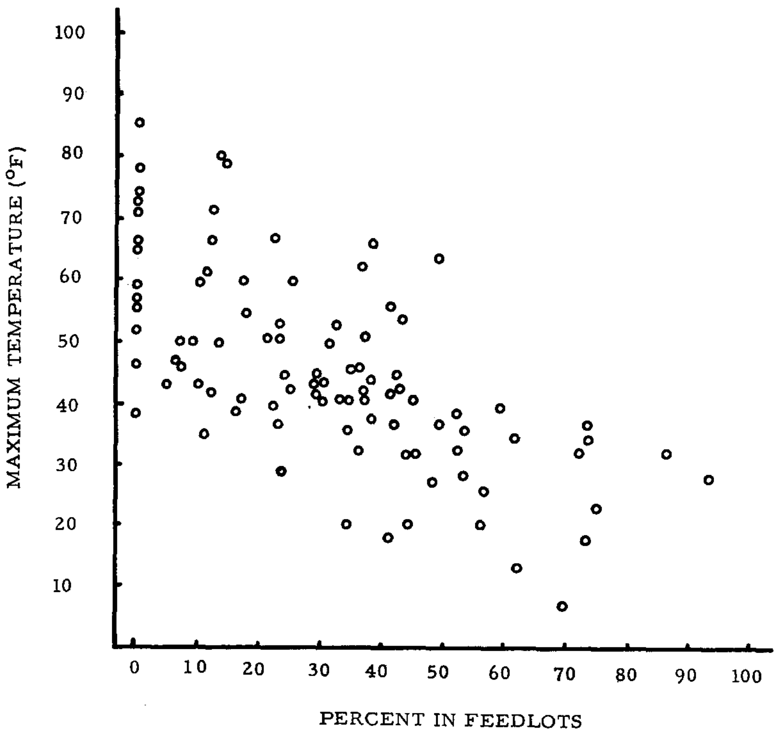

Figure 2. Effect of temperature on the per cent of Starlings in feedlots.

The total number of birds, total number of flocks, mean flock size, per cent feeding, and the per cent in feedlots all generally declined as daily temperatures increased. All of the following correlations relate to changes in maximum temperature. The maximum temperatures are grouped into nine temperature classes, each representing a range of 10°F. The general increase in the number of birds and flocks with lower temperatures is more apparent than real, especially after December. As previously discussed, fall variability was complicated by migration. Colder temperatures concentrated birds at feedlots. During relatively warm, stable weather Starling flocks were less integrated, and they spread out in fields over the countryside. The per cent of birds feeding in feedlots declined (fig. 2), and the per cent feeding away from feedlots increased (fig. 3) with rising temperature. Thus the per cent feeding in feedlots is the reciprocal of the per cent feeding in fields. More birds generally were seen feeding in all areas on cold days than on warm days, and so the per cent of birds loafing increased with warmer weather. Cloud cover did not influence activity (figs. 4 and 5).

Precipitation as a whole had little or no effect on abundance and activity. However, the type of precipitation did affect the total population and the per cent feedlot use in opposite ways. Snow increased the apparent population by concentrating birds at feedlots, but rain decreased feedlot use and apparent numbers of birds. Rain accompanied by milder temperatures melted snow and ice on the ground; therefore Starlings were less reliant on feedlots, and they spread out in fields. The significant increase and decrease in Starling numbers corresponding with snow and rain, respectively, are

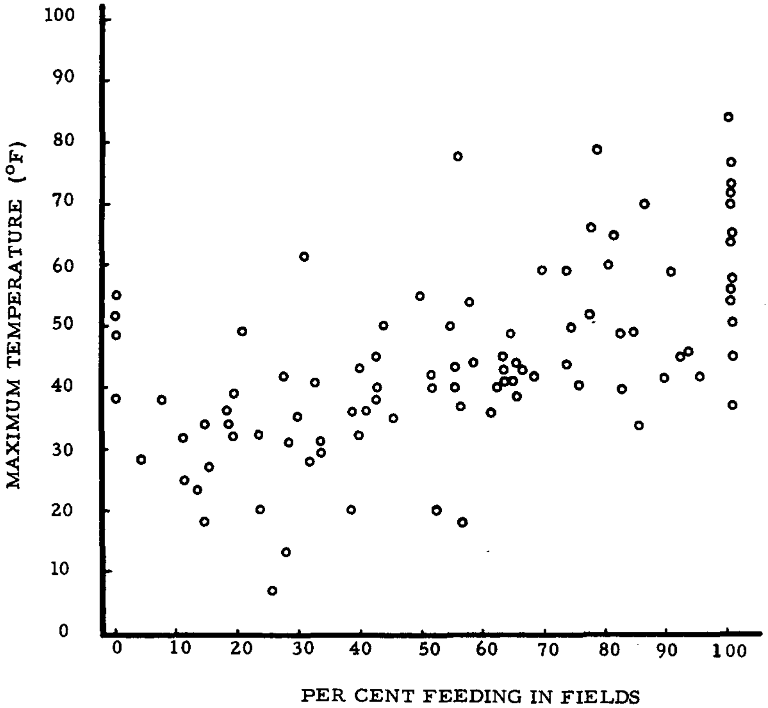

Figure 3. Effect of temperature on the per cent of Starlings feeding in fields.

