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Received November, 1968; revised, June, 1969.

THE YELLOW-SHAFTED FLICKER (COLAPTES AURATUS) ON NANTUCKET ISLAND, MASSACHUSETTS

By John V. Dennis

Flickers, more than any other of the North American woodpeckers, can adapt to relatively treeless situations. The Yellow-shafted Flicker shows this through its ability to establish itself in prairie regions of the Great Plains and relatively treeless islands and coasts in New England and the Maritime Provinces. Nantucket Island off the southeastern coast of Massachusetts offers an interesting example. This gently rolling seventeen-mile-long island was denuded of trees not many years after settlement began in 1659. Except for a few pockets of original timber in low places and a few plantings, the Island was essentially treeless for the two hundred years between 1700 and 1900.

Cutting of trees for firewood and lumber, and sheep grazing, seem to have been the chief factors in keeping the Island open for this long period of time. Salt spray, storms, and fires were contributing factors. A decline in farming and sheep grazing, beginning early in this century, and more and more interest after 1850 in establishing

plantings, began to make for a return to forested conditions. Pitch pine was introduced in 1847, English larch and Scotch pine in 1876, and Japanese black pine in 1895. This century has seen an acceleration in planting. Extensive plantings of white pine were made in 1913. Japanese black pine, because of its salt-resistant qualities and ability to grow on poor sandy soil, has been used ever more extensively. Also elms, maples, and other shade trees have been planted widely in yards and along streets.

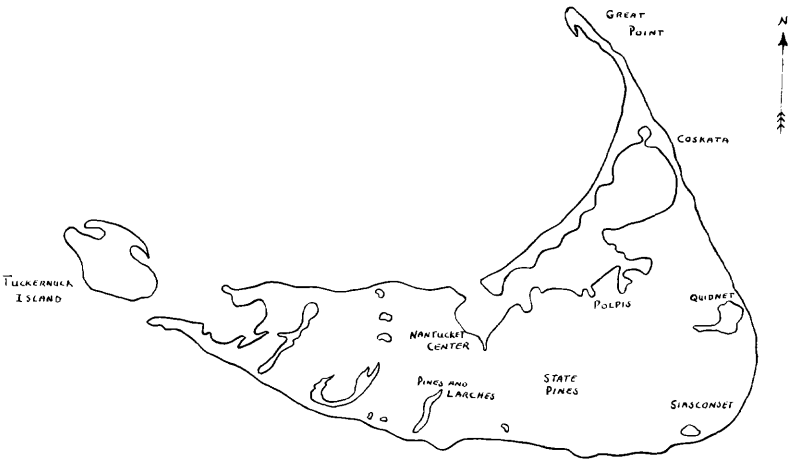
The change from a semi-treeless to a more verdant state has been slow. Rice (1946), writing of conditions around 1940, calls the Island mostly open and states that trees were limited largely to hollows and borders of roads. The open rolling parts of the Island, known as moorland, have only slowly responded to absence of sheep grazing. Since 1950 the moorland has increasingly changed from low woody or herbaceous growth to low woodland dominated by native oaks and introduced pine. Once a woody growth does become established progress toward forested conditions becomes rapid. Today about one half of the Island can be considered wooded or semi-wooded and the other half open.

The Yellow-shafted Flicker population on Nantucket has shown marked changes during this century. A return to more wooded conditions at first saw a striking increase in numbers. Absence of most mainland predators (skunk, possum, raccoon, mink, weasel, fox, squirrel, and most snakes) has made for few natural checks.

At the same time that an increase in the Flicker population was taking place, the Starling (*Sturnus vulgaris*) was becoming increasingly abundant. In 1966 the Flicker population was probably at its peak for this century. The following two years saw a sharp decline; this followed in 1969 by an increase in the number of pairs nesting. In any superficial analysis of the causes of the decline, the blame could have easily been placed upon the Starling. Numerous examples have been observed of Starlings destroying or otherwise pre-empting Flicker nests. The Flicker on Nantucket, however, seems to have adjusted amazingly well to this kind of competition and probably its ability to do so has been assisted greatly by an abundance of dead or diseased trees. The immediate cause of the Flicker's sharp decline in numbers in 1967 seems to have been abnormally severe weather conditions immediately prior to the nesting season.

The presence of a large Starling population, which seems partially dependent upon the Flicker for nesting sites, has, however, influenced the habits and distribution of the Flicker on the Island to a marked degree. In the period of eleven years covered by this study the Flicker has largely given up its nesting places in more open situations and has moved into a few wooded areas. Nesting by the Flicker in some cases has become almost colonial and with densities of several pairs to an acre.

In one wooded part of the Island Flickers are now nesting in close proximity to Starlings and, in spite of this, are maintaining a stable population. In another wooded area, where there has been very



little Starling competition, the Flicker population has varied considerably from year to year.

It would seem that a diversity of ecological factors are at work in shaping the destiny of the Flicker on Nantucket. The present study looks into a number of these factors and particularly ones that may have a bearing upon nesting success. The chief limiting factor to the Flicker population is believed not to be Starling competition but periods of cold and other severe weather that overtake birds prior to the nesting season.

