

BIRDS THAT EAT SCALE INSECTS.

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INTRODUCTION.

The importance of birds to the farmer in his warfare against insects is everywhere recognized; indeed, it may be said that successful agriculture would be well-nigh impossible without their aid. One important rôle, however, is filled by birds, in which the value of their services has not been appreciated, chiefly, no doubt, because the facts are not generally known. This is as destroyers of scale insects. Very little has been published on the subject, although at least six foreign species and about the same number of native ones have been reported as feeding upon scales. These facts have been either overlooked or little weight has been attached to them. Indeed, only recently currency has been given to a statement that birds never feed upon scales. Not only is this statement not true, but investigations by the Biological Survey prove conclusively that scales are eaten by many species of birds and that with some species they are a favorite food.

DAMAGE TO TREES AND CROPS BY SCALE INSECTS.

Before attempting to estimate the value of the services of birds in reducing the number of scale insects, it will be well to review briefly the nature and extent of the damage inflicted by these pests. Many authorities class the scales among the most destructive of insects. They have caused the loss of hundreds of valuable orchards and are dreaded by the horticulturist above all other insects, being especially feared because of the insidiousness of their attack. When present in small numbers they are easily overlooked and thus may become firmly established in an orchard before their presence is detected.

When young and still more or less active, scale insects are carried from tree to tree by numerous agencies, and hence spread with great rapidity. When adult they firmly attach themselves to the plant, upon the sap of which they feed, and their combined attacks gradually reduce its vitality till finally death ensues. Many varieties of plants are infested by them, and often large trees are completely incrustated by a mass of scales composed of hundreds of thousands of individuals. Even perfectly healthy trees do not survive the attacks of these minute pests more than two or three years.

In such extreme cases all methods of relief generally fail, and when once the vigor of a tree is seriously impaired by scales there is no remedy. The old growth must be cut down and burned and new stock introduced. In most instances of scale attack, however, the problem is less serious, and various suppressive measures are effectual. It is during the lighter infestations that the controlling power of natural enemies of the scale is most apparent.

NATURAL ENEMIES OF SCALE INSECTS.

In extreme cases of infestation by scales their natural enemies are rarely able to control them, at least until the insects have done much damage. The greatest value, therefore, of the natural enemies of scales is in preventing undue increase of the insects, in restraining them within what may be termed natural bounds, when the harm they do is comparatively of little moment.

As an example of a species usually harmless but occasionally increasing beyond the limit of safety, the plum scale (*Eulecanium cerasifex*) may be cited. Of this species Luggler, in a report on Minnesota insects, says: "This is usually an uncommon species, but is now found in destructive numbers, not alone upon the cherry, but also more frequently upon the plum; though apples, pears, and other trees do not escape."^a

The plum scale is injurious also in New York, but in many parts of its range it is not numerous enough to be a pest, which indicates that in these localities its enemies have been able to hold it in check and thus maintain the balance. This is the ideal state. Under primitive conditions a balance among organisms, both animal and vegetable, was more frequent and more stable than it now is, when man's interference with the operation of natural laws, destroying some species and protecting and propagating others, constantly disturbs the equilibrium.

Owing to various changes, among the most important of which has been the importation of unlimited numbers of foreign scales, which, for a time at least, have enjoyed almost entire immunity from natural enemies, the balance between scale insects and their enemies has been most seriously affected, and the scales have increased enormously. Hence in attempting to reduce the numbers of scale insects every effort should be made to foster their natural enemies.

For the purpose of considering their economic value, the latter may be divided into two groups—the parasitic and the predaceous enemies. So effectively do the parasites (in great part minute Hymenoptera) wage war against scales that they sometimes destroy not less than 85 per cent of the pests, together with their eggs. Nevertheless, as has been stated by Dr. L. O. Howard, "it is perfectly obvious that these

^a Bul. 69, Agr. Exp. Sta. Univ. of Minn., p. 217, 1900.

parasites will not accomplish complete extermination." However, they do not have to fight the battle alone, for as allies they have the group of predaceous enemies which comprises beetles, syrphus and lace-wing flies, and true bugs among insects, and also mites, birds, and mammals. Among these, beetles are undoubtedly the most important. Coccinellid beetles, or ladybirds, of many species feed upon the scale insects, and in their ranks are the most successful destroyers of scales known. One of them almost completely exterminated the cottony cushion scale, formerly the most destructive insect of its kind in California.

