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Thesis
on
The Economic Value
of
The White-bellied Nuthatch and Black-capped Chickadee.

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By E. Dwight Sanderson.

THESIS

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ON
THE ECONOMIC VALUE
OF THE WHITE-BELLIED NUTHATCH AND BLACK-CAPPED CHICKADEE.

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The value of our common birds as insect-destroyers has of late years come to be recognized as an important field of investigation for the ornithologist and a large item in rural economy. Much valuable work has been done in determining their economic relations, but there has also been a large amount of assumption by various writers based on insufficient data. It is my purpose in this thesis to determine the character and amount of food and the economic relations of two of our most common residents, the White-bellied Nuthatch (*Sitta Carolinensis*, Lath.) and the Black-capped Chickadee (*Parus atricapillus*, Linn.), from the analysis of the stomachs of 34 specimens of the former, and 28 of the latter, notes taken while collecting them, and from as much reliable data as could be found elsewhere.

Method of Analysis.

In no instance was any food found in the true stomach, mouth, or gullet, and the only part containing food was that ordinarily called the gizzard. This was removed and the contents carefully washed into a glass dish, in which it was spread out and examined under a dissecting microscope. The per cent of matter was determined by dividing the whole contents into various equal parts of the different components, as accurately as possible. In many instances the food was so finely divided that

only its most general nature could be ascertained, and hence, a stomach is often tabulated as containing only one insect of a certain order when it doubtless contained the parts of many more, which were indistinguishable. Prof. F. H. Porush states that chickadees frequently pick out only the internal organs of larvae, and as these are easily digested and not individually recognizable, such work would escape observation. The contents were then placed in vials holding $3\frac{1}{2}$ cubic centimeters in 70% alcohol. The quantity of the stomach contents was determined by a linear measurement of the height of the material in the vials- as shown in diagram at bottom of Tables I and II. The vials were $4\frac{1}{2}$ centimeters high and hence contained $7/8$ c.c. for every linear centimeter. The seeds were kindly determined, as far as their isolated condition would permit, by Prof. C. F. Wheeler and Prof. W. L. Fernald, while part of the eggs were identified by Prof. H. H. Henshaw of the Division of Entomology, U.S. Department of Agriculture. Many insects of the stomachs could be named further than genus, with any degree of accuracy, and often it was impossible to determine anything further the order.

The specimens were all collected within a radius of five miles from the college. Record was kept of the sex, but no difference in the feeding habits was noticed, although most of the Nuthatches were secured in pairs. Notes upon the weather were also kept, but specimens were secured under all conditions,- both during a bright February thaw and a March snow-storm, and except as caused by the ground being covered with snow, no difference could be seen, save as noted between different periods. Neither did the time of day seem to cause any variation.

White-bellied Nuthatch (*Sitta Carolinensis*, Lath.).

Table I exhibits the results of the examination of 34 stomachs. The first 23 were collected during the winter season, snow covering the ground much of the time; while the last 11 were secured during the spring, before the foliage was out. Hence, I have made two totals, showing the difference in feeding habits between the seasons. (I had wished to secure specimens during the early summer for further comparison along this line, but as the birds were becoming very scarce near the college and little time was available for the work, I was unable to do so. Such a series would doubtless give some interesting data). The numbers across the top are those of the stomachs as secured. Under each number the food is indicated by the name opposite at the left. The amount of contents in cubic centimeters is given at the bottom, together with a diagram showing the relative amounts of the different kinds of food. Each line is the same length as the food was in that bottle (see above); that portion in red ink represents animal matter; that in black, seeds; and the white space between, if any, is gravel. The date of collection is also given. A list of those insects which could be more or less accurately identified is given, from which can be determined the relative number of noxious and beneficial forms.

Vegetable Food.

Misled by the name, it has always been stated that Nuthatches feed on the kernels of nuts which they break open. I was fortunate enough to secure one specimen while "hatching" an acorn, which was done at the apex, and secured the fruit. It had been cracked in two, and was quite

wormy. Careful analysis of the vegetable matter found in the stomachs, - even by microscopical sections- failed to reveal a trace of any acorn meat, and furthermore it would seem that if that was desired, a sound specimen would have been selected by the bird. In view of these considerations, I am led to believe that the nuts- such as acorns and beech-nuts- are sought merely for the insects which they contain. (See notes upon this in Bibliography).

During the winter the larger portion of the food was composed of seeds, which gradually decreased as insect life became more abundant. Those determined were; Zea mays in 12 stomachs, Ambrosia artemesifolia in 8, and 2 Helianthus sp?. Numerous other seeds were so badly broken as to be undeterminable. All were digested, and none, whether of noxious or beneficial plants, were consumed in quantities of any economic importance.

Insect Food.

