

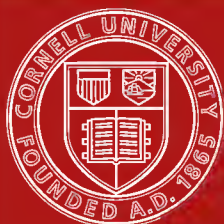
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The Commonwealth of Massachusetts.

STATE BOARD OF AGRICULTURE.

ECONOMIC BIOLOGY — BULLETIN No. 3.

THE NATURAL ENEMIES OF BIRDS.

By EDWARD HOWE FORBUSH,
State Ornithologist.



BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
32 DERNE STREET.

1916.



THE FOXES' DEN.

The fox is an enemy of all game birds and ground birds. (See page 20.) (From a photograph by James G. Parker.)

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APPROVED BY
THE STATE BOARD OF PUBLICATION.

PREFATORY NOTES.

This bulletin has been written to exhibit the utility of native natural enemies of birds and to show the misfortunes that might follow their extermination, as well as to set forth the conditions under which they may need restraint, and to point out those species that are believed to be most destructive.

The present strong sentiment for bird protection, commendable as it is, has resulted in a war of extermination against the enemies of birds that may, in time, defeat its own ends. Bounties are paid on the heads of predatory creatures by individuals, towns, counties and States. Farmers, sportsmen, gunners, game keepers, game commissioners and wardens join with bird protectionists in destroying indiscriminately all creatures that are believed to kill birds or destroy their eggs or young, and the high and increasing prices now paid for furs offer an incentive to the trapper to pursue the fur-bearing animals as never before. It is true that some of the more crafty birds and mammals, such as the fox, the Cooper's hawk and the crow, may become too numerous and too destructive to bird life under some conditions, and that certain natural enemies of birds introduced by man from foreign countries, such as the cat and the English sparrow, persecute birds excessively at times and in certain places, but the majority of the larger and more destructive native enemies of birds always are held in check by the gunner, the farmer and the trapper, through motives of self-interest, and with the constant increase in the numbers of game preserves and bird preserves there is danger that we shall overdo the destruction of so-called vermin and thereby bring about serious consequences.

Much time, thought and care have been given by the writer of this paper to a study of the relations of birds and their

enemies, and the experience of many other observers has been drawn upon in preparing this bulletin. Nevertheless, it may be noted that the statements concerning the economic value of the various creatures as set forth in these pages are supported by comparatively little evidence. Thus they lack the apparent authority that a fuller presentation of the evidence would have given them. Had the original plan been followed many more pages might have been filled with material fully confirming the conclusions arrived at, but lack of space forbade, and it was impracticable to secure the publication of the bulletin except in its present abridged form. Therefore, the statements and recommendations made and the conclusions drawn should be taken as the judgment of an observer who, having opportunity, has endeavored to inform himself fully, and who is confident that his conclusions have value as guides to all who seek to protect birds.

The names of mammals given in this bulletin have been brought down to date through the kindness of Dr. Glover M. Allen. Those of North American birds have been taken from the "American Ornithologists' Union Check-list," third edition (1910). Other zoölogical names are such as are given in the various publications quoted or cited.

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THE NATURAL ENEMIES OF BIRDS.

3

INTRODUCTION.

It is well known to naturalists that in a state of nature the natural enemies of any species are as essential to its welfare as are food, water, air and sunlight. Unthinking people are slow to realize this, as they see only the apparent harm done by the so-called rapacious creatures, and fail to observe and reason far enough to perceive the benefits that such creatures confer upon the species on which they prey.

Insect-eating, fish-eating and flesh-eating animals are essential in the great scheme of nature, as they serve to check the increase and regulate the numbers of other species, which in turn, when so regulated, tend to perform a similar office for vegetation. Thus these predatory creatures may be regarded among the chief controllers of life upon this planet. Man, the savage, of course must be included among them, and civilized man, if guided by reason and wisdom rather than greed or folly, may exercise a beneficial control over many of the lower animals. In matters relating to the control of wild life, however, he is only beginning to exhibit reasoning powers somewhat superior to those of the ape.

NATURAL ENEMIES REGULATE THE NUMBERS OF ANIMALS.

All organic beings naturally produce a superabundance of offspring and thus tend to increase in numbers. This is a provision of nature intended to prevent the extinction of the species. The rate of multiplication varies greatly in different animals, but should any form increase without check it eventually would come to be so numerous that it would devour its entire food supply and become extinct from starvation, or it would compete with other forms which feed on similar food,

until all became extinct for lack of food and from diseases that accompany crowding, starvation and weakness. Natural enemies tend to prevent this by disposing of the surplus individuals.