Mammals may be dismissed in this connection with the statement that so far as known they count for but little in the warfare against scales; one instance is known of mice devouring the *Lecanium* scales from a peach tree in England.

As was noted in the introduction, comparatively little has found its way into print as to the part birds play as destroyers of scale insects. Among the most interesting published observations on this point are those of R. Newstead, Chester, England.^a He mentions four scale insects which were preyed upon by five species of birds, and it is to be noted that two of the scales and two of the birds are identical with species occurring in the United States. The house sparrow was found apparently feeding upon the hawthorn scale (*Eulecanium genevense*), which occurs only in Europe. Another scale insect, nevertheless, and an injurious one, the oyster-shell bark-louse (*Mytilaspis pomorum*), which was eaten by the birds Mr. Newstead studied, is a common pest in the United States. It was fed upon by the tree-creeper, a near relative of our own brown creeper. The English author says:

Many times I have seen, with the aid of field glasses, the tree creeper (*Certhia familiaris*) collecting this species during winter and spring; and from what I have seen of the marsh tit (*Parus palustris*) and the blue tit (*P. cæruleus*), they, too, are fond of the species.

He found a few of these scales likewise in the stomach of the long-tailed tit (*Acredula caudata*). The latter bird, together with the blue tit, fed also upon another scale insect which occurs in the United States. This is a golden-colored scale (*Asterolecanium variolosum*), which is sometimes injurious to shade trees. Newstead says:

I firmly believe this species is eagerly sought for by various species of tits. Here, in Cheshire, the characteristic little depressions made in the twigs of the oak by this species are to be found in thousands. Rarely is it that the Coccids are found in them. This fact for many years led me to suspect the birds had taken them. It was not until 1894 that the matter was placed beyond doubt [by stomach examination]. The May record is of the greatest interest, as at that time there would be a good selection of bird food. It proves, therefore, that the species is a selected item in the dietary of the two species of birds.

^a The Entomologist's Monthly Magazine, 2d ser., VI [XXXI], pp. 84-86, 1895.

It is significant that the fourth species of scale insect (*Aspidiotus zonatus*) found by him in the stomachs of birds is related to the notorious San Jose scale. It was eaten by the blue tit (*Parus cæruleus*). Among other foreign birds known to feed upon scales is a South African species, the white-eye (*Zosterops capensis*), which selects the larger soft scales (Lecaniinæ).

Recent investigations show that a very much larger number of our North American birds prey upon scales than was expected, and some eat them to a considerable extent. Their influence upon the number of these pests, while doubtless less than that of the predaceous insects, is of far more importance than has yet been recognized. Among the scales they devour are some most notorious pests.

SCALES EATEN BY NORTH AMERICAN BIRDS.

At least two native birds eat the plum scale, which is destructive to cherry and plum trees. One of them is the beautiful rose-breasted grosbeak (*Zamelodia ludoviciana*). A female of this species collected by the writer in Indiana had eaten 36 of these scales, composing 95 per cent of the stomach contents. Two other grosbeaks from Illinois did still better. One consumed about 45 plum scales, which made up 95 per cent of its food, while the other had eaten nothing but plum scales, of which its stomach contained more than 100. The cardinal or redbird also feeds upon the plum scale, one taken in Texas in April having consumed a number sufficient to form 84 per cent of its stomach contents.

These two species of birds devour other scale insects also, some of which are closely related to the plum scale. The rose-breasted grosbeak has been found to eat the hickory scale (*Eulecanium caryæ*) and the tulip scale (*Eulecanium tulipiferæ*). The latter is very destructive to shade trees in some parts of the eastern United States. While both the rose-breasted and the cardinal grosbeak eat scales of the genus *Eulecanium* in large numbers, we have been unable to identify specifically any others, with the probable exception of the locust scale, *Eulecanium robinarium* (Douglas), from the stomach of a cardinal collected in Texas. Another grosbeak, the black-headed (*Zamelodia melanocephala*), at home in the western United States, preys upon scales of the same genus. It is known to select the frosted scale (*Eulecanium prunosum*), which attacks fruit trees such as apricot, peach, prune, and cherry, and is already important economically, with possibilities of becoming a serious pest if unchecked. It relishes also the apricot scale (*Eulecanium armeniicum*), which is an enemy of apricot, prune, pear, and other trees.

In the southeastern United States occurs an allied genus of scale insects, *Toumeyella*. The cardinal feeds upon at least one species of this group.