A remarkable increase in the per cent of insect food is seen in the second series over the first, it forming 79.5% in the spring, while only 25.7% during the winter. Seeds, on the other hand, were just the reverse, forming 67.4% during the winter and only 13.5% in the spring. The proportion of gravel remained comparatively constant at 6.2% and 7%, as did also the amount of food at an average of .8 c.c. and .34 c.c. for the respective periods. It will be noticed that in the latter series all the insects were adult, while in the former almost one-third were eggs or larvae.

Hemiptera, largely Piesma cineria, were the most important insects

in the first series; with Coleoptera next. These two orders made up the bulk of insect food during this period with the exception of a single stomach which contained some 25 Myrmicidae. During the second period, Hymenoptera were found in considerable numbers, all being beneficial, and with about equal parts of Perlidae and Coleoptera constituted the greater part of the insect food.

In the latter period there seemed to be a tendency to take larger insects, as evidenced by several good sized moths, which of course would lessen the number of individuals. Though the number of the insect forms eaten by the Nuthatches is comparatively small to that of those eaten by the Chickadees, yet it is no doubt one of the fact that their insect food is much more rapidly digested by the aid of the gravel, than in the Chickadees, which have none.

Almost no well known injurious insects were found, the most common noxious form being *Pissina cineria*, which never does any considerable injury. As mentioned, one stomach contained 25 *Myrmica* sp? which may be considered noxious. On the other hand, a large number of beneficial forms, such as, Braconids, Reduviids, and Carabids were found, and many that may be considered neutral as Perlidae- and even these might be considered as valuable in the larval stage for fish food.

Thus it is seen that the insect food is taken more or less indiscriminately and that the beneficial forms fully equal those more or less injurious, while there were none found feeding upon any insect pest.

Habits.

The birds are invariably found in pairs; on only one instance did I

find half a dozen together on a river bank, which doubtless were several pairs. The timber in this neighborhood consists of small lots of a few acres and each of these will ordinarily be occupied by only one pair of Nuthatches. They invariably feed upon rough barked trees; half of my specimens being taken on elms, with almost equal parts of the majority of the remainder on ash and oak. Three specimens were secured in an old apple orchard quite distant from any dwellings, and no others were found around fruit trees, possibly on account of the expressed preference for rough barked trees.

Abundance.

The abundance of the individuals or approximate number per square mile is very difficult to determine. I generally secured about three for every two miles travelled. As I generally covered a radius of a quarter-mile each way from the straight line over the country travelled, I should think about five per square mile would be a fair average for this portion of the state. This would also, without doubt, be a fair sample of the greater part of the state, as there is only a moderate amount of bird life in this section. At Ithaca, N.Y. Mr. F.F. King found one for every two miles travelled.

It is to be regretted that I have been unable to secure any specimens from any infested orchard, so as to ascertain whether or not they will eat the most abundant food offered them.

Partial Domestication.

They have become very tame upon the campus and frequent the doors of the boarding-clubs, where they feed upon the refuse scraps. A pair of them have frequently been seen upon a porch-roof below my window, where

they were feeding on the meat left in walnut shells, fruit, parings, and other refuse dropped there, and they would often come up and perch on the window sill. This would go to show that where protected, they would become permanent residents, quite soon, and they are not naturally of timid disposition. Many authorities consider them highly beneficial, in fact, class them with the Chickadees (see Bibliography), but with the exception of their being found eating *Mytilus edulis* pomorum by Professor Forbush in Massachusetts, there seem to be no satisfactory notes or data upon which to base this assumption.

Value.

Though, in view of these facts, I should desire to experiment somewhat with them in an infested orchard, before declaring them to be merely neutral, yet from all the data secured there would seem to be but little doubt that the Nuthatch, both from its food and habits, is either absolutely neutral or of comparatively small economic importance.

A bibliography of literature concerning the food and habits of the Nuthatch is appended, embracing everything of importance concerning which I could find mention.

TABLE I.Analysis of Contents of Stomachs of White-bellied Nuthatch.

Number.	<u>1.</u>	<u>7.</u>	<u>8.</u>	<u>9.</u>	<u>10.</u>	<u>11.</u>	<u>14.</u>	<u>20.</u>	<u>21.</u>	<u>22</u>
Date.	Jan.14./Jan.18.	/ ----Feb. 2.-----					/Feb.10./Feb.16			
Hymenoptera. %			8							8
" Adults.		2								25
Lepidoptera.										2 1/2
Hemiptera. %				Tr.	30	8	10			10
" Adults.					2	2	21	1		4
" Eggs.						20				
Coleoptera %		80	80	50	10		2			
" Adults.		2	2	2	1		1			
" Larvae.		15	5							
Orthoptera.			1		10 1/2					
Neuroptera.										
Diptera.		3 1/2								
Total Adults.		6	3	2	4	2	22	1		29
" Larvae.		15	5							1. P
" Eggs.						20				
" Insect Forms.		21	8	2	4	4	22	1		30
Spiders.										5 1/4
% of Animal Matter.	0	83	88	50	50	8	12	Tr.	0	23
% " Vegetable "	100	2	10	49	50	92	80	98	93	72
% " Gravel.		10	2	1			8	2	2	5
Total Contents. C.C.	.93	1.	.77	.62	.7	1.03	.77	.7	.93	1.08

TABLE I Continued.