Darwin says, truly, that the struggle for existence is greatest between individuals or varieties of the same species. Natural enemies protect a species against itself by keeping its numbers low enough to prevent serious competition for food.⁶

NATURAL ENEMIES PRESERVE THE FITNESS OF THE ANIMALS ON WHICH THEY PREY.

Natural enemies also serve to preserve the fitness of a species by (a) acting to check the spread of disease and (b) operating to preserve by selection the most active, agile, cautious or otherwise efficient and mentally and physically fit individuals.

The spread of epidemics or contagious diseases is checked by the natural enemies of a species, which readily capture and destroy those slightly weakened by disease, as such animals are slower to act or react than those in robust health. Sick birds, for example, readily are captured, not only by enemies sly, swift or strong enough to catch healthy birds, but also by an additional number of slower enemies, which birds in full vigor would escape with ease.

On this subject Professor Spencer F. Baird of the Smithsonian Institution wrote as follows:—

It has now been conclusively shown, I think, that hawks perform an important function in maintaining in good condition the stock of game birds by capturing the weak and sickly, and thus preventing reproduction from unhealthy parents. One of the most plausible hypotheses explanatory of the occasional outbreaks of disease amongst the grouse of Scotland has been the extermination of these correctives, the disease being most virulent where the gamekeepers were most active in destroying what they considered vermin.¹

Mr. James Henry Rice says that in South Carolina the bobwhite sometimes is attacked by a deadly disease which affects the head of the bird in such a way that it becomes stupid,

¹ Letter from Prof. Spencer F. Baird to Mr. J. W. Shorton, published in the Jour. of the Cincinnati Soc. of Nat. Hist., 1882, Vol. V., pp. 69, 70.

comes out in the open and lies in the sun. There it is readily detected and killed by hawks, and thus the progress of the contagion is stayed.

A similar selection is seen in the removal and destruction by natural enemies of the dull, slow-witted, deformed or otherwise unfit individuals which, in the long run, are the first to be caught and killed, while the active, quick-witted, strong and well-formed individuals are more likely to escape. A sharp-shinned hawk dashed into a flock of juncos feeding on the ground. All escaped by flight but one, which seemed to have lost its wits or failed to make use of them, and, crouching close to the ground while its companions were already in flight, fell a victim to its swift rapacious enemy. Individual birds which vary widely from the protective coloring of the species to which they belong are more readily seen, followed and destroyed by their enemies. Thus albinos, which because of their whiteness are conspicuous, are weeded out, and the protective color of the species is kept true.

Evidently, then, the tendency to increase is serviceable in maintaining a species, provided only that there exist effective checks to this increase to regulate the species, preserve its fitness and prevent it from increasing too much in numbers. Natural enemies provide such checks.

SOME NATURAL ENEMIES REGULATE OTHERS.

In a brief treatise like the present this subject cannot be handled exhaustively, but there is another way in which natural enemies benefit the species on which they prey which cannot be overlooked here, and that is the regulation by some of them of the numbers of certain other natural enemies. For example, one must count among the foes of birds hawks, owls, crows, jays, shrikes, foxes, weasels, minks, squirrels, snakes, rats and mice, but certain large hawks destroy smaller hawks; large owls destroy smaller owls; hawks and owls kill crows, jays, shrikes, weasels, minks, squirrels, snakes and rats; weasels destroy squirrels, snakes eat other snakes, and all catch mice. If rats, ground mice and climbing mice, lacking these and other checks, were allowed to increase too much in numbers they might exterminate most birds by destroying their eggs

and young, and this might be equally true of squirrels and weasels or crows and jays.

Rats and mice, although they must be classed as enemies of birds, do not constitute a menace to bird life if themselves held in check by their own enemies, and they perform a great service to birds by maintaining their own numbers at such a point that they furnish a great surplus of individuals, and become the main food supply for hawks, owls and other enemies of birds. Therefore rats and mice, while thus serving as food to maintain the numbers of birds' enemies also attract the attention of these enemies sufficiently away from the birds, and therefore tend to keep them from becoming too destructive to bird life.

As Professor Forbes says, the whole series of forces pressing one on another is like an arrangement of springs, working one against another, keeping all in place, thus maintaining the general equilibrium and safeguarding the general welfare.

USEFUL SPECIES MAY BECOME HARMFUL IF NOT HELD IN CHECK BY NATURAL ENEMIES.