Distributed chiefly along the Pacific coast is a scale which is closely related to those of the above-mentioned genera and is preyed upon by many birds. This is the black olive scale (*Saissetia oleæ*, fig. 1). Its great economic importance is emphasized in the following quotation from Mr. C. L. Marlatt, of the Bureau of Entomology:

The most destructive insect enemies of fruits in California are undoubtedly the scale insects, few if any other insects, aside from the grape Phylloxera, at all approaching them in this respect. Of these the ones of greatest moment, and in the control of which vast sums of money are expended, are the black scale, the red scale, and the San Jose scale. * * * Of the three, * * * the most serious pest at the present time in California is undoubtedly the black scale. * * * This insect is not only a

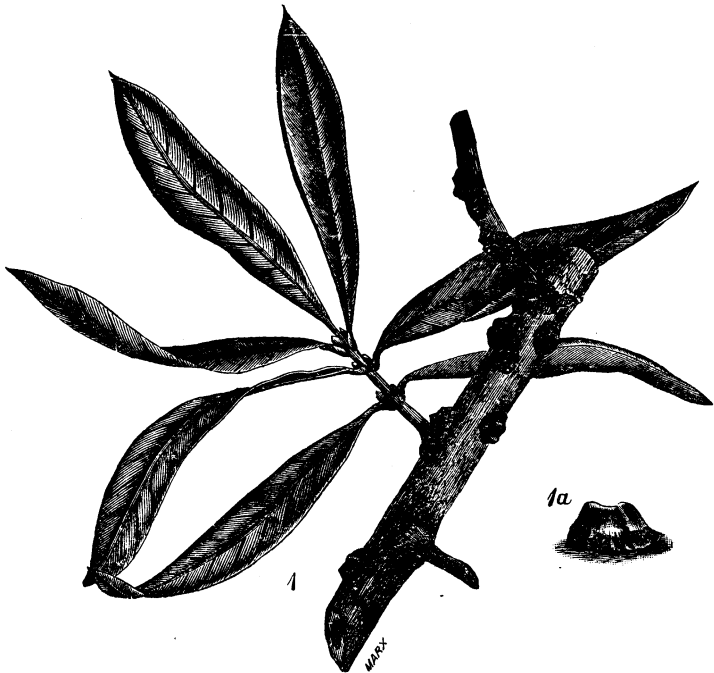


FIG. 1.—Black olive scale (*Saissetia oleæ*). (From Koebele, Bureau of Entomology, after Comstock.)

heavy drain on the vigor of the trees, but exudes a great quantity of honeydew, in which a fungus propagates, creating a black, stifling deposit, which adheres closely to the twigs and leaves and discolors the fruit. This scale infests both citrus and deciduous trees, but is particularly injurious to the former, and also to the olive.^a

This abundant and injurious scale is at present known to be fed upon by no less than 29 species of birds, and their importance in checking its increase can not be overlooked. These include three woodpeckers, a jay, an oriole, five sparrows, four vireos, six warblers,

^a Yearbook U. S. Dept. of Agriculture, 1896, p. 220.

two wrens, a nuthatch, four tits, a gnatcatcher, and a bluebird. Several of them consume the black scale in great numbers, the two most conspicuous in this respect being the black-headed grosbeak and the bush-tit (*Psaltriparus minimus*). Eighteen per cent of the entire food of 120 grosbeaks consisted of black olive scales, while 21 per cent of the year's subsistence of more than 350 bush-tits was of the same nature.

The work of birds upon the black scale is so conspicuous that it has attracted the attention of field observers. In a letter to the Biological Survey, F. S. Daggett says (March 17, 1903):

A thick top of pepper tree is opposite a window of my house. It is infested by black scale, and the past few years I have noticed several varieties of birds going through the top, carefully picking off scale. Audubon warblers do it, especially when it is cold and no insects are flying; when it is warm they stay about the top, flying out after insects, but do not seem to take the scale. The intermediate sparrow, however, is commonly seen in small flocks working on this scale, and they go through many gymnastic motions, not expected in a sparrow, in order to get at the scale on the underside of the twigs. The top is scarcely 10 feet from the window and I have watched them closely. There is an overgrown cypress hedge under one side of the tree, from which the sparrows work up.

Prof. F. E. L. Beal, of the Biological Survey, while at Haywards, Cal., May, 1906, noted particularly the relation of birds to this scale. He writes: "I have proved that they eat them freely."