Little is known of the status of the Flicker on Nantucket during the period when the Island was essentially treeless. Griscom and Folger (1948) state that William Brewster did not record the Flicker on Nantucket during the many summer visits he made to the Island during the last quarter of the nineteenth century and early in this century. Burns (1900), in describing Flicker damage to gate posts, fence posts, and utility poles on Cape Cod, infers that this kind of damage also took place on Nantucket. He stated that the Flicker used man-made structures for nesting in island and coastal areas because of the near absence of suitable sites in trees.

Whatever the case early in this century, the Flicker was well established as a nesting bird in the 1940's. Griscom and Folger (1948) were probably too conservative when they estimated that only three to five pairs nested on the Island. The writer, on first visiting the Island during the late summer and fall of 1946, was impressed by the large numbers of Flickers he saw and the many holes in utility poles and fence posts. While many of the birds were doubtless transients, there also appeared to be a sizable resident population.

During the 1959 nesting season, the writer began banding adults and young at nesting holes. This effort was expanded the next year,

and, at the same time, observations were made on the life history of the species. On return visits to the Island since this period, the writer conducted a census of Flicker nesting sites and attempted to seek explanations for variations in numbers. The census covered most wooded parts of the Island where the bird was known to nest. Difficulties in access and terrain prevented a thorough coverage of the whole Island. Probably the census accounted for about four-fifths of the total population. Essentially the same nesting areas were covered in 1960, 1963-1964, 1966-1969. A partial census was made in 1961.

NESTING SITES

During the period 1959-1968 active Flicker nests were noted in eleven kinds of trees and five other sites not in trees (Table 1). Of 128 sites, 112 or 87.5 per cent were in trees and the remainder in man-made structures, or, in one instance, an underground burrow. Of tree sites, 38 or 33.9 per cent were in trunks of living trees, five or 4.4 per cent in dead branches or stubs on living trees, and 69 or 61.6 per cent in standing trunks of dead trees. Wherever birds have utilized living trees, decay has been present. Usually this has been in the form of heart rot or butt rot. Birds have either drilled through green wood to get to a decayed or hollow interior, or they have gained access through knot holes or other openings.

Japanese black pine (*Pinus Thunbergii*) is present in several large plantations near Squam and Quidnet on the east coast, near Polpis, somewhat inland from the east coast, and also in widely scattered plantings over the Island. In recent years the black turpentine beetle (*Dendroctonus terebrans*) has caused heavy mortality among older trees. The trunks of recently dead trees provide the single most heavily utilized Flicker nesting sites on the Island. Nestings were recorded in 34 dead trunks or stubs.

Black oak (*Quercus velutina*) is the most abundant oak on the Island. Although heavily cut in the past, stands survived because of the ability of this oak to send up shoots from the stump. The largest stand at Coskata appears to consist largely of sprout growth from old stumps. Since a large percentage of sprouts have butt rot, the decayed interiors of more or less mature trees supply many potential Flicker nesting sites. The fungus causing interior rot was identified as *Poria* sp. Hepting and Fowler (1962) state that about one oak sprout out of every four contains butt rot decay as a result of infection from the parent stump. Hollows in oaks were heavily utilized as is seen by the fact that 19 active sites were recorded in trunks of living oaks and five in dead oaks.

White pine (*Pinus strobus*), planted in 1913, forms two plantations, which with lesser numbers of other pines, cover 137 acres in the central and south-central parts of the Island. The southernmost planting, which contains a stand of 57 acres of white pine, has been one of the most important Flicker nesting areas on the Island. Many trees, although otherwise outwardly sound, show signs of basal decay. This decay or butt rot often extends internally well up into

TABLE 1. NESTING SITES UTILIZED BY THE YELLOW-SHAFTED FLICKER FLICKER ON NANTUCKET, 1959-1968

	Living trunk	Dead trunk	Dead branch	Other	Total no. sites
Japanese black pine		34			34
Black oak	19	5			24
White pine	13	4			17
Pitch pine		12			12
Fence post				8	8
Tupelo (black gum)		2	4		6
European larch	2	3			5
Scotch pine		5			5
Willow	4				4
Utility pole				3	3
Birdhouse				2	2
Aspen		2			2
Gray birch		2			2
House				2	2
Apple			1		1
Burrow site				1	1
	38	69	5	16	128

the trunk. Samples examined from interiors of several trees show that the decay organism was very probably red heart fungus (*Fomes pini*). Living white pine with heartwood rot have become increasingly important as Flicker nesting sites. A close analogy exists between this habit of the Flicker's on Nantucket and the habit of the Red-cockaded Woodpecker (*Dendrocopos borealis*) in nesting only in living pine trees infected by red heart fungus (*Fomes pini*). The Red-cockaded goes on to drill numerous small holes in the trunk of the pine tree in which it nests. The resin dripping from these holes is believed to serve a protective purpose. This habit was not observed in the Flicker. Nevertheless the entrance is sometimes quite sticky and possibly to a degree that would impede predators. An example of attempted predation was seen at a Flicker hole in a living white pine in early June 1966. Cat fur was found sticking to resin all around the rim of the entrance. Also balls of cat fur were found on the ground below the tree. From all evidence the cat failed in its attempted predation.