Number.	44.	45.	46.	47.	48.	49.	50.	51.	52.	56.	57.	Total
Date.	----- April 10. ----- / Apr. 17. -----											(11)
Hymenoptera %			20	70							60	(5)
" Adults.		1	2	8	2						1	14
Lepidoptera.			.5/1	.12/1						Tr.	30/1	(4)4
Hemiptera.		3					2					(2)5
Coleoptera. %			50						2		3	(10)
" Adults.	1	2	2		3	1	1	1	1	1	1	12
Orthoptera.		1		1								(2)2
Homoptera.		1						11	40/5			(3)17
Diptera.					1	1			3/2			(3)4
Total Adults.	1	3	5	9	7	2	3	12	3	2	3	60
" Larvae.												0
" Immature.	1	3	5	9	7	2	3	12	3	2	3	60
Spiders.	1								10/1		2/1	(3)3
Centipedes.	80	35	95	90	100	25	45	90	60	100	95	72.5
Scorpions.	0	0	5	8	Tr.	55	45	0	30	0	5	13.5
Other Insects.	20	5	Tr.	2		20	10	10	10	Tr.		7.
Total Insects.												
C.C.	.7	.77	1.13	1.16	1.	.46	.54	.77	.4	.93	1.39	.84

23. 24. 25. 26. 29. 30. 31. 32. 33. 34. 35. 41. 43. Total.
 (23)
 ---- Feb. 16.-----/ -----Feb.20. -----/ Feb.24/" 22.

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|-----|-----|-----|-----|-----|-----|-------|-----|----|----|----|--------|------|---------|
| | | | | | | | | | | | | | (2) |
| | | | | | | | | | | | | | 27 |
| | | | | | | | | | | | | | (1) 1P |
| 5 | | 12 | | | | | | | | | | | (11) |
| 3 | 1 | 3 | | | | | | 1 | 1 | | | | 46 |
| | 2 | | | | | | | | | | | | 21 |
| | 75 | Tr. | | 10 | | | | 10 | | | 10 | | (13) |
| | 1 | | 2 | 1 | | | | 1 | 1 | | | | (17) |
| | 2 | | | | | | | | | | | | 32 |
| | | | | | | | | | | | | | (2) 2 |
| | | | 1 | | | 5 1/2 | 1 | 4 | | | 20 1/2 | 1 | 5 1/2 2 |
| | | | | | | | | | | | | | (4) 3 |
| | | | | | | | | | | | | | (1) 2 |
| 3 | 3 | 8 | | 3 | 1 | 1 | 6 | 2 | 2 | 1 | 1 | 2 | 101 1P |
| | 2 | | | | | | | | | | | | 33 |
| | | | | | | | | | | | | | 31 |
| 3 | 5 | 3 | Tr. | 3 | 1 | 1 | 6 | 2 | 2 | 1 | 1 | 2 | 145 |
| | | | | | | | | | | | | | (1) 4 |
| 5 | 76 | 12 | 0 | 20 | 10 | 5 | 94 | 10 | 10 | 20 | 10 | 5 | 35.7 |
| 60 | 23 | 85 | 80 | 55 | 80 | 95 | 5 | 80 | 33 | 78 | 30 | 90 | 67.4 |
| 35 | 1 | 3 | 20 | 10 | 10 | 0 | 1 | 10 | 2 | 2 | 10 | 5 | 6.3 |
| .82 | .77 | .93 | .77 | .54 | .54 | .77 | .62 | .7 | .3 | .7 | .77 | 1.39 | .3 |

- List of Insects Found in 34 Stomachs of the White-bellied Nuthatch. -

Hymenoptera.

Evaniidae- 1 in #45.

Braconidae- 6 in #46, #47, and #48.

Tenthredinidae- 1 in #47.

Formicidae- Myrmica sp? - 25 in #22.

Total Hymenoptera- 51 adults in 7 stomachs.

Lepidoptera.

Tineidae- Tenebrionix sp? 1 pupa in #30.

Total Lepidoptera- Adults- 4, Pupae- 1, in 5 stomachs.

Diptera.

Muscidae- 2 in #7.

Cynipidae- 1 in #40.

Total Diptera- 3 Adults in 4 stomachs.

Coleoptera.

Carabidae- 3 in #56 and #42.

Harpalus sp? 4 in #7 and #8.

Pterostichus sp? 2 in #32.

Elateridae- 1 larva in #7.

Euprestidae- 1 adult in #41.

Scaphidae- 1 in #40.

Total Coleoptera- Adults- 29, Larvae-22, in 23 stomachs.

Neuroptera.

Perlidae, 23 in #32, #31, #43, #51, and #52.