Following is a list of the birds which thus far are known to feed upon the black olive scale:

Willow woodpecker (<i>Dryobates turati</i>).	Lutescent warbler (<i>Helminthophila c. lutescens</i>).
Nuttall woodpecker (<i>Dryobates nuttalli</i>).	Audubon warbler (<i>Dendroica auduboni</i>).
California woodpecker (<i>Melanerpes f. bairdi</i>).	Pacific yellowthroat (<i>Geothlypis t. arizela</i>).
California jay (<i>Aphelocoma californica</i>).	Golden pileolated warbler (<i>Wilsonia p. pileolata</i>).
Bullock oriole (<i>Icterus bullocki</i>).	Black-headed grosbeak (<i>Zamelodia melanocephala</i>).
Intermediate sparrow (<i>Zonotrichia l. gambeli</i>).	Cactus wren (<i>Heleodytes brunneicapillus</i>).
Western chipping sparrow (<i>Spizella s. arizonæ</i>).	Vigors wren (<i>Thryomanes b. spilurus</i>).
Spurred towhee (<i>Pipilo m. megalonyx</i>).	Slender-billed nuthatch (<i>Sitta c. aculeata</i>).
California towhee (<i>Pipilo crissalis</i>).	Plain titmouse (<i>Bæolophus inornatus</i>).
Western warbling vireo (<i>Vireo g. swainsoni</i>).	Chestnut-backed chickadee (<i>Parus rufescens</i>).
Cassin vireo (<i>Vireo s. cassini</i>).	Wren tit (<i>Chamæa fasciata</i>).
Hutton vireo (<i>Vireo huttoni</i>).	California bush-tit (<i>Psaltriparus m. californicus</i>).
Least vireo (<i>Vireo pusillus</i>).	Black-tailed gnatcatcher (<i>Poliophtila californica</i>).
Yellow warbler (<i>Dendroica æstiva</i>).	Western bluebird (<i>Sialia m. occidentalis</i>).
Myrtle warbler (<i>Dendroica coronata</i>).	

Several of the above birds eat other scales, besides the one which infests the olive. One of these is the greedy scale (*Aspidiotus rapax*, fig. 2), which Dr. L. O. Howard says "was found until recently only on the Pacific coast and in the far Southwest," where "it levies a heavy

annual tax on the fruit growers," and which "has the present season [1894] made its appearance in Mississippi and Texas."^a The greedy scale attacks both citrus and deciduous trees, infesting a very large number of food plants, among which it shows little preference, and is one of the destructive scale insects. Investigations by the Biological Survey prove that at least four species of birds—the myrtle and Audubon warblers, wren-tit, and bush-tit—devour this scale, some individuals examined having their stomachs filled with it.

Another scale insect which is eaten by several birds, but which differs from the last-mentioned species in that it confines itself to a single host plant, is the oak scale (Kermes). Oak scales are not conspicuously injurious, but this fact does not detract from the value of the birds which feed upon them, since we can be assured

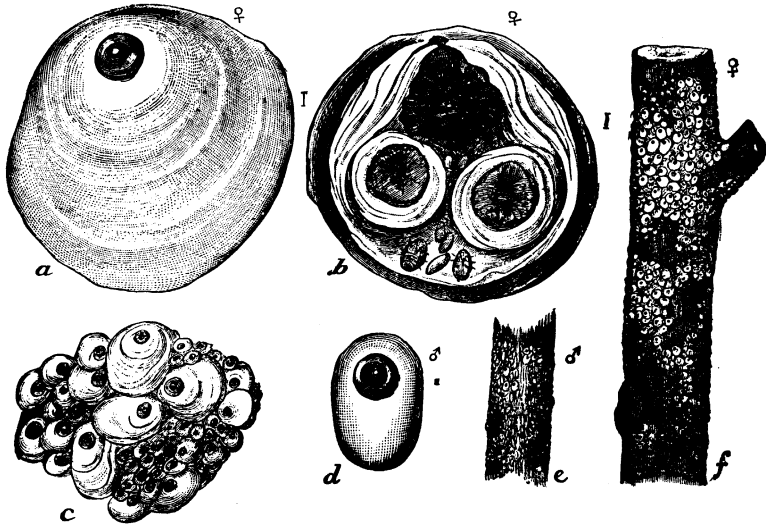


FIG. 2.—Greedy scale (*Aspidiotus rapax*). (From Howard, Bureau of Entomology.)

they do not neglect other kinds which are destructive. In fact, one of the oak-scale feeders, the rose-breasted grosbeak, is already known to feed upon other and harmful scales.