Apparently nesting by the Flicker in living white pine is a new habit on the Island. The first such nesting was observed in 1959. The writer knows of no reference to this habit elsewhere. Lawrence (1966) refers to a single example of a Flicker nesting in a hole in living white pine at Pimisi Bay, Ontario, but she adds that the hole had probably been made by a Pileated Woodpecker.

No Flicker nestings have been observed in the more northern stand which generally seems to be healthier. The southern tract has supported the heaviest Flicker nesting concentration on the Island. The number of active Flicker sites per year, during years when a census was made, is as follows:

	White pine	Scotch pine
1959	1	
1960	2	
1961	1	
1963	5	
1964	6	1
1966	10	1
1967	3	1
1968	3	
1969	7	

The first sharp increase in number of pairs nesting was seen in 1963. A population peak was reached in 1966 when eleven Flicker nesting sites were present in the 57 acre tract. The nesting density on the tract in 1966 was 19.29 pairs per 100 acres. In several instances nests were unusually close to each other for a non-colonial species. The closest example was nest holes only 22 feet apart. Simultaneous rearing of young by Flickers was seen in these two holes in 1969. The years 1967 and 1968 saw a crash in the Flicker population throughout the Island. This was reflected at the white pine tract in a 72.2 per cent loss in nesting pairs. But in 1969 there were seven pairs nesting, which was the same number that nested in 1964.

Of sites recorded in white pine through 1968, 13 were in living trees with hollow or decayed interiors and four were in dead trees. It is probable that prior to 1963 a number of sites were overlooked. The tract was not covered as thoroughly during earlier years of the study. Not enough undiscovered sites, however, would have been involved to have altered the picture of rapid increase in population between 1959 and 1966.

Pitch pine (*Pinus rigida*), although one of the most abundant trees on the Island, with 12 sites has shown far less utilization by Flickers than Japanese black pine or white pine. In 1959 and 1960, a large number of pitch pine were dead and in the final stages of decay before toppling over. The dead trees were the result of earlier fires and damage by the Nantucket pine tip moth (*Rhyacionia frustrana*). Well-decayed pitch pine proved to be particularly susceptible to predatory activity by house cats. Since 1960 few pitch pine soft enough for nest-hole excavation have been available.

Fence posts, with eight sites, have been more important than numbers indicate. In many instances, birds have come back to the same sites year after year and even, in some cases, after the tops have decayed out. With older posts rotting out and new ones

chiefly creosoted pine, there is little left in the way of fence-post nesting opportunities on the Island today. No posts at all were found with nesting Flickers in 1968 and 1969.

Tupelo (*Nyssa sylvatica*), with six sites, is relatively unimportant. Four were in dead tops or branches of living trees and two were in trunks of dead trees. Tupelo is fairly common in low, wet places, and was probably one of the native trees that persisted in some numbers during the long nearly treeless period.

European larch (*Larix decidua*) is common only at a plantation of introduced trees on the south side of the Island known as "The Pines and Larches". Two Flicker sites were in living larch with heart rot (*Fomes pini*) and three in dead larch. Scotch pine (*Pinus sylvestris*) has provided five nesting sites—all in dead trees. Willow (*Salix nigra*) has provided four nesting sites. All were in living trees growing in close proximity to each other. The trees contained hollow or decayed interiors. The decay organism was identified as *Daedalea conflagrosa*.

Utility poles were formerly very important as Flicker nesting sites. During the summer of 1960, with the aid of J. Clinton Andrews of Nantucket, the writer made a survey of Flicker utilization of poles throughout the Island. Of 1,812 poles checked, 229 or 12 per cent showed signs of Flicker work. Damage to poles consisted either of enlargement of checks, where birds may have been digging out hibernating insects, or partially completed or completed nest holes. Of three holes occupied by Flickers early in the 1960 season, two were later appropriated by Starlings. An additional ten holes were occupied by Starlings, five or six by Tree Swallows, and one or two by Black-capped Chickadees. Still other holes were not used.

Since the 1960 survey, less and less Flicker activity has been noted on poles. Only one Flicker nesting occurred in a pole in 1963 and one again in 1964. No nestings were discovered in poles after 1964. Starling competition appears to be the main reason for a decline in pole nesting. Whether or not the replacement of older poles by new ones is a factor is not known. Dennis (1964) has given examples showing that several woodpecker species, including the Flicker, actually do more damage to new well-creosoted poles than they do to old ones.

For several years prior to the present study birdhouses were relatively important as Flicker nest sites. In 1956 and 1957, the writer placed 26 birdhouses in widely scattered locations. Houses were readily accepted by Flickers, Starlings, Tree Swallows, and Sparrow Hawks. By 1960, six houses had a record of use by Flickers. About three times as many houses had a record of occupancy by Starlings. During the period of the present study most of the older birdhouses had either fallen down or fallen into disrepair. Only two houses supplied a record of Flicker occupancy.

Aspen (*Populus tremuloides*) has provided two nesting sites. Gray birch (*Betula populifolia*), a rare tree on the Island, has provided two sites. Apple (*Pyrus*; *Malus*), an uncommon tree on the Island, supplied one site.