Libellulidae- 1 in #45.

Total Neuroptera.- 16 in 7 stomachs.

Hemiptera.

Tingitidae, Piesma cineria- 37 adults in 3 stomachs.

Reduviidae, 22 eggs in #11 and #24.

Coreidae, 2 adults in #10.

Jassidae, 7 adults in #14 and #45.

Total Hemiptera- Adults- 51, eggs- 21, in 13 stomachs.

Orthoptera.

4 in #8, #10, #45, and #48.

Total Insect Forms:-

Adults- 161, Pupae- 1, Larvae- 22, eggs- 21; = 215.

Arichnida- 7.

Pages 8 and 9
to be
opposite.



~~Pages 9 and 10~~
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Bibliography Concerning the Food of the White-bellied Nuthatch.

Audobon, J.J.

Insects- breaks open acorns and cheshuts for them.

Baird, Brewer, and Ridgway. Vol.I, Pg.115.

"Their favorite food is insects in every condition. With this, when abundant, they seem content. In winter when snow or ice covers the branches or close against them the trunks of the trees, they will even alight on the ground in quest of seeds. The European species collect and store away the fruit of the hazel and other nut-bearing trees. Our bird is supposed to do the same, but this is by no means an undisputed fact."

Chapman, Frank M.-Handbook of Birds of Eastern North America. PG.336.

"Their name is derived from their habit of wedging nuts (with our species usually beechnuts) in a crevice and then hatching them with repeated strokes of the bill. ---- When the cares of a family devolve upon him, the Nuthatch eschews all society and rarely ventures from his forest home. But in the winter I believe even the birds are affected by the oppressive loneliness; the strangers of the summer become for a time boon companions, and we find the Downy Woodpecker, Chickadee, and Nuthatch wandering about the woods or visiting the orchards on apparently the best of terms."

Cook, A.J. Birds of Michigan, Pg. 125.

"Will place acorns containing weevil grubs in some cavity of the bark and hold them secure and then pick out the delicate tit-bit."

Coues, Dr. Elliott, North American Birds, Pg. 82.

"Chiefly insectivorous, but also feed on hard nuts."

Davie, Oliver. Nests and Eggs of North American Birds.

"Two broods are not infrequently reared in a season. Usually select for their nesting place the decayed trunk of a tree or stub, ranging all the way from 2 to 30 feet above the ground. Often the old excavation of the Downy Woodpecker is made use of."

Dowse, W.B. Boston, Mass. Bulletin Nuttall Ornithological Club. Vol. 4 Pg. 61.

"While collecting in Waltham, in November, I observed a *Sitta Carolinensis* feeding on a small dead locust tree. It finally went to the end of a broken limb and took therefrom quite a large larva, which it tucked into a crevice, bent the bark upon it, gave a few light raps over the place, and then proceeded to do the same with more larvae."

Forbes, S.A.

"Beetles, Titulididae, cotenididae, and lady bugs. Corn is four staples."

Also Bulletin, Vol. 1, Ill. State Dep. of Natural History.

Forbush, W.H. Birds as Protectors of Orchards, Insect, 1915, Pg. 26.

"Mr. Bailey found that the Titlarks were feeding on scales- Tytilaspis perniciosus- which they found on limbs of apple-trees."

Keeler, Chas. A., Berkley, Cal. Ornithologist and Oologist, Vol. 13, Pg. 12

King, F.H. Economic Relations of Wisconsin Birds. Geology of Wisconsin Vol. 1, 1873-79, Pg. 486.

"Of twenty-five specimens examined, fourteen had eaten thirty-two

beetles- among which were three Elaters, one long-horn, and a lady bug; one, two ants; one, two caterpillars; one, two grubs of a beetle; one, a spider; one, a chrysalid; one, small toad stools; five, acorns; and one corn." Of these ten were recognized as noxious, two as beneficial and eighty unknown. (Assumes that the Nuthatch is highly beneficial from above data.)

Samuels. Larvae and eggs.

Warren's Birds of Pennsylvania.

"Insects, nuts, acorns, Indian corn, and seeds."

Wilson, Alexander. American Ornithology, Pg.39.

"Search for spiders, ants, insects, and their larvae. From the great numbers that I have opened at all seasons of the year, I have every reason to believe that ants, bugs, small seeds, insects and their larvae form their chief subsistence. Neither can I see what necessity they would have to circumambulate the trunks of trees with such indefatigable and restless diligence while bushels of nuts lay scattered around their nests."

Black-capped Chickadee. (*Parus atricapillus*, Linn.)

Table II gives the contents of 22 stomachs; the first nineteen of which were secured during the winter, and the last nine in the spring, being the same periods in which the Nuthatches were collected. The table is similar in arrangement to Table I. A list of insects found in the stomachs, which were wholly or partially identified, is also given.

Vegetable Food.