The following species of birds have been found to devour the oak scale:

Rose-breasted grosbeak.
Red-eyed vireo.
White-eyed vireo.
Worm-eating warbler.

Magnolia warbler.
Blackpoll warbler.
Canadian warbler.

The oaks, infested as they are by the comparatively innocuous Kermes, are fortunate in comparison to the maples, which are attacked by *Pulvinaria*. The cottony maple scale (*Pulvinaria innumerabilis*) is a special pest of the tree from which it derives its common name, but

^a Yearbook U. S. Dept. of Agriculture, 1894, p. 249.

it is found upon scores of others. The writer once observed an infestation of this scale so severe that shade trees along the streets of a small town in Indiana, together with fruit trees, appeared almost white from the choking masses of cottony wax produced by the scale insects. Maples, poplars, and cherry trees were the principal hosts in this case. According to Dr. L. O. Howard, "birds destroy the full-grown scales, although one would hardly suppose a mouthful of wax to be very palatable." Doctor Howard "has often observed the English sparrow apparently feeding upon this species."^a

The same little vagrant foreigner that attacks the maple scale, and about whose value there has been unending discussion, must be cred-

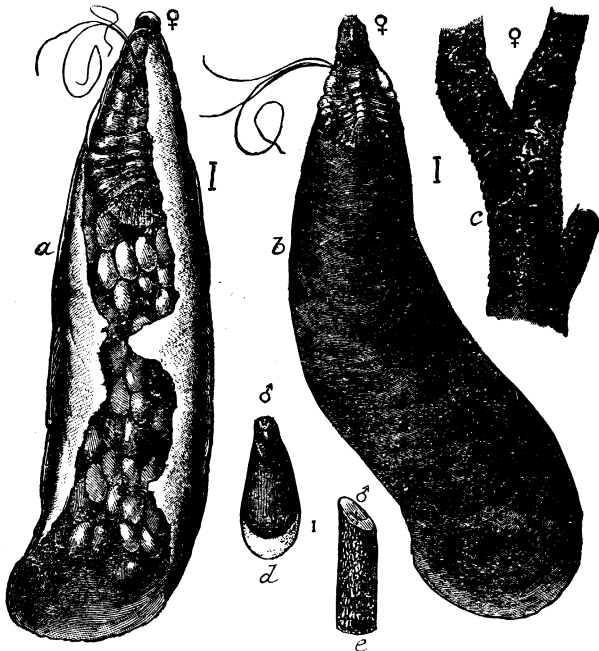


FIG. 3.—Oyster-shell bark-louse (*Mytilaspis pomorum*). (From Howard, Bureau of Entomology.)

ited with preying upon still another of these destructive pests. Dr. C. V. Riley and Dr. L. O. Howard note that "Miss Jennie R. Bush, of San Luis Obispo County, Cal., finds it destroying a scale insect upon the climbing rose."^b

Among scale insects eaten by birds other than those above mentioned is a very abundant and widespread species, the oyster-shell bark-louse (*Mytilaspis pomorum*, fig. 3), which is sometimes quite injurious. Indeed it is said that in some sections the oyster-shell bark-louse is, with the exception of the San Jose scale, the most

^aBul. 22, U. S. Dept. of Agriculture, Division of Entomology, p. 12, 1900.

^bInsect Life, V, p. 349, July, 1893.

destructive scale insect. It will be remembered that in England this scale was found to be devoured by titmice and the tree creeper. In America the same kinds of birds also select it. In regard to the brown creeper of the United States (*Certhia familiaris americana*), V. H. Lowe says:

That it feeds extensively on scale insects there is little doubt. It may often be seen on scale-infested trees both in summer and winter pecking at the scales, especially the larger ones, such as the oyster-shell bark-louse, evidently for the purpose of getting the eggs or the live scales.^a

Of American titmice the black-capped chickadee is known to devour the same pest. In an analysis of the stomach contents of one of these birds Prof. C. M. Weed mentions "bark-lice (Coccidæ), apparently oyster-shell bark-louse (*Mytilaspis pomorum*)."^b The white-breasted nuthatch of the same family of birds also manifests a liking for the scale. Mr. E. N. Forbush records the following concerning this species:

March 20, 1895, Mr. Bailey brought in specimens of apple twigs infested with the bark-scale louse (*Mytilaspis pomorum*). He reported that the nuthatch was feeding on them.^c

With this insect ends the list of scales which have been specifically determined to serve as food for birds. It is to be remarked, however, that scales are difficult to identify^d under the most favorable conditions, and in the state in which they are often found in the stomachs of birds their identification is impossible. Hence there are a number of birds which, while not mentioned in connection with particular scale insects, are nevertheless known to feed upon scales. These birds, 16 in number, include several woodpeckers, which, as their method of feeding would indicate, pick up many scale insects. The downy woodpecker is one of the most successful in gathering these minute tree pests.