Although houses and other wooden structures are frequently damaged by Flickers, only two active nesting sites were discovered. Both were in unoccupied wooden buildings. Flicker damage to buildings is occasionally severe on Nantucket. This is particularly true of abandoned or little-used buildings. Damage takes two forms: (1) holes for roosting or nesting, and (2) holes in shingles or siding where the motive seems to be search for insect food.

During the 1964 nesting season a cavity under the roots of an uprooted pitch pine was found to contain an active Flicker nest. Six eggs were found at the end of a 17-inch-long burrow. The burrow appeared to be a natural cavity made by the pull of the tree's roots when the tree fell over. It was four inches high, seven inches wide, and slanted downward to a depth of six inches below the surface. Five days after the site was discovered the eggs were gone and no adult Flickers were in evidence.

A second below-the-surface site was found in the hollow base of a living oak tree. Birds entered the hollow by a natural hole in the tree trunk three inches above ground level. Eggs were at the bottom of the hollow base of the tree, and this was on a level five and a half inches below the surface. Burns (in Bent, 1939) reported instances in which the Yellow-shafted Flicker had nested both in Kingfisher burrows and in enlarged Bank Swallow holes. Gabrielson and Jewett (1940) reported several examples of Red-shafted Flickers nesting in burrows in a railroad cut in a part of Portland, Oregon. Buchheister (in Bent, 1939) reported a Flicker nest six inches below ground level in a tree cavity. Many other odd Flicker nesting sites have been reported. Examples of eggs being laid on bare ground and completely in the open are not uncommon.

HEIGHT OF OPENING

Openings to nesting cavities varied in height from ground level (burrow site) to 17 feet. This is a much lower height range than the two to 60 feet given by Burns (in Bent, 1939) for middle and eastern States. Average heights of openings each nesting season are given below:

Year	*No. sites measured*	*Average height*
1959	8	3′ 10″
1960	30	4′ 2″
1961	9	4′ 0″
1963	27	4′ 2″
1964	31	3′ 11″
1966	31	4′ 4″
1967	19	5′ 4″
1968	14	4′ 11″

The average height of 169 nest sites measured over eight nesting seasons was 4′ 4″. Average heights varied from 3′ 10″ in 1959 to 5′ 4″ in 1967—a difference of 18 inches. Only small variations in average heights were recorded from one year to another and no trend was evident toward higher or lower openings.

Absence of any trend suggests that the Flicker on Nantucket has not attempted to adapt to competition or predation through changes in nesting height. The main factor controlling height seemed to be convenience in establishing the nest hole. The Flicker is a relatively weak-billed woodpecker and hence it avoids difficult excavating in hard wood. Because of the presence of so much low butt rot and heart rot in trees on Nantucket, the Flicker finds many of its best nesting opportunities at low levels. On the other hand, the easiest excavating in newly-dead trees can be expected near the top of broken trunks or stubs. Decay is likely to be most rapid at the top and this is where the hole is at first most often located. Since few trees on Nantucket reach any great height, sites at tops of dead trunks and stubs are likely to be at heights no greater than 15 feet or so. As the dead tree becomes more decayed throughout, the top part with the earliest Flicker hole is likely to break off. A new hole may be started near the top of the same stub. Holes in broken stubs thus become progressively lower. While some birds are exploiting ever shorter stubs, others are making holes near the tops of taller recently-dead trees. With new trees dying every year, as is presently the case on Nantucket, the average nesting height stays about the same.

Trees that have died of fire or insect attack have generally provided higher nesting sites; trees that have died from heart or butt rot or which, although living, are infected with rot fungi have generally provided lower nesting sites. Variations in heights of nest holes among five commonly used tree species are shown below:

	No. sites	*Highest opening*	*Lowest opening*	*Average height*
Tupelo (black gum)	9	12′	3′ 9″	7′ 5″
Japanese black pine	43	17′	1′ 8″	6′ 4″
Pitch pine	11	10′	1′	4′
White pine	16	6′ 8″	1′ 3″	3′ 4″
Black oak	23	5′ 6″	3″	3′ 1″

Tupelo, Japanese black pine, and pitch pine, trees where rotting is first most pronounced toward the top, are seen to have higher sites, on the average, than black oak and white pine. The last two species, which are particularly subject to basal rot, are seen to contain the lowest sites. Sites in pitch pine might have averaged much higher had not most trees been in the final stages of decay when Flickers were nesting in them, and hence sites were quite low.

Lawrence (1966), in discussing nest sites of the Flicker and three

other woodpeckers in the Pimisi Bay region of Ontario, cites light as an important factor in both the height of the nest hole and the compass direction of the opening. Holes tended to be at heights and in directions where there was more light and warmth. Height of opening on Nantucket, however, was dictated largely by ease in excavating and, in some cases, by whether or not the diameter of the tree was large enough to accommodate a cavity of the size needed by the Flicker (a factor also mentioned by Lawrence).

Lawrence was unable to find an explanation for the frequency with which the Flicker and Downy Woodpecker at Pimisi Bay selected nest sites close to the top of broken-off stubs of dead trees. The greater softness of the wood near the top, which the writer has tested out to his satisfaction with an increment borer, would seem to provide the explanation. Also by use of an increment borer he established the fact that the Flicker picks the narrowest thickness of wood when drilling through to the decayed interior of an outwardly sound tree. A hole 34 inches up in the trunk of a living white pine was where the outside thickness was only one inch. Although the rot extended upward at least seven feet from the ground, tests showed that a hole any higher than the site selected would have required the drilling through of two or more inches of solid wood.