There are certain bounds set by nature to the numbers of each species within which it serves a useful purpose, but whenever through any fortuitous circumstances, such as may arise by reason of man's interference, any species overflows this high-water mark, normal habits may change and severe injury to other species, even to man himself or his property, may result.

Animals considered serviceable to mankind, such as insectivorous birds, toads, bats, shrews, etc., are useful if they are kept within certain limits. The injurious species, so called, are mainly those which tend to increase beyond normal bounds. Then, by reason of abnormal multiplication and consequent shortage of food, they become destructive. The so-called useful species may become harmful under such circumstances by changing their food habits when they outrun their usual food supply. Insectivorous birds, mammals or insects may then attack grain, fruits or other products of man's industry. No one can tell what any animal may eat in case of necessity. Carnivorous creatures then may devour grass, leaves or fruit.

Vegetable feeders may prey on other animals. No mammal is considered more carnivorous than the wolf, yet at times it feeds voraciously on berries. My son saw a mink eating the bark and foliage of fruit trees. Wallace says that the carnivorous sable feeds partially on fruits or seeds in winter.¹

It is a well-known fact that grain-eating birds have strong, muscular stomachs or gizzards lined with a hard, corrugated membrane which, with the assistance of pebbles, swallowed for the purpose, triturates or grinds up the grain or other seeds eaten, thus practically masticating them in the stomach. Nevertheless, most birds provided with such a stomach readily turn to animal food. It is well known, also, that flesh-eating birds have soft stomachs not fitted for grinding grain, but many of them will eat grain at need. Hon. John E. Thayer informs me that the hooded merganser (*Lophodytes cuculatus*), a fish-eating duck, readily learns to eat corn. In the Shetland Islands the herring gull (*Larus argentatus*) is said by Dr. Edmonstone to live on grain in summer and fish in winter.² In America our closely allied species has not been recorded as a grain eater.

A bird may vary its food habits by necessity, and such a change may even transform the lining of the stomach. Dr. Hunter fed a seagull for a year on grain and at the end of that time the appearance and structure of the stomach had so changed that it resembled the gizzard of a pigeon, and Dr. Edmonstone asserts that the herring gulls of the Shetland Islands thus produce a change in the structure of the stomach twice a year as they shift from grain to fish.

Similar transformations have been observed in the stomach of a raven and that of an owl, and Dr. Holmgrén has proved by experiment that the stomachs of pigeons, fed for a long time on meat, gradually come to resemble those of rapacious birds.³

When it is shown how all animals tend to increase in numbers, and how readily some of the most useful may change their feeding habits and become injurious under the spur of

¹ Wallace, Alfred Russell: Darwinism, 1890, p. 191.

² Semper, Karl: Animal Life as affected by the Natural Conditions of Existence, 1881, p. 61.

³ *Ibid.*, pp. 67, 68.

necessity and competition, it becomes plain that the creatures which prey on such species and so keep their numbers within normal bounds are essential to the welfare of all.

NATURAL ENEMIES SUPPLEMENT AND CHECK ONE ANOTHER.

When we examine broadly the relations of birds and their enemies we find that some species appear far more destructive to bird life than others. Certain swift hawks, for example, seem to feed almost wholly on birds whenever they can obtain them, while other slower hawks rarely take any except helpless, sick or disabled birds, but feed largely on small mammals, such as squirrels and field mice. Thus one species is seen to take an excess of birds while the other takes an excess of their enemies, the effect of the activities of one tending to balance those of the other. Again, a certain animal may be a destroyer of certain birds and a protector of others. The skunk, for example, is known occasionally to destroy the eggs and young of grouse and other birds which nest on the ground, as well as those of domestic fowls. On the other hand, the skunk is the appointed guardian and protector of young water birds, which are unsafe except in shallow waters, where there are no great fish to eat them. Therefore they frequent such shallow waters, and there their greatest enemy is the snapping turtle. Wherever these great turtles are numerous practically no young water birds can be raised, as these cold-blooded monsters hide in the mud of the bottom or swim under water, and pull down the young birds by their feet.

During four summers I watched many of these turtles depositing their eggs and burying them in the earth near the shores of a river, and in every case within twenty-four hours the skunk unearthed and ate every egg laid. Where skunks are numerous it seems impossible for any snapping turtles' eggs to hatch, but where skunks have been extirpated turtles increase rapidly in numbers and in time prevent the multiplication of wild ducks or geese.

Although the turtle is an enemy of wild fowl, it may unwittingly befriend the ground-nesting birds locally by providing the skunk with a tempting supply of turtle eggs at a time

when the eggs of the ground birds are in the nest, and thus so occupying its attention and attracting it away from birds-egging as to save many early broods of birds.