During the winter, 20.3% of the food was vegetable, though 1/3 of the stomachs contained no seeds whatever, while in the spring the food was wholly insect. The seeds identified were one *Arenaria salina*, and one *Ambrosia artemisiifolia*, being practically the same as those upon which the Nuthatch fed.

Differences in Food as Affected by Season.

The same increase of insect food in the spring over that in the winter is shown in Table I. During the winter, 70.3% of the food was animal, while in the spring no vegetable matter was to be seen eaten. No trace of gravel was found in any of the stomachs. This is doubtless due to the small amount of vegetable food eaten, necessitating the necessity of a longer course of grinding to bring the food into a digestible condition.

The total amount of food actually reached nearly one cc., being .48 c.c. in the winter and .58 c.c. in the spring. This is very little; but in the latter season, the food was in the spring quite more solid, in comparison with the winter of soft and loose, and was more easily digested. Whereas

in the winter about $2/13$ of the insect forms were adult, $8/13$ larvae, and $7/13$ eggs; in the spring, $4/5$ were adult, $1/30$ larvae, and $1/6$ eggs. While the total bulk of the food in the spring was $1/10$ larger than that of the winter, yet there were over 60 times more forms eaten in the winter than in the spring, which was largely due to the enormous numbers of Reduviid eggs then consumed.

Character of Food.

Hemiptera, eggs and adults, formed by far the greater part of the food of the first period, with Coleoptera and Lepidoptera next, or possibly from an economic standpoint of equal importance. During the second period, the greater part of the food was adult beetles, with a large portion of adult Lepidoptera. In two stomachs, worms of considerable size were found. One was a small, white and cylindrical form, while the other was white, but more flattened, with longer segments, and a true tape-worm.

Several well known insect pests were found in considerable numbers. Among them, - 2 or *Eucelatrix* sp? pupae in two stomachs; 62 leetrid larvae in five; 105 Coleopterous boring larvae in two; 15 *Aphis mali* eggs in 28; and 77 *Mytilaspis pomorum* scales in four stomachs. (Each of the latter doubtless covered hundreds of eggs, so that their destruction at this stage cannot be overvalued). The only beneficial forms found were nine adult Carabidae in four stomachs and possibly the 450 Reduviid eggs secured from twelve stomachs may also be so considered, but the amount of their value is very uncertain. Thus it is seen, that the injury done by eating beneficial insects is very small and of doubtful amount, while

almost the entire food is composed of more or less noxious forms. The injurious forms were also eaten in large numbers, showing that the bird would be of considerable value toward their removal when placed among a large number of them, and undoubtedly would be especially useful in destroying a pest during the winter season. In fact, Prof. Forbush has shown by actual experiment (see Bibliography) that when these birds are present in the winter the destruction of the eggs at that time rendered it possible for the summer birds to destroy all the larvae during a severe attack of the canker-worm, and the orchard thus produced a good yield, whereas, elsewhere the trees were largely defoliated.

Habits.

Its habits of life also commend^{it} as being beneficial. The Chickadees are usually found in small flocks of from six to a dozen, of which the larger number are females. These often mix with those of Goldfinches and Tree Sparrows, or are found in company with a pair of Nuthatches, during the winter, but become more independent as spring advances and there is an abundance of bird life all about them. Over half of my specimens were secured in bushes on low, damp, marshy ground, or along a creek or roadside. They often descend to the ground in marsh land and scratch among the dead rushes for any insects there. I am inclined to think that most of the Reduviid eggs were secured on such marshy ground. Tamarack was a favorite resort with many. About one-fourth were taken from oak trees, but on these they searched for insects upon the tips of the smooth branches, rather than on the rough trunk as do the Nuthatches. Two were secured in an apple orchard, while five others were seen coming from one. Many times they were seen in orchards near dwellings, where I

was unable to secure them by use of the gun. When feeding on heavy timber, they frequent only the edges, where the injurious insects are invariably the most plentiful.

Abundance.

Owing to the fact that they go in flocks and are therefore not so evenly distributed as the Nuthatches, it is more difficult to determine their abundance. Although, on the average, about two were secured for every mile travelled, yet as they go in small flocks several were generally secured in an immediate vicinity. A flock of seven Chickadees is doubtless a fair average for each square mile and in some parts of the state, especially the south eastern, I am sure that they are much more abundant in orchards than here.

Ability to Check Insect Pests.

If fifty-five insects were consumed per day, by each bird, as will be shown to be the case, 385 would be consumed per day, and about 137500 per year in each square mile. Thus upon the land surface of Michigan there will annually be about 8,000,000,000 insects destroyed by the Chickadees alone. Surely no mean number.

During the summer after the young have been reared the number of individuals should be for some time at least tripled, giving us 20 to 25 per square mile. The census of 1890 shows that there are about 8,500,000 apple-trees planted in Michigan, and of the fruit trees, apple orchards are the Chickadees' favorite haunt. This would give an average of about 150 trees per square mile- enough for four ordinary sized orchards- or the average conditions existing in the better part of the state. As the

worst period of insect attack is during and after the breeding season, this would allow six birds to each orchard.