Excessively low holes were seen to be free of Starling usurpation. A hole 20 inches above ground level in a house had no record of Starling occupancy, nor have other holes below 30 inches. Holes in fence posts at 32 and 33 inches, respectively, were taken by Starlings and so were holes at 31 and 32 inches in black oaks. There was no evidence, however, to indicate that Flickers deliberately seek low holes as a way to avoid competition by Starlings.

NESTING SUCCESS

Detailed figures on nesting success are available for the 1960 season and again the 1969 season. Of 30 sites located in 1960, 22 were successful in that at least one of the brood left the nest as a fledgling. No young left the other eight nests. This was a nesting success of 73.3 per cent. The average number of young fledged from each successful nest was 5.1; the overall average per nest was 3.7. The largest number of young to leave a nest was eight and the smallest was one. Cat predation appeared to be responsible for five failures, two failures were from unknown causes, and one was from Starling usurpation.

The average height of the opening in 22 successful nests was 4′ 6″ and the average height in the eight unsuccessful nests was 3′ 4″. These findings are consistent with those reported by Holcomb and Twiest (1968), who find that nesting success in the Red-winged Blackbird improves with greater nesting height.

Sturdiness of the nest site seemed to be an even more important factor than height in affecting nesting success. Sites in very decayed wood were far more subject to predation than sites in relatively solid wood. There was no evidence that house cats were ever able

to obtain young by reaching down through the opening. All instances of house-cat predation involved breaking down the walls of flimsy nesting sites. Pitch pine sites, as already mentioned, were generally in the last stages of decay in 1960 and thus afforded little security from cat predation. Nesting sites in 1960 and number that were successful or unsuccessful are shown below:

	No.	*No. successful*	*No. unsuccessful*
Pitch pine	6	2	4
Black pine	5	3	2
Black oak	5	4	1
Fence post	3	3	
White pine	2	2	
Utility pole	2	1	1
Gray birch	1	1	
Scotch pine	1	1	
Quaking aspen	1	1	
Larch	1	1	
Tupelo	1	1	
Willow	1	1	
Birdhouse	1	1	

Nesting success was checked again in 1969. Nearly all of the nest sites were followed through until the departure of young. On the basis of at least one bird leaving the nest safely, nesting success was 100 per cent. No instances of attempted predation were noted. The feral cat population on the Island appeared to be unusually low. This factor, along with dry storm-free weather, would seem to account for the extremely good nesting success.

DIMENSIONS AND DURABILITY OF NEST CAVITY

Depths were measured at 35 nesting holes. The most shallow hole was seven inches deep (measured from lower rim of entrance hole), and the deepest hole was 23 inches. Kind of site, maximum and minimum depths, and average depths are shown below:

The average depth of the 35 holes was 11.9 inches. Very little differences in average depths were noted between the various sites. Compared with depths recorded elsewhere, Nantucket nesting holes were unusually shallow. Burns (in Bent, 1939) gives depths in New York and New England as between 10 to 36 inches; Illinois (14 to 24 inches), Pennsylvania (10 to 18 inches), and Minnesota (9 to 18 inches).

The unusually shallow holes made by Nantucket Flickers may be attributed to one or more factors. With the absence of most

	No. sites	*Maximum depth*	*Minimum depth*	*Average depth*
Black oak	7	15.0″	8.5″	12.3″
White pine	6	18.0″	10.0″	12.1″
Pitch pine	4	14.5″	7.0″	11.2″
Black pine	4	11.0″	8.5″	10.0″
Fence post	5	23.0″	10.5″	13.8″
Misc. sites	5	21.0″	8.0″	12.0″
Tupelo	2	14.5″	10.5″	12.5″
Larch	2	12.5″	8.0″	10.2″
	35			

predators present on the mainland, birds may not be under compulsion to dig very deep holes. Starlings, by pre-empting holes before they are finished and by forcing Flickers into making hastily-constructed secondary sites, may be the most important factor in the shallower holes on Nantucket. However the data gathered by Burns go back 70 or 80 years and before the Starling could have influenced the habits of native birds. Data on present-day Flicker nest-depths from the mainland are needed if this question is to be viewed in proper perspective.

It should be added that with repeated use a hole may become more shallow and not, as might be expected, deeper. While incubating eggs or brooding young, a bird will often "while away the time" by chipping at the sides of the nest cavity. Such chips are not removed and, together with regurgitated seeds and other debris, accumulate at the bottom of the hole. This material, which decomposes into a dirt-like consistency, apparently is never removed. With repeated use over a period of years the accumulation becomes quite substantial. In one old hole, three inches of dirt-like debris were found; in several other holes around two inches.

Flicker nest sites on Nantucket seldom last more than five years. Records of beyond normal longevity are as follows: dead pitch pine 7 years, living white pine 8 years, living black oak 9 years, and fence post 9 years. The average longevity is probably around two or three years. Not only do sites break off and holes rot out, but the birds themselves many times hasten the process by enlarging insides of the cavity beyond needed dimensions. Even though inside diameters range between 4½ and 5½ inches, which seems to be adequate, birds continue chipping while engaged in nesting duties. Sometimes only a thin shell is left or birds break through to the outside and thus ruin the value of the cavity as a nest site.