The marsh hawk (*Circus hudsonius*) feeds to some extent on marsh birds and their young, but a much larger part of its food consists of meadow mice and frogs. These mice certainly would be very destructive to young birds were they not held in check, and large frogs are known to swallow the young of water birds. Marsh hawks and other enemies prevent many frogs from reaching a size when they would be dangerous to young birds.

The larger hawks feed commonly on snakes, which are known to be destructive to birds. Even the rattlesnake is a common prey of the large red-tailed hawk (*Buteo borealis*).

NATURAL ENEMIES TEND TO KEEP THE NUMBERS OF BIRDS AT THEIR NORMAL LIMIT.

Under natural conditions, wherever man and his satellites — cats, rats, dogs, hogs, goats, etc. — have not interfered with the balance of natural forces the native natural enemies of birds do not tend, on the whole, to reduce the numbers of any species to a point much below that at which its natural food supply will maintain it. Any species having a bountiful food supply constantly tends to increase rapidly in numbers, and natural enemies and meteorological checks are necessary to keep its increase below the limit of its supply of food. If for any reason these forces were unable to do this, and a species became too numerous, starvation and disease would follow.

A school of writers has risen of late who refer to the natural enemies of birds as far more destructive than the hunter, and assert that it is useless to attempt to protect birds and increase their numbers anywhere unless natural enemies (which they denominate as vermin) be first destroyed. It even is asserted positively that if a certain tract of land be set aside, and all shooting upon it be stopped for a series of years, the game and birds will lessen rather than increase, because of the unrestrained destructiveness of their natural enemies. This contention apparently is not supported by facts.

If we go back to the times of the early settlers we find that

birds and game were remarkably numerous, far more so than now, and that not only were eagles, hawks, owls, skunks, weasels, raccoons and other foes of birds far more abundant then than now, but there were also pumas, wolves, lynxes, bears and ravens, which are now rarely or never found in southern New England. It must be accepted as a fact that the natural enemies of birds did not then tend to diminish their numbers. Going back only to the days of the civil war we find that in the southern States, when white men were practically all in the army, when negroes had no guns and when very little hunting was done, game increased to enormous numbers in spite of its natural enemies.

In 1877-78, when I was on the Indian River, Florida, game was more abundant than I have ever seen it anywhere since. Hosts of wild fowl blackened the waters. Bobwhites and wild turkeys were plentiful, and myriads of herons, egrets, shore birds and land birds were seen, some of which are now nearly extinct. But eagles were more than common, so common that a collector secured nearly 100 sets of their eggs. Seven nests of the great horned owl were found in a limited region on Merrit's Island; barred owls and hawks were numerous and breeding; raccoons, lynxes and opossums were abundant; while bears, panthers and alligators were so common that, allowing such creatures to be game exterminators, it would seem an unfavorable country for game. All these animals have been much reduced in numbers now, but the game also has decreased enormously.

We are told that in France to-day (1916), now that nearly every able-bodied man is in the army and little is done to protect the game or to destroy vermin, game has increased so since the war began in 1914 as to become a menace to agriculture.

These instances tend to disprove the contention that the natural enemies of birds, and not the hunters, are responsible for the decrease of birds and game. They give no support to the theory, so often advanced, that it is necessary to shoot into the coveys of game birds to "break them up" in order that the individuals may pair and breed. It may be that hawks and other natural enemies attend to such breaking up

of flocks as is necessary. In any case, the birds breed rapidly under natural conditions when undisturbed by man. If birds and game are below their normal numbers in any region they will increase if *protected from poachers, lawbreakers, cats and dogs*, under a law prescribing a long close season. If they do not, it is a sure indication that *adverse human influences are at work*.

Darwin said that if not one head of game were "shot during the next twenty years" in England, and if at the same time no vermin (natural enemies) were destroyed, there would in all probability be less game than "at present," although hundreds of thousands of game animals were then shot annually. But Darwin spoke of a *probability*, not of a *fact* observed. He was merely stating this probability to sustain one of his theories. Even if such a thing might have been probable in England, the conditions there, under a system of game preserving by the landowners, were absolutely different from the more natural conditions obtaining here; and if recent articles in the press can be relied on, it is a fact that since England has been recruiting by wholesale for the war, — sportsmen, keepers and poachers having gone to the front, — and since shooting has been given up, the game in England and Scotland has increased rather than diminished. But it must be borne in mind that whereas the natural enemies of a species tend to allow an increase in its numbers up to nearly the limit of its food supply, they tend to decrease them after that limit is reached, as the birds that first feel the effects of want, being weak, are first caught and killed, while the well-nourished birds survive.