Nineteen Chickadees contained a total of 330 insect forms, a large majority of which were noxious, and the remainder of a doubtful character as regards their value. That the Chickadees which it would be possible to secure in a fair sized orchard, a half-dozen, would consume at least 275 forms a day, but probably 350 would be a much fairer estimate as the larvae are quite rapidly digested and many were so finely divided as to render numerous individuals wholly indistinguishable. Now if these could be persuaded to nest here and rear their young, which would probably average five in number, 1200 insects would be required per day to feed the young and old birds. Prof. Forbush states that 5000 canker-worms will strip a large apple-tree. Thus the number of insects eaten would be sufficient to prevent the defoliation of a large tree every four days, and young trees in proportion, with no expense whatever to the farmer for labor or insecticides.

Value of Winter Residence.

But this fails to take into account the large number of eggs eaten in the winter, from which the larvae, when hatched, might be impossible to destroy- as shown by the observations of Prof. Forbush cited above. Again, the destruction of adult insects and larvae during the winter is far more valuable than later, because they are mostly the ones which lay the eggs in the spring and thus keep up the life cycle. There are but few other birds present here in winter to perform this work and these two birds also secure their food from places where no other birds present

at that time of year would search for it. In this they form a well balanced couple, the Nuthatch securing his food from the rough bark of the main trunk while the chickadee pecks away at the small buds and joints, loose bark, etc. of the smaller, smooth limbs. In addition, it can be said in favor of both these birds that they are inclined to remain in one vicinity and do not wander far from it, but steadily and thoroughly work over one feeding ground.

Possibility and Desirableness of Partial Domestication.

Both these birds are very easily approached, and will readily be lured to orchards or shade trees, - they are quite common upon the shade trees of Lansing and as stated before are very tame on the campus.

It is then, self-evident that by every means they should be encouraged, by placing food for them till they become at home, by erecting suitable nesting sites, and by careful protection, to feed and nest in the orchards. It might be interesting to try the experiment of destroying as many old woodpecker holes as possible and by placing suitable nesting sites in the orchard to thus entice them. Yet in general, the old holes in which they nest should not be all cut out when securing fire wood, but a sufficient number be allowed to remain. If the farmer will take a very little time now and then in thus attracting these feathered insect-destroyers to his orchard, he will soon find very little if any need for insecticides except for extraordinary attacks. "An ounce of prevention is worth a pound of cure", is truly more applicable to the destruction of insect life than to almost any other phenomena.

I append a bibliography of the literature pertaining to the food and habits of the Chickadees, much of which supplements and confirms the above conclusions and recommendations.

TABLE II.

Analysis of contents of Stomachs of Black-capped Chickadees.

| <u>Number.</u> | <u>2</u> | <u>3</u> | <u>4</u> | <u>5</u> | <u>6</u> | <u>12</u> | <u>13</u> | <u>15</u> | <u>16</u> | <u>17</u> |
|----------------------|---|-----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <u>Date.</u> | Jan. 19. --/---Jan. 20.---/-----Feb. 21.----- | | | | | | | | | |
| epidoptera % | 60 | 5 | Tr. | | | | 15 | | 7 | |
| " Adults. | | | | | | | | | | |
| " Larvae. | 45 | 1 | | | | | 1 | | 1 | |
| emiptera % | | | | | | 25 | 30 | 10 | 20 | 12 |
| " Adults. | | | | 3 | | | 1 | 35 | | |
| " Eggs. | | | 3 | 57 | | 50 | 10 | | 77 | 40 |
| oleoptera % | 15 | 62 | | | 40 | 40 | 20 | 25 | 23 | 13 |
| " Adults. | 1 | 10 | 2 | | 4 | 1 | 2 | 2 | 1 | 1 |
| " Larvae. | | 6 | | | | 1 | 2 | | | |
| Orthoptera. | | | | | | 2 E | | | | |
| Diptera. | | 10%
1L | | | 20%
5L | | | | | 1
1L |
| Total Adults. | 1 | 10 | 2 | 3 | 4 | 1 | 3 | 37 | 0 | 1 |
| " Larvae. | 45 | 8 | 0 | 1 | 5 | 1 | 3 | 0 | 2 | 1 |
| " Eggs. | | | 3 | 60 | | 52 | 10 | | 77 | 40 |
| " Insect Forms. | 46 | 18 | 5 | 61 | 9 | 54 | 16 | 37 | 74 | 42 |
| Spiders % | 25 | 8 | | | 35 | 35 | 10 | | 10 | |
| " Number. | 15 | 2 | 1 | 1 | 3 | | 1 | | 1 | |
| % Animal Matter. | 100 | 85 | 100 | 100 | 95 | 100 | 75 | 35 | 70 | 25 |
| % Vegetable " | | 15 | | | 5 | | 25 | 65 | 30 | 75 |
| Total Contents. C.C. | .03 | .3 | .4 | .23 | .4 | .3 | .4 | .5 | .62 | .54 |

18. 27. 28. 36. 37. 38. 39. 40. 42. Total. (19.)