COMPASS DIRECTION OF OPENING

Compass directions of 118 sites on Nantucket occupied by Yellow-shafted Flicker are compared below with compass directions of 89 sites at Pimisi Bay (Lawrence, 1966) occupied either by Yellow-shafted Flicker, Hairy Woodpecker, Downy Woodpecker, or Yellow-bellied Sapsucker, and with 142 holes made by PileatedWoodpecker in utility poles in eastern Texas (Dennis, 1964):

	S	SE	NE	N	W	SW	E	NW
Nantucket	22	20	16	16	15	12	10	7
Pimisi Bay	27	17	2	4	13	4	19	3
Eastern Texas	50	10	9	14	9	16	19	15

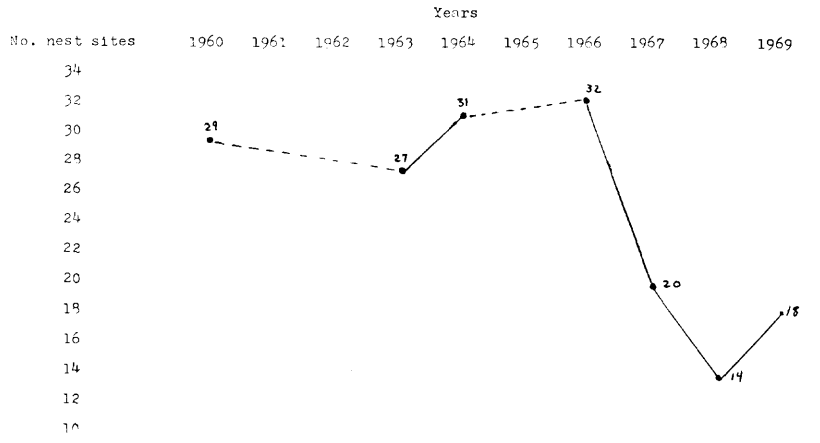
Except for more openings facing NE, N, and SW on Nantucket and fewer facing E, the directions are quite similar at both Nantucket and Pimisi Bay. An even closer comparison can be seen between Flicker holes on Nantucket and Pileated Woodpecker holes in Texas. Shown below are percentage of Nantucket and Pimisi Bay openings facing in general directions:

	Easterly	*Westerly*	*Northerly*	*Southerly*
Nantucket	39	29	39	54
Pimisi Bay	43	22	10	54

	South or eastward	*West or northwards*
Nantucket	68	56
Pimisi Bay	77.5	29

The only striking difference, on the basis of percentage figures, are more holes facing northward and west on Nantucket. A greater percentage of openings faced to the northward and west in northern Europe (Blume and Pynnönen in Lawrence, 1966). Otherwise European findings agree closely with those obtained by Lawrence. Thus compass direction of openings on Nantucket not only agree closely with data reported from central Ontario but even more closely with data reported from northern Europe.

While early-morning warmth and light seem to be very plausible reasons for the large percentage of openings facing to the south and southeast, there could be other factors involved. Lawrence, quoting Blume and Pynnönen, mentions the possibility of easier excavation on east-south exposures because of wood structure and also another theory suggesting better foothold on northern exposures because of greater roughness of bark. However, the writer in examining 142 Pileated Woodpecker holes in utility poles in eastern Texas found a very strong south orientation and generally the same compass orientations that he found on Nantucket. On utility poles there



would not be compass-oriented differences in wood structure or foothold.

Early-morning warmth and light would appear to be the most plausible reasons by far for the so widely-reported east and south orientations of woodpecker holes. Lawrence finds evidence in her observations that holes constructed later in the season and hence when warmth and light would not be such important factors are more likely to be in some direction other than east or south.

POPULATION TRENDS

The Flicker population in terms of number of active nest sites has been followed during most years since 1960. The population appears to have been quite stable between 1960 and 1966. The minimum number of sites counted during this period was 27 and the maximum number was 32 (Table 2). In 1967 the number of active sites fell to 20, and in 1968 to 14. In 1969 the number of active sites had increased to 18. This increase, together with excellent nesting success that year, indicates a possible early return to previous high population levels.

The total Island population, because of the omission of a few localities in the nest census, is probably around 20 per cent greater than figures used in Table 2. Thus the total population in 1966, the peak year, might have been around 38 or 39 pairs. Nantucket has a land area of about 25,000 acres. In 1966 the Flicker population for the Island as a whole had reached a density of approximately one pair per square mile. No account in these calculations is taken of the nearby island of Tuckernuck, which does have some suitable nesting habitat, and which, therefore, may contain additional nesting pairs.

LIMITING FACTORS

It has already been mentioned that severe weather, and not competition for nest holes by Starlings, is believed to be the chief factor limiting the size of the Flicker population on Nantucket. This assumption is supported by the finding of largely decomposed remains of adult Flickers in or below holes that were being examined for signs of nesting. Dead birds, that had presumably been using the holes for roosting, were found every year beginning in 1966. One of eight dead Flickers found in such situations had obviously been shot. Because of the damage it does to buildings, the Flicker is subject to some loss from shooting. This is believed to be a minor cause of mortality. The other birds found are believed to have died as a result of adverse weather.