If nature is undisturbed, therefore, all the birds are reared and maintained that the land will support, but when civilized man steps in and disturbs the natural arrangement and balance, then, and perhaps then only, the natural enemies of birds may become unduly destructive, and must be checked.

NATURAL ENEMIES OPPOSE MAN'S ATTEMPTS TO SECURE ABNORMAL INCREASE.

Whenever man, in poultry raising or gamekeeping, attempts to produce, by excessive feeding and artificial means, more birds to the acre than the land naturally will support, nature

brings her destructive forces to bear against the project. The natural enemies of game and poultry, finding in the crowded birds a numerous, easily accessible source of food, attack eggs, young and adults, and unless every resource is used to protect them, the poultryman, the sportsman or the gamekeeper will reap neither pleasure nor profit from his venture in propagation.

Bearing in mind that only when man steps in and in some way disturbs the biologic balance does it become necessary for him to destroy the natural enemies of birds, let us inquire under what circumstances this destruction may be proper.

WHEN MAN MUST REDUCE NATURAL ENEMIES.

Man must reduce (not exterminate) certain natural enemies of birds: (1) when he attempts to rear poultry or game birds in excessive numbers; (2) when, because of the disturbance of the biologic balance caused by extensive agricultural operations, he needs to increase the number of insectivorous birds beyond what the land naturally would support; (3) when the most sagacious natural enemies of birds, like the fox and the crow, — their own enemies having been reduced or exterminated by man himself, — take advantage of the extra protection and food afforded them in civilized communities and thus become too numerous and too destructive; (4) wherever man hunts and destroys wild game he may also reduce somewhat the numbers of the enemies of the game and thereby relieve the game of a part of the pressure brought to bear against its increase. In all such cases discrimination must be used, and it is unsafe to reduce too far the numbers of any but the most powerful predatory animals.

MAN THE ONLY EXTERMINATOR.

It is now believed that even before historic times man became the greatest natural enemy of birds and the chief exterminator of species. There is every probability that giant Pleistocene birds, such as the moas of New Zealand (the largest being able to reach a height of twelve feet) and the *Æpyornis* of Madagascar, were exterminated by primitive man.

There is no evidence, however, to sustain the belief that

primeval man ever exterminated any bird that possessed more than very limited powers of flight. Most of the species that were extirpated by the aboriginal inhabitants of all countries were great flightless land and water birds. The swift flying birds were able in a great measure to escape the destructive weapons of early man, and it has remained for civilized man to create a demand for dead birds in great quantities and to produce weapons to strike unerringly the bird in the air. Thus the nineteenth century saw the extinction of far more species of birds than any other within historic times.

Since the beginning of history, man (assisted by his satellites the cat, dog, rat, hog, etc.) has been responsible, directly or indirectly, for the extermination of most if not all of the species of birds that have disappeared from the earth; but I have referred to this at length in other papers¹ and cannot repeat my observations here.

MAN'S SATELLITES AND ASSISTANTS IN EXTERMINATION.

Man's protégés, which, by reason of his care or protection and because of introduction by him into new countries, become unduly destructive to bird life, consist first of the species that he domesticates or partially domesticates and then allows to run at large. Such are the cat, the dog and the hog, in the order of their significance. Next in importance are the creatures which he introduces intentionally or inadvertently from one country into another, and which, being free in the new country from the restraint exercised in their native land by their natural enemies, increase unduly. Such are the rat, the mongoose, the English sparrow and the starling. Finally we may consider the domesticated animals which ordinarily are confined or controlled, such as the horse, ox, sheep and goat. The hog may be included in this group in New England, as hogs are not allowed to run wild here.

¹ Special Report on the Decrease of Birds and its Causes, pp. 477-486; Useful Birds and their Protection, pp. 356-361; Game Birds, Wild Fowl and Shore Birds, Part II., pp. 399-404.

Introduced Domesticated Enemies.

CAT (*Felis libyca domestica*).

The cat, because of its numbers and intelligence, has no rival in this country as a bird destroyer, except perhaps the dog in States where there is no dog tax. Undoubtedly there are other mammals and some birds which kill more birds individually than the average cat; but the species, including strays, vagabonds and those that have run wild and bred in the woods, has become far more abundant now than any other animal of equal individual destructiveness. I have already devoted a bulletin to this subject (Economic Biology, Bulletin No. 2, Massachusetts State Board of Agriculture, 1916), and cannot spare more space to it here.