Feb.21/Feb.16/ -----Feb. 24.-----/Feb.25.

| | | | | | | | | | |
|----|-----------|-----|-----|-----|----|-----|----|-----|----------|
| | 15 | 15 | | | | | 25 | | (3) |
| | | 4 P | | | | | 2P | | 6 P. |
| | 26E
10 | 5 | | | 1 | | 2 | | 66 26 E. |
| 10 | 29 | 25 | 35 | 85 | | 5 | | | (15) |
| 31 | 16 | | | 2 | 2 | 2 | | 1 | 108 |
| 2 | 80 | 45 | 26 | 25 | | 52 | | 9 | 461 |
| 5 | 55 | 70 | | | | 49 | 35 | | (16) |
| 1 | | | | | | 2P | 1 | 3 | 29 2P. |
| | 50 | 55 | | | 1 | | 1 | 2 | 118 |
| | | | | | | | | | (1) 2 |
| | | | | | | | | | (3) 8 |
| 36 | 16 | 4P | | 2 | 2 | 2 | 3 | 4 | 125 8P. |
| | 60 | 60 | | | 2 | 2P | 3 | 2 | 193 |
| 2 | 106 | 45 | 26 | 25 | | 52 | | 9 | 504 |
| 38 | 182 | 94 | 26 | 27 | 4 | 56 | 6 | 15 | 830 |
| | | | | | | | | | (3) 24 |
| 15 | 99 | 100 | 35 | 85 | 10 | 99 | 60 | 100 | 70.7 |
| 85 | Tr. | | 65 | 15 | 90 | 1 | 40 | | 29.3 |
| .7 | .7 | .62 | .23 | .23 | .4 | .54 | .4 | .7 | .48 |

TABLE II Continued.

| <u>Number.</u> | <u>53.</u> | <u>54.</u> | <u>55.</u> | <u>58.</u> | <u>59.</u> | <u>60.</u> | <u>61.</u> | <u>62.</u> | <u>63.</u> | <u>Total.</u>
(6) |
|----------------------|---------------------|------------|------------|------------|------------|------------|------------|------------|------------|----------------------|
| <u>Date.</u> | -----April 17.----- | | | | | | | | | |
| Lepidoptera -Adults. | | 1 | 1 | 1 | | | Tr. | 1 | 2 | (3)6 |
| " Larvae. | | | | 1 | | | | | | 1 |
| Hemiptera. | | | | | | | 5E | | | (1)5 |
| Coleoptera-Adults. | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 5 | 4 | (9)13 |
| Total Adults. | 1 | 2 | 3 | 2 | 1 | 2 | 1 | 6 | 6 | 24 |
| " Larvae. | | | | 1 | | | | | | 1 |
| " Eggs. | | | | | | | 5 | | | 5 |
| " Insect Forms. | 1 | 2 | 3 | 3 | 1 | 2 | 6 | 6 | 6 | 30 |
| Spiders. | | | | | | 1 | | | | (1)1 |
| % Animal Matter. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Total Contents. C.C. | .4 | .7 | .62 | .46 | .07 | .23 | .4 | 1.16 | .62 | .53 |

- List of Insects Found in 28 Stomachs of the Black-carred Chickadee.-

Lepidoptera.

Pieridae- *Pieris brassicae* L. 1 in #11.

Ennomidae- *Ennomos magnaria*, 27 eggs in #27 and #30.

Noctuidae- 1 *Catocala* (?) egg in #27.

62 larvae in #3, #12, #27, #30, and #33.

Total Lepidoptera:- Adults-6, Pupae-3, Larvae-67, Eggs-28; in
9 stomachs.

Diptera.

Adults- 1, Larvae- 7, in 4 stomachs.

Coleoptera.

Carabidae. 3 adults in #6, #15, #40, and #42.

Scarabidae. 3 " " #58 and #60.

Cerambycidae. 2 pupae in #39.

Borer larvae. 105 in #27 and #28.

Total Coleoptera:- Adults-43, Pupae-2, Larvae- 118, in 16 stomachs.

Orthoptera.

2 eggs in #12.

Hemiptera.

Tingitidae, *Piesma cineria*- 3 adults in #27 and #42.

Reduviidae. 450 eggs of two species in 12 stomachs.

Pentatomidae. *Stiretrus anchorago*, 7 eggs in #5.

Aphidae. *Aphis mali*- 15 eggs in #28.

Coccidae,- *Mytilaspis pomorum* scales, 77, in #15, #13, #27, and #39.

Total Hemiptera:- Adults-93, Eggs-436; in 15 stomachs.

(Arachnida-25.