Losses to weather could occur within a wintering population or to migrants that may return to the Island anywhere from early March to late May. In spite of much banding, the migratory status of Flickers nesting on Nantucket is not known. Birds that winter on the Island (sometimes in considerable numbers) may partly be local in origin and partly migrants from the mainland. Relative abundance of bayberry and poison ivy, two of the staple winter foods, probably determines to a large extent the size of the wintering population.

The sharp decline in the Flicker population, when number of nesting pairs dropped from 32 to 20 in 1967, can almost certainly be blamed upon bad weather in May. Rainfall during May, reported by the Nantucket Weather Station, was 10.38 inches. Sustained winds of 49 MPH and gusts of 70 MPH were recorded during a storm on May 24, 25, and 26. Foster (1967), reporting upon the effects of the May storm elsewhere in Massachusetts, writes that losses to birdlife were "unbelievable". He states that "food became scarce or non-existent for a short period of time with the result that countless numbers of swallows, thrushes, warblers, tanagers, and orioles perished."

Two factors, besides direct storm mortality, may have made for an unusually poor nesting season. Numerous dead stubs, many with former Flicker holes, were destroyed by the storm. Aggravating what may have already been a serious shortage was a change in Starling nesting dates. The Starling normally begins nesting in early to mid-May and thus about two weeks ahead of the Flicker. In 1967, the Starling, also badly hit by the storm, began nesting at the same time as the Flicker. With both species competing at the same time for nest holes, the Flicker must have been more hard pressed than usual. Evidence of a poor nesting season is seen in the fact that only 14 pairs of Flickers were back nesting in census areas the next year—the lowest total yet.

Although numerous examples of Starlings pre-empting Flicker sites have been observed, it is believed that competition of this kind is not an obstacle to nesting success if the Flicker still has time to excavate new holes. Where there are an abundance of dead or diseased trees on the Island suitable for nest hole excavation, the

Flicker is able to adjust to rather severe competition by the Starling. However, when nesting by the two species takes place simultaneously, as in 1967, the Flicker is often obliged to accept poorer sites. Such sites may be susceptible to loss from the weather or to predation by house cats.

In the absence of suitable substitute sites in the form of dead or diseased trees, the Flicker loses out to the Starling. This is particularly true where nesting sites are in the open. There has been a marked trend during the eleven years of this study toward more concentrated nesting in a few favored localities. In 1960, for example, 29 pairs were nesting at 20 locations through the Island. The largest number of pairs nesting at any locality was four. In 1969, on the other hand, 18 pairs were nesting at eight localities. In one locality no less than seven nesting pairs were present.

At Coskata Pond, where there is an abundance of oak trees with butt rot, the Flicker has maintained its numbers in spite of a marked increase in the Starling population. Prior to 1964, no Starlings were nesting at this location. Beginning with one pair in 1964, the Starling population had increased to at least ten pairs in 1969. The Flicker population at this locality has remained at two to three pairs in every census since 1960. A thorough search for unused nesting cavities was made of this 50-acre tract of oak wood in 1969. The presence of six or more unused nesting cavities suggests that neither the Starling nor the Flicker had reached a saturation point in numbers so far as availability of nesting sites was concerned. A similar abundance of excess nesting sites was observed the same year at the white pine plantation.

Unlike the situation at the oak wood at Coskata, the Flicker population in white pine has fluctuated considerably from year to year. These changes have occurred without much interference from Starlings. Since 1964 Starlings have nested sporadically but never with more than three nesting pairs in any year.

It is seen, therefore, that other factors than competition for nest holes have been responsible in limiting the size of the Flicker population on Nantucket. In isolated locations where there have been few, if any, substitute sites available, the Flicker has given way in many instances to the Starling. This trend was first seen in towns and along utility lines where Flickers nested quite commonly before 1960. By 1960 the Flicker had retired to more wooded parts of the Island. It has held its own, or even increased, at sizable wooded tracts with an abundance of nest sites. Thus there has developed a tendency toward more concentrated nesting at a few favored locations.

The chief limiting factor appears to be severe weather prior to the nesting season. Mortality due to the weather probably takes place every spring and winter. Unusually bad weather, as in 1967, results in a drastic decline in the population. Losses are not solely from the direct effects of the weather but include later losses that result from the necessity of having to accept insecure nesting sites. The house cat may then become a limiting factor of consequence.

OTHER BIRDLIFE

The birdlife of Nantucket has changed markedly during this century to meet the steady encroachment of woodland upon moors and to meet other ecological changes. Griscom and Folger (1948), writing of the changes in birdlife on Nantucket during the historical period, state that "few localities in the northeast can boast the many shifts and oscillations in their bird life which are positively known to have taken place on Nantucket". The Yellow-shafted Flicker is only one of many species, rare or absent on the Island early in the century, that have responded favorably to reforestation. Within the past twenty years various insect pests and tree diseases have provided the Flicker with an ever wider choice of nesting sites. Dead trees have also provided nesting sites for a number of other hole-nesting birds. Starling and Black-capped Chickadee are the two species that most often take advantage of holes excavated by the Flicker. The Great Crested Flycatcher, a recent colonizer but probably not yet firmly established, also uses Flicker holes for nesting. In June of 1968, the writer discovered Saw-whet Owls (*Aegolius acadicus*) nesting in a Flicker hole in a living white pine and with an opening only 16 inches from the ground. Two young were raised in this first known nesting of the Saw-whet owl on the Island.