Following is a list of birds ascertained to feed upon scale insects none of which were specifically identified:

Hairy woodpecker (<i>Dryobates villosus</i>).	Blue jay (<i>Cyanocitta cristata</i>).
Northern downy woodpecker (<i>Dryobates p. medianus</i>).	Orchard oriole (<i>Icterus spurius</i>).
Red-cockaded woodpecker (<i>Dryobates borealis</i>).	Baltimore oriole (<i>Icterus galbula</i>).
Arctic three-toed woodpecker (<i>Picoides arcticus</i>).	Cedar waxwing (<i>Ampelis cedrorum</i>).
Yellow-bellied woodpecker (<i>Sphyrapicus varius</i>).	Townsend warbler (<i>Dendroica townsendi</i>).
Red-headed woodpecker (<i>Melanerpes erythrocephalus</i>).	Tufted titmouse (<i>Bæolophus bicolor</i>).
	Bridled titmouse (<i>Bæolophus wollweberi</i>).
	Carolina chickadee (<i>Parus carolinensis</i>).
	Ruby-crowned kinglet (<i>Regulus calendula</i>).
	Varied thrush (<i>Ixoreus naevius</i>).

^a Trans. N. Y. State Agr. Soc. and Bureau for Farmers' Inst. Rpts., p. 321, 1898.

^b Bul. 54, N. H. Agr. Exp. Sta., p. 93, 1898.

^c Mass. Crop Rep., p. 384, 1895.

^d Mr. James G. Sanders, of the Bureau of Entomology, has named several of the scale insects mentioned in this paper and has given assistance in other ways.

SUMMARY.

All told, 57 species of birds have been found to eat scale insects. It is interesting to note that this number comprises representatives of 12 families, differing widely not only in structure but in habits. They are distributed as follows: 9 woodpeckers, 2 jays, 3 orioles, 8 sparrows, 1 waxwing, 6 vireos, 11 warblers, 2 wrens, 1 tree creeper, 2 nuthatches and 8 tits of the titmouse family, 1 kinglet and 1 gnatcatcher of the Old World warbler family, and the varied thrush and the bluebird.

At first thought it seems strange that the larger birds should take the trouble to pick up such small insects as scales. Yet the numerous representation of woodpeckers on the list and the fact that the grosbeaks among the bulkier species are most conspicuous scale destroyers prove it unsafe to assume that a direct relation exists between the size of a bird and its insect food. At the other extreme of size among scale eaters are some veritable feathered midgets, as, for example, the ruby-crowned kinglet, the black-tailed gnatcatcher, and the bush-tit, the last of which makes more than one-fifth of its food of scales.

Among the majority of these birds, both great and small, there is noticeable one similarity of habit. They are tree frequenters. On their arboreal excursions they must constantly come across scale insects, and as the latter are no doubt nutritious and are toothsome to the avian taste, it is only natural that birds should feed upon them. A few species which do not often visit trees, but which are included among the birds known to eat scales, probably secure them very rarely.

It is worthy of note that the birds thus far found to prey upon scales are practically the only species in their respective families that have been carefully studied. Thus only a few stomachs of the black and white creeper, one of the most exclusively arboreal birds in North America, have as yet been examined; and while it can not be included in the present list, there is little doubt that, in common with many of its warbler kin, it subsists partly upon scale insects. Investigation of the rôle birds play in destroying these insects is far from complete, and, bearing in mind the number of scale-eating birds of each of the families named above, it is fair to conclude that the majority of the species of woodpeckers, vireos, arboreal warblers, nuthatches, tits, kinglets, and gnatcatchers ultimately will be found to eat scale insects. The fact that 57 kinds of birds feed upon scales, 29 of them destroying one of the two most destructive species in the United States, is most encouraging.

While in the present state of our knowledge it can not be claimed that birds are among the chief enemies of scales, yet they are proven to be one of nature's means of keeping these insects in check, and there is no doubt that their aid is important.