depicted in figure 6. Rain and snow are indicated in the scatter diagram by noting in which temperature class precipitation occurred. The average population was considerably higher when it snowed (11° to 30°). Precipitation in the 31° to 40° class represents either rain or snow; thus the population was almost the same on days when precipitation was present and absent, respectively. The combined effects of rain and snow tend to cancel each other out. Precipitation at above 41° always represented rain and a temporary winter thaw. Therefore the population was considerably higher

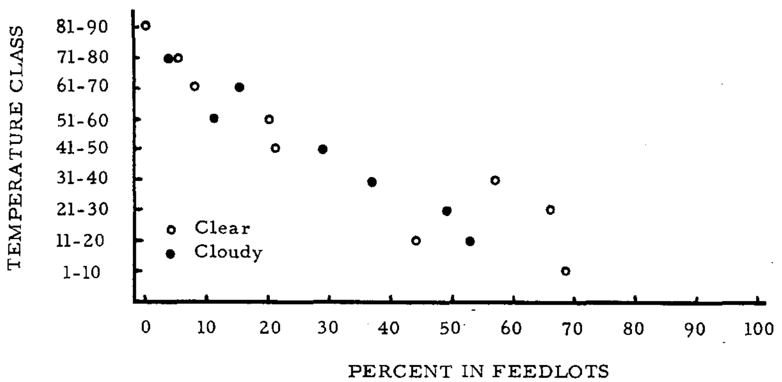

Figure 4. Effect of cloudiness on the average per cent of Starlings in feedlots.

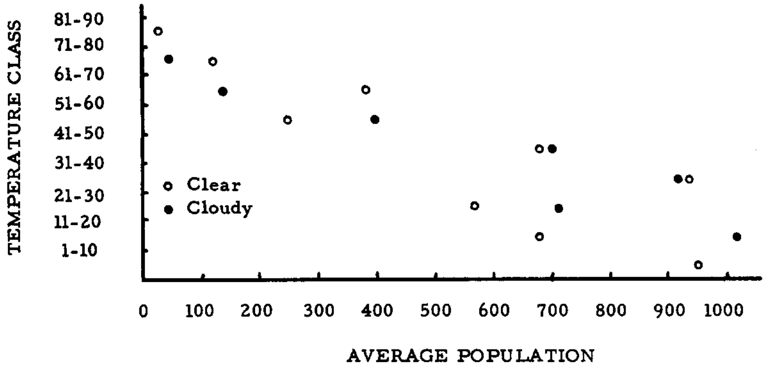

Figure 5. Effect of cloudiness on the average Starling population.

on days when there was no precipitation. Neither rain nor snow influenced the percentage of birds loafing and feeding.

Wind above 10 miles per hour failed to affect the average total number of birds, the number of flocks, mean flock size, and the per cent of birds in feedlots. Wind had a marked effect on the distribution of birds in the study area. On windy days birds were much less frequently seen loafing in customary, high, exposed places, such as trees, telephone wires, and rooftops (fig. 7). Strong winds caused a greater than usual concentration of birds on the ground (fig. 8). Starlings normally seen on the ground were feeding. But it was impossible to distinguish between birds actually feeding and those loafing on the ground instead of at customary places more exposed to the wind. Wind would be expected to cause an increase in the amount of time Starlings spend feeding, because birds lose energy faster in wind and hence must feed more; however, this was not discernible, as feedlot use did not increase in windy weather. Thus the primary effect of wind appeared to be on where birds loafed rather than on the percentage of time they spent loafing or feeding.

Snow cover on the ground (one-half inch or more) had a strong influence on abundance and behavior. Snow remained on the ground only when temperatures

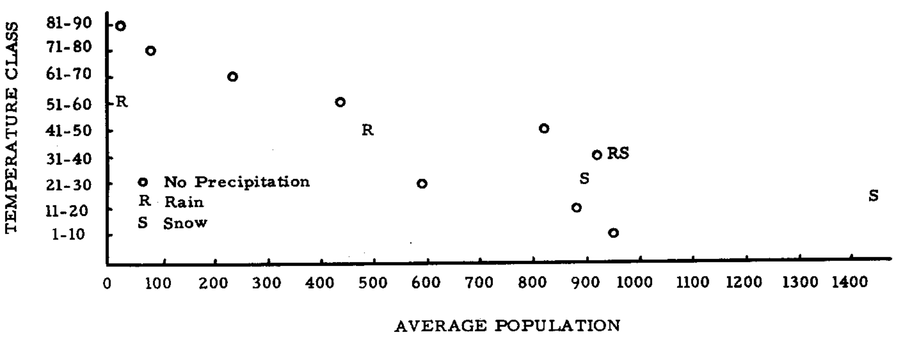

Figure 6. Effect of precipitation on the average Starling population.