In spite of reforestation, no other woodpeckers have become established. The Downy Woodpecker is a fairly common migrant through the Island during some fall seasons; also the bird has appeared occasionally in summer and may have nested. The less common Hairy Woodpecker has a similar status. The Yellow-bellied Sapsucker is a common to abundant migrant through the Island during the fall. Also there is a heavy fall movement of non-resident Flickers through the Island. It is probable that during some years a few such birds stay on through the winter.

The white pine plantation where the Flicker presently nests in considerable numbers is often frequented by Barn Owls. Pellets of Barn Owls collected during the nesting seasons in 1966, 1967, and 1969 contained mainly remains of small rodents and also bones and feathers of Starlings and a few other birds. No detectable Flicker remains were found. On the basis of samples examined, the Starling is an important item in the Barn Owl's diet on Nantucket. Barn Owl predation has probably greatly reduced Starling competition for Flicker holes at the white pine plantation and perhaps elsewhere on the Island.

SUMMARY

For two hundred years prior to 1900, Nantucket was essentially treeless. With a return to partially wooded conditions during this century, the Yellow-shafted Flicker became an abundant nesting bird. In 1966, a peak year, 32 nesting sites were counted and the population of the Island was around 40 pairs or one pair per square mile of land area. Severe weather prior to the nesting season is

believed to be an important limiting factor during some years. A heavy loss in number of nesting pairs in 1967 was associated with a severe storm in late May. The Starling, through usurpation of Flicker nest sites, causes some dislocation and losses. The main effect of Starling competition has been a marked change in the nesting distribution of the Flicker. Prior to 1960 the Flicker nested widely over the Island and in such exposed sites as fence posts and utility poles. During a ten-year period the Flicker has moved more and more into a few heavily wooded areas. Nesting densities are greater than ever before. An average of 19 pairs per 100 acres was recorded in white pine in 1966, and active sites have been as close as 22 feet.

In 1960 the Flicker achieved a nesting success of 73.3 per cent. Although most mainland predators are absent, insecure nest sites are subject to predation by house cats. Higher sites were more successful than lower ones. In 1969, there was no evidence of cat predation and nesting success was believed to be 100 per cent.

The average height of 169 nest holes, measured over a ten year period, was 4′ 4″. There has been no trend toward higher or lower nesting. Several burrow-type or below the surface holes have been observed. The highest hole was 17′. Height of nesting cavity seemed to be determined largely by presence of decay. Butt rot in living pine and oak has been a factor in unusually low nesting. Very low holes were not subject to take-over by Starlings.

Living white pine with heartwood decay have become increasingly important as nest sites. A parallel is seen in use of living white pine and larch by the Flicker and use of living pine trees with red heart disease by the Red-cockaded Woodpecker. One instance was noted of a house cat apparently being repelled by sticky resin at a hole in a living white pine. Japanese black pine, black oak, pitch pine, tupelo, and larch are also important in furnishing nest sites. Of 112 Flicker nesting holes recorded in trees over a ten year period, 33.9 per cent were in living trees with heart or butt rot and the remainder were in dead trees or dead branches.

Hole openings showed a strong south or southeasterly orientation; this in keeping with reported directions for Flickers and other woodpeckers elsewhere.

The average depth of 35 nest holes was 11.9 inches. Flicker nesting holes on Nantucket are considerably more shallow than were holes reported from mainland situations late in the last century. Because of decay, as well as excess excavating by the occupants, sites seldom last over two or three years. In a few cases sites have lasted as long as seven to nine years.

The Flicker is the only woodpecker that nests regularly on the Island. A number of other hole-nesting birds use holes made by the Flicker. A recent first observed nesting of the Saw-whet Owl on Nantucket was in a low Flicker hole in a living white pine.

Barn Owl pellets with Starling remains were found during three nesting seasons at a white pine plantation. At this location, and perhaps at other nesting areas, the Barn Owl may keep the Starling population reasonably well in check.

From all indications the Flicker is a highly successful species on Nantucket. The population comes back quickly after losses to weather. So far Starling aggression apparently has not affected overall numbers. However, rapid loss of nesting cavities through decay and Starling interference makes it imperative that the Flicker have numerous substitute sites in the form of dead or diseased trees. As a result of fire, insect damage, and disease there is presently an abundance of such sites on Nantucket, and this, probably more than any other factor, explains the large Flicker population.

ACKNOWLEDGEMENTS

For help in several phases of this study, the writer is indebted to Mr. and Mrs. J. Clinton Andrews of Nantucket. Mr. C. L. Morris of the Virginia Division of Forestry supplied identifications of plant diseases and helped generally on many questions pertaining to forestry. Dr. Emil F. Guba provided added information on insect pests and diseases of plants on Nantucket.

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Received November, 1968; revised July, 1969.