DOG (*Canis familiaris*).

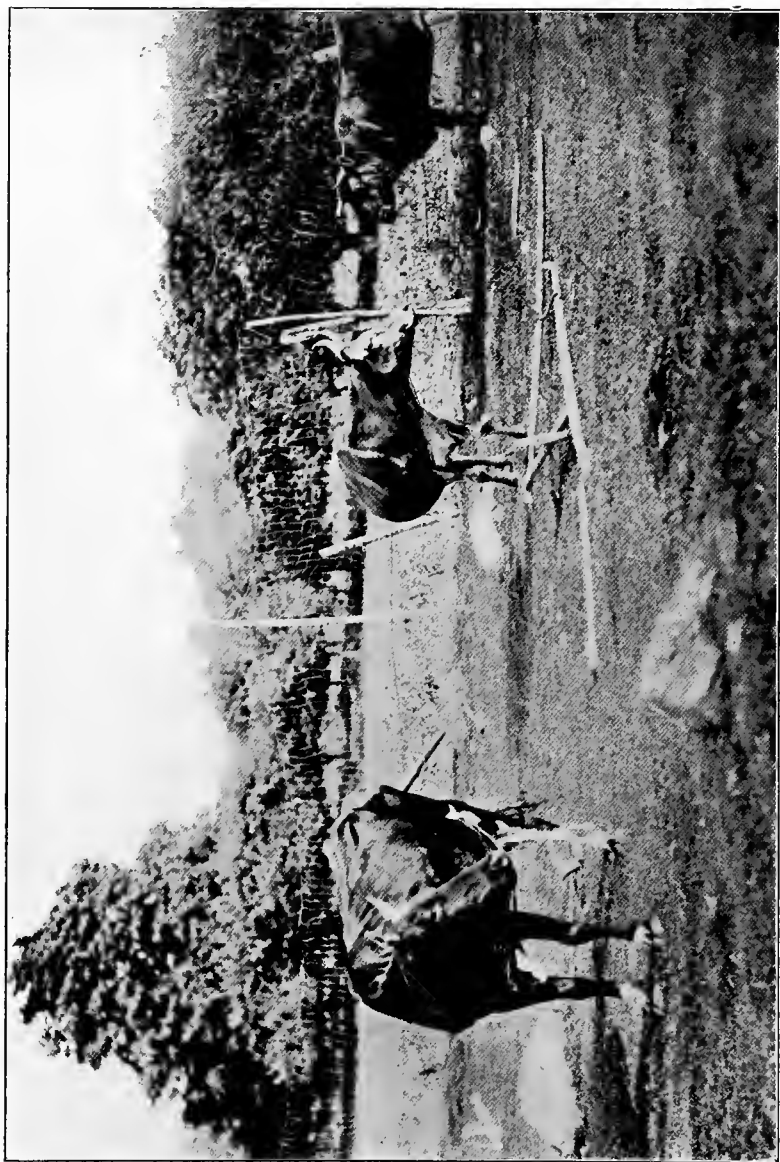
The dog is believed to be individually even more deleterious than the cat to certain birds which breed on the ground, but it is not so skillful and crafty as the cat and cannot climb. In Massachusetts dogs are not one-tenth as numerous as cats, and most of them are kept under better control, while many are confined to buildings or kept under the eyes of the owners.

Dogs are readily taught to obey their masters, while cats are not, and the dog license law has reduced tremendously the number of dogs kept as well as the number of vagrant dogs. In South Carolina, where there is no dog license law, Miss Belle Williams, secretary of the State Audubon Society, who has conducted a painstaking investigation of the decrease of birds, finds that dogs are terribly destructive to birds in nearly all parts of the State. Indigent negro families keep many dogs, which are obliged largely to pick up their own living, and therefore range the fields and woods, eating quantities of eggs and young birds. The conditions in regard to the dog there are similar to those that obtain in relation to the cat in Massachusetts. Even here dogs are so numerous that they have practically ruined the sheep industry, and driven sheep from New England pastures where once many thousands grazed. Many dogs here are allowed to roam and hunt at will. Some owners never feed their dogs meat but permit them to



ESKIMO DOG.

Any dog allowed to run at large in the nesting season is likely to destroy birds' eggs and young. Dogs not fed meat are most destructive. Eskimo dogs are a scourge to bird life. (Original photograph.)



GRAZING ANIMALS DESTROY BIRDS.