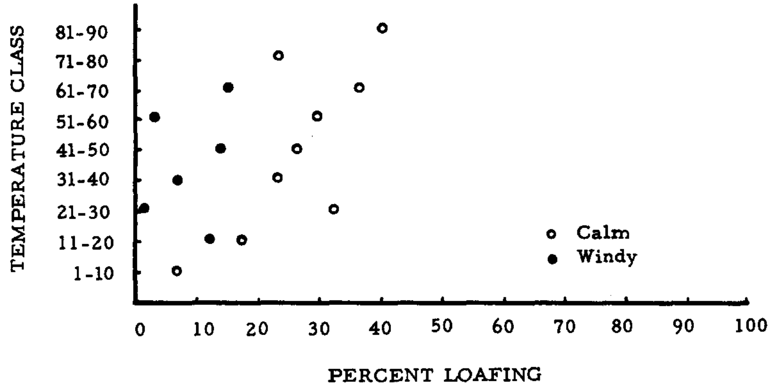

Figure 7. Effect of wind on the average per cent of Starlings loafing in customary exposed places.

were low, resulting in a positive correlation of these two variables. Low temperatures coupled with unbroken snow cover forced the majority of Starlings to rely on feedlots for food, and therefore the apparent population increased (figs. 9 and 10). The inverse relationship appears for days on which the ground was bare, but the average population always remained above 750 birds when snow covered the ground, regardless of temperature. The average number of birds observed in each respective temperature category was considerably higher when there was snow on the ground. The average per cent observed in feedlots was never less than 49 on days when snow covered the ground. The average per cent of birds loafing and feeding was not affected by snow on the ground alone. The per cent loafing and feeding, respectively, was about the same for each temperature class both when the ground was covered and when it was free of snow.

Klonglan (1955) found that wind and increased relative humidity reduced the number of pheasants seen on roadside counts; dew, precipitation, and rising temperature increased counts. Cloudiness did not affect the number of birds counted per mile. Fisher *et al.* (1947) also noted that cloudiness had little or no effect on roadside censuses for pheasants. Unlike Klonglan, they found no correlation between temperature and the number of birds observed.

The inverse relationship between daily temperatures and the total number of Starlings, the per cent feeding, and the per cent using feedlots seemed especially obvious. When temperatures significantly drop, the birds must spend more time feeding to maintain their energy balance (Verbeek, 1964). Lower temperatures necessitate a higher metabolic rate to maintain body temperature; thus food intake must increase. Sabine (1955) found that the number of daily visits of junco (*Junco oreganus*) flocks to a winter feeding station rose with falling temperatures. Seasonal changes in the energy balance of captive English Sparrows (*Passer domesticus*) were studied by Davis (1955). There was a lag in the feeding response to changes in temperature; when the temperature rose, the sparrows ate just as much as at lower temperatures, due to delayed physiological response. Thus he doubts that birds are able to respond to day-to-day changes in temperatures, but they do respond to more general weekly and monthly trends in temperature. Starlings in the study area also exhibited their sensitivity to low temperatures in regard to their communal roosting

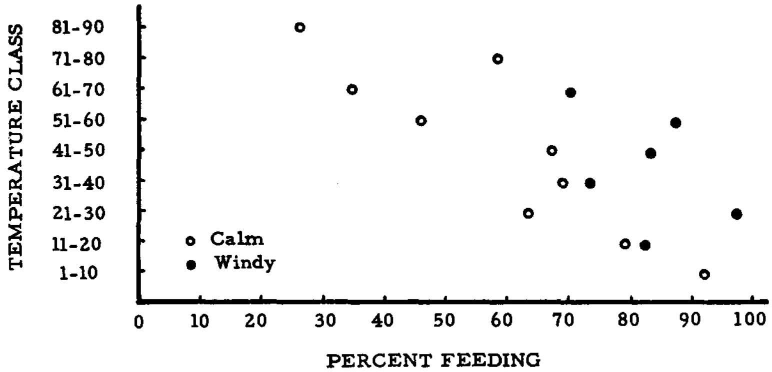

Figure 8. Effect of wind on the average per cent of Starlings observed on the ground.

habits. During the milder fall and spring nights they roosted in open cattail marshes. But in midwinter they resorted to cattle sheds and barns for added warmth and protection. This shift in roosting location with cold weather is a further indication that Starlings in northern Utah probably find maintenance of warmth and energy storage critical and must make major changes in their habits to meet those needs.