Total Insect Forms:-Adults-149, Pupae-3, Larvae-194, Eggs-464 - 245 A

- Bibliography Concerning the Food of the Black-capped Chickadee. -

Baird, Brewer, and Ridgway. Vol.1, Pg. 98.

"Though nearly omnivorous in food they prefer insects to everything else."

Davie, Oliver. Nests and Eggs of North American Birds.

"The nest is constructed in deserted woodpecker holes, natural cavities in trees, decayed stumps, hollow fence-posts, etc. These places are filled with a mass of leaves, moss, dry grasses, and warmly lined with downy feathers, hair from cattle, and often the fur of smaller quadrupeds."

De Kay. Nuts, numerous insects, and larvae.

Forbes, S.A. Bulletin #3 Ill. State Lab. of Natural History, May 1883,

Pg.8.- "Unfortunately, was not at all common in the orchard (one badly infected with canker worm); and only two specimens were taken, one in each year. 61% of their food consisted of canker-worms, eaten by both birds, and Coleoptera made the entire remainder. These were nearly all Cerambycidae (*Psenocerus supernotatus*) and Rhynchophora of undetermined species, 35% of the former and 10% of the latter.

Bulletin #4 Vol.1 Ill. State Lab. of Natural History- contains a more extended discussion, but was unobtainable.

Forbush, E.H. Mass. Crop Report, July 1895, Series 1895, Bulletin #3,

Birds as Protectors of Orchards- as noticed in Auk, Pg.333, 1895.

"Paper relates largely to the destruction of eggs of the canker-worm moth by winter birds, notably the Chickadee, which also feeds

in the fall on the wingless females of the same destructive insect. An account is given of an attempt to protect an old and neglected orchard from insect ravages by getting winter birds to make it their haunt by suspending in it pieces of meat, etc. The experiment shows not only that birds can thus be attracted in large numbers to a particular area, but that they prove wonderfully destructive to insect pests affecting fruit trees."

Same article in Museum, July, 1895, Pg.26.

"Mr. Bailey placed twenty-two female canker-worms on one tree, and in a few minutes twenty of them were captured and eaten by Chickadees." ---- It was noticed as spring approached and insects became more numerous that the Chickadees came very seldom to the meat.--- Toward the last of April the English Sparrow began to appear and apparently drove the Chickadees to the woods, as they disappeared and did not nest in the orchard, but remained in the woods, where they pair^d and nested.--- Believes that the English Sparrow is largely responsible that Chickadees are not found nesting nor as abundant in orchards as formerly- especially near cities. Noticed that while trees in neighboring orchards were seriously infested with canker-worms and tent-caterpillars, those in the orchard which had been frequented by the Chickadees during the winter and spring were not seriously infested and that comparatively few were to be found there. The trees to which the Chickadees had been lured during the winter had been so well protected that the summer birds were able to destroy the few remaining larvae, while the trees at a distance from these contained so many larvae that the birds were not

numerous enough to dispose of them or make any effective reduction in their numbers. The Chickadees living in their retirement in the woods came out to the orchards, flying some distance to procure canker-worms with which to feed their young. May 18, Mr. Pailey saw a female Chickadee carry 20 larvae to its nest, all but two being canker-worms, and these tent caterpillars. "No other orchard in the neighborhood will produce any fruit this year- except one, saved by tarred-paper bands-and the destruction of tent-caterpillar nests."

Keeler, Chas.A. Berkley, Cal. Ornithologist and Cologist, Vol.13, Pg.12.

King, F.H. Economic Relations of Wisconsin Birds. Wisconsin Geological Survey, Vol.I, 1873-79, Pg.441.

"Of twelve specimens examined, seven had eaten fourteen larvae, ten of which were caterpillars; seven, thirteen beetles; two, spiders; one, three heteropterous insects related to the genus Tingis; and one, five eggs of some insect. One of the twelve had in its stomach a few seeds." With valuable notes upon its habits, etc. The table shows 42 adult forms eaten by 12 birds, 14 larvae by 7, and 5 eggs in one. Two beneficial forms were eaten by two individuals, while 17 noxious ones were consumed by eight. 37 insects in 10 stomachs were of unknown value.

Maynard, C.J.

"Insects,- larvae and eggs- berries, fruit, acorns, pine, and sunflower seeds, and poke berries. Also canker-worms."

Warren's Birds of Pennsylvania.

"Insect life and seeds of various weeds, grasses, and plants.

Crumbs of bread, pieces of meat, fragments of apples, pears, and other fruits."

Wilson, Alexander. American Ornithology, Vol.I, Pg.133.

"They traverse the woods in regular progression, from tree to tree, tumbling, chattering, and hanging from the extremities of the branches, examining about the roots of leaves, buds, and crevices of the bark for insects and their larvae. They also frequently visit the orchards, particularly in fall, the sides of the barn, and barnyard, in the same pursuit, trees in such situations being generally much infected with insects."

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