The cropping of the grass and the trampling are destructive to birds' nests in the pasture. Quail have been nearly exterminated on great cattle ranges and grouse on islands occupied by sheep. (Original photograph.)

run in the fields and woods, where they kill and eat young birds, birds' eggs, mice, squirrels and any living thing that they can find. One might as well turn out a ravenous wolf to prey on eggs and young birds as to loose such a dog in the country. In the winter some dogs are almost as expert as the fox in catching ruffed grouse in the snow. Others become skilled in picking up the young in spring, and will snap up young bobwhites almost as quickly as a toad will catch a fly. There are instances on record where dogs, given their liberty on islands occupied by breeding sea birds, have destroyed all the eggs and young. In the North the Eskimo dogs, allowed to forage for themselves, are very destructive to land birds and sea fowl.

No dog should be permitted to hunt alone during the breeding season of the birds. There is no reason why a dog should be allowed at large in the country at this time except under the care and control of the owner, who should be compelled by law and public sentiment to manage a dog just as he is compelled to keep within bounds larger domestic animals.

HOG (*Sus scrofa*).

The hog is not allowed to roam at large in Massachusetts, but when hogs are turned out in large enclosures they exterminate or drive out practically all animal life occupying the ground within the boundaries of their pasture. In some parts of the South, where hogs are allowed to run practically wild, they destroy the eggs and young of birds that nest on the ground.

GRAZING ANIMALS.

Horses, cattle, sheep and goats often trample the nests of birds or the young before they are able to fly well. The cropping of the grass, where such animals are pastured intensively, exposes the nests of ground birds to enemies, and sometimes results in the extirpation of species over wide areas. Goats when introduced on islands have been known to destroy the shrubbery, thus removing all cover and driving out the birds that hide or nest in such cover. Close pasturing by sheep has a similar tendency.

BROWN RAT (*Rattus norvegicus*).

The status of the rat is peculiar. It may be domesticated but ordinarily it is neither a wild nor domesticated animal but is domiciled as a parasite on mankind. Rats when numerous destroy eggs and attack the young of many species of birds. I have treated this subject in Bulletin No. 1 of this series.

FERAL ENEMIES.**Mammals.**

The larger native carnivorous, mammalian enemies of birds, the bear, puma and wolf, have been extirpated from Massachusetts and need not be considered. The two species of lynx, or so-called wildcats (*Lynx ruffus ruffus* and *Lynx canadensis canadensis*), are now rare and local, and where they are found they feed more on mammals, such as hares, than on birds. Of all the larger native enemies of birds, next to the wild house cat the fox is the most important because of its ability to maintain itself in considerable numbers in a thickly settled country.

RED FOX (*Vulpes fulva fulva*).

In the natural order of things the fox, no doubt, is beneficial as a regulator of the numbers of mice, insects and other small animals, but we have destroyed its natural enemies, and it is so crafty that it is able to exist, thrive and multiply unduly in settled communities where, unless held severely in check, it may become destructive to poultry, game and birds, and so detrimental to the public welfare.

If I were to consult only my own experience in tracking foxes for many miles and studying their food habits I should regard them as almost wholly beneficial, and as living mainly on mice, insects, refuse scraps and wild fruit, varying their fare with an occasional cat or a woodchuck, but many correspondents have sent me notes which go to show that foxes when numerous may become nuisances or even pests. I have published elsewhere a little of this evidence.¹

¹ Special Report on the Decrease of Birds and its Causes, fifty-second annual report, Mass. State Board of Agr., 1904, pp. 490-498.

Foxes have been seen to follow people who were photographing or observing birds' nests, and the nests were robbed after the investigators had passed. Foxes find and destroy the eggs and young of many ground-nesting birds, including those of the ruffed grouse and bobwhite. They spring after birds on the wing and catch them. Ruffed grouse, woodcock and bobwhites have been found in fox stomachs. They catch both young and old game birds in summer, even wild ducks. In winter they catch grouse, pheasants and bobwhites under the snow, or under the lower branches of coniferous trees where the birds take shelter for the night.

Long experience of many observers leads to the belief that where foxes are too plentiful game becomes scarce and when foxes are reduced in number game increases. Quantities of feathers and other remains of birds, particularly those of the ruffed grouse, have been found where fox dens have been opened. In a region in western Massachusetts where foxes were plentiful I was unable in two days to find a ruffed grouse or hear one drumming, and the only traces of the species that could be found were feathers at the entrance of two fox dens. Although it is true that foxes live chiefly on mice and insects, they destroy many species of birds, domestic fowls (including turkeys, geese and pigeons), also lambs, fawns, cats, young pigs, porcupines, hares, rabbits, woodchucks, muskrats, mice, moles, shrews, frogs and insects. Foxes often kill numbers of turkeys and chickens that are allowed to run at large in or near woods or to roost in the trees. In one such case that came under my observation a poultryman lost more than two hundred hens and chickens in a short time and gave up the business. Foxes were the only creatures seen to take them. Those who doubt the destructiveness of the fox should consult the "Diseases and Enemies of Poultry," by Drs. Pearson and Warren, published by the State of Pennsylvania. All that is said here of the red fox will apply to the Cross fox and the black fox. The northern gray fox (*Urocyon cinereoargenteus borealis*) is almost equally destructive to birds and game, but is not common in Massachusetts.

MINKS (*Mustela vison vison* and *Mustela vison lutrecephala*).

The mink may be regarded as a large, robust, water-loving weasel. It feeds largely on fish, mussels and other aquatic forms of life, on muskrats, rats, mice and other small mammals, birds, earth worms and possibly insects, but the birds that it takes are believed to be mainly rails, ducks and similar species that inhabit the marsh. Its predilection for fresh fish is such that it sometimes becomes a serious detriment to the industry of fish culture, as it is fond of trout and kills more than it can eat.

People living on streams that are frequented by minks occasionally lose large numbers of ducks or chickens. Minks have been known to kill from thirty to forty of these fowls in a single night. The high price of its fur acts as a continual bounty for the destruction of the mink, and its numbers are not very large.

WEASELS (*Mustela noveboracensis noveboracensis* and *Mustela cicognanii cicognanii*).

In all my observation and research very little conclusive evidence has been found to convict weasels of destroying wild birds. European naturalists assert that weasels kill birds and suck eggs, but give little proof of it, and American writers have passed their statements along. Field observers seem to have seen very little destruction of birds by weasels. I have tracked and followed weasels for miles, and never yet have seen any evidence of the killing of a wild bird or the destruction of nests or eggs. They are, nevertheless, in proportion to their size the most rapacious of all mammals that roam the woods. Their thirst for blood seems insatiable, and, like the domestic cat, they often kill apparently for the mere joy of killing or for the pleasure of sucking blood, leaving their victims to lie where they fall. No fiercer slayers exist. Size considered, their courage and strength are greater than that of the lion or the tiger. They follow their prey by scent, and are as keen as bloodhounds on the trail. Their chief food supply in my experience consists of rats and mice, particularly white-footed mice, and many insects. With the possible exception

of some of the hawks and owls, the weasel family seems to contain the world's greatest mouse destroyers. Weasels follow mice into their holes and kill enormous numbers. Wherever they appear they slay or drive out all rats, and in these respects they appear to be the most useful of all mammals. Grain stacks and barns filled with grain are almost always infested with swarms of rats and mice, but let a weasel or two appear and the rodents quickly vanish. When mice and rats grow scarce, however, weasels often have been known to enter poultry houses and kill considerable numbers of fowls. Individuals sometimes become pests on the game farm or preserve. Weasels can enter such small holes that only mouse-proof buildings and pens are a sure protection against them. In winter they sometimes destroy many hares or rabbits, and trail or hunt down ruffed grouse or bobwhites in or under the snow. Hence they are regarded as pernicious by the sportsman and are killed at sight. I have not known them to be destructive to any squirrel except the chipmunk, which they sometimes exterminate locally, but weasels can climb well, and probably they destroy some young birds in their nests, although I have no conclusive evidence of this. Mr. Hugh Malloy of Freeland, Pennsylvania, found thirteen out of fourteen newly hatched ruffed grouse chicks which he believes were killed by a weasel. He slew the weasel and thus, he says, saved one chick.¹ Mr. A. W. Rhoads of Wilkesbarre, Pennsylvania, has known a weasel to destroy eleven out of thirteen ruffed grouse eggs about to be hatched.² Dr. J. L. Warren avers that he has twice known weasels to kill small birds,³ and tales are told of weasels springing up like a cat or a fox and catching low-flying birds or young birds in flight. In nature the weasel no doubt serves a useful purpose in keeping down the increase of rats, mice and insects, but it is not a creature to be tolerated about a poultry yard, game farm or game preserve.

¹ Pearson, Leonard, and Warren, B. H.: *Diseases and Enemies of Poultry*, 1897, p. 430.

² *Ibid.*, 1897, p. 432.