After temperature, the effect of snow on the ground seemed strongest. Unbroken snow cover greatly curtailed or entirely prohibited feeding away from feedlots. Extremely low temperatures made the Starlings even more dependent on cattle feed. In New York important dietary changes were necessitated by snow cover (Hamilton, 1949); Starlings increased their consumption of garbage as an emergency ration.

The Starlings' apparent reliance on supplemental food during severe winter weather suggests a potential local control method. If they were unable to procure cattle feed and possibly added shelter during critical periods, many would either move elsewhere or die. Starlings probably could be prevented from obtaining silage with properly designed feed mangers and pits. Feeding cattle after dark might also help.

SUMMARY

During the winters of 1960–1961 and 1961–1962 an intensive study of the diurnal

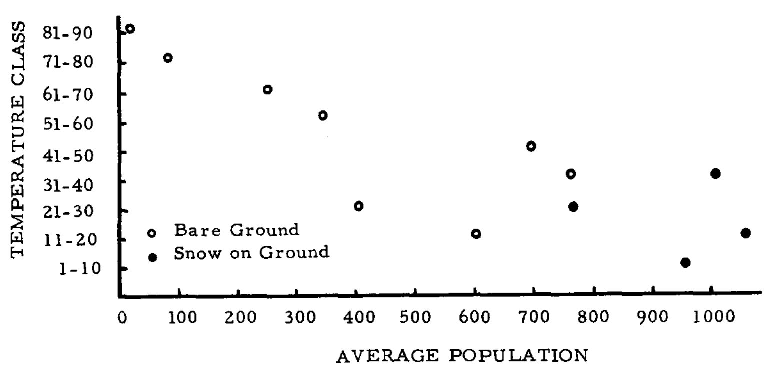

Figure 9. Effect of snow-covered ground on the average Starling population.

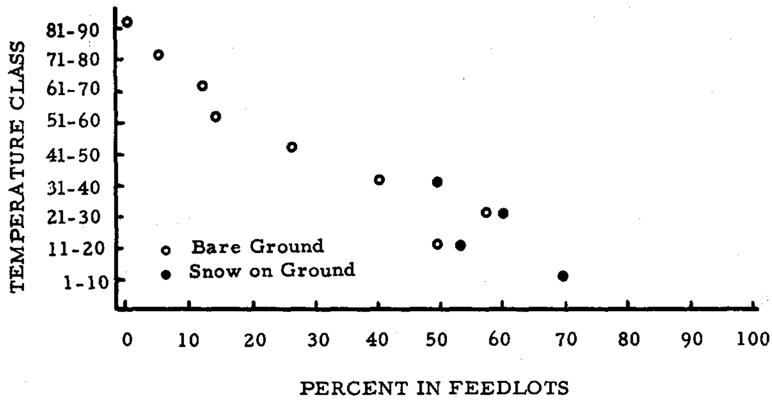

Figure 10. Effect of snow-covered ground on the average per cent of Starlings in feedlots.

activities, abundance, and distribution of the European Starling was made in Box Elder County in northern Utah.

Between 5 October 1961 and 31 May 1962, 97 standardized roadside censuses were taken to measure the relative abundance, distribution, and activity of Starlings in the study area. Day-to-day population changes for the eight months of censusing were often great, especially in the fall. Peak numbers occurred in December, when the average number of birds counted per day was 1211. After December the population declined except for a temporary rise in early March. In late March and early April spring migration to breeding areas ensued, and the population dropped sharply.

Weather changes strongly affected the distribution, abundance, and activity of Starlings. Cold, unstable weather concentrated Starlings at feedlots, resulting in higher population counts. Daily maximum and minimum temperatures generally varied inversely with the number of birds seen, the average per cent of birds feeding, and the per cent utilizing feedlots. The average per cent of birds feeding in fields and the per cent loafing increased as temperatures rose. Wind caused the average per cent of birds loafing in trees and other high places more exposed to the wind to be lower than usual and the per cent observed on the ground to be higher.

Cloudiness or clearness failed to influence Starling numbers or feeding activity. Precipitation as a whole had little or no effect on Starling numbers and behavior because the opposite effects of rain and snow largely nullified each other. Snow increased feedlot use, causing the apparent population to rise; rain dispersed feeding flocks over the countryside. Unbroken snow cover on the ground forced Starlings to depend largely on feedlots for food. Mean flock size and the total number of flocks usually varied directly with the size of the population. Small flocks of from 11 to 25 birds were most commonly seen. Large flocks of over 1000 were present only in October, and flocks in excess of 500 birds were never seen after January. The tendency toward larger flocks in the fall was probably associated with fall migration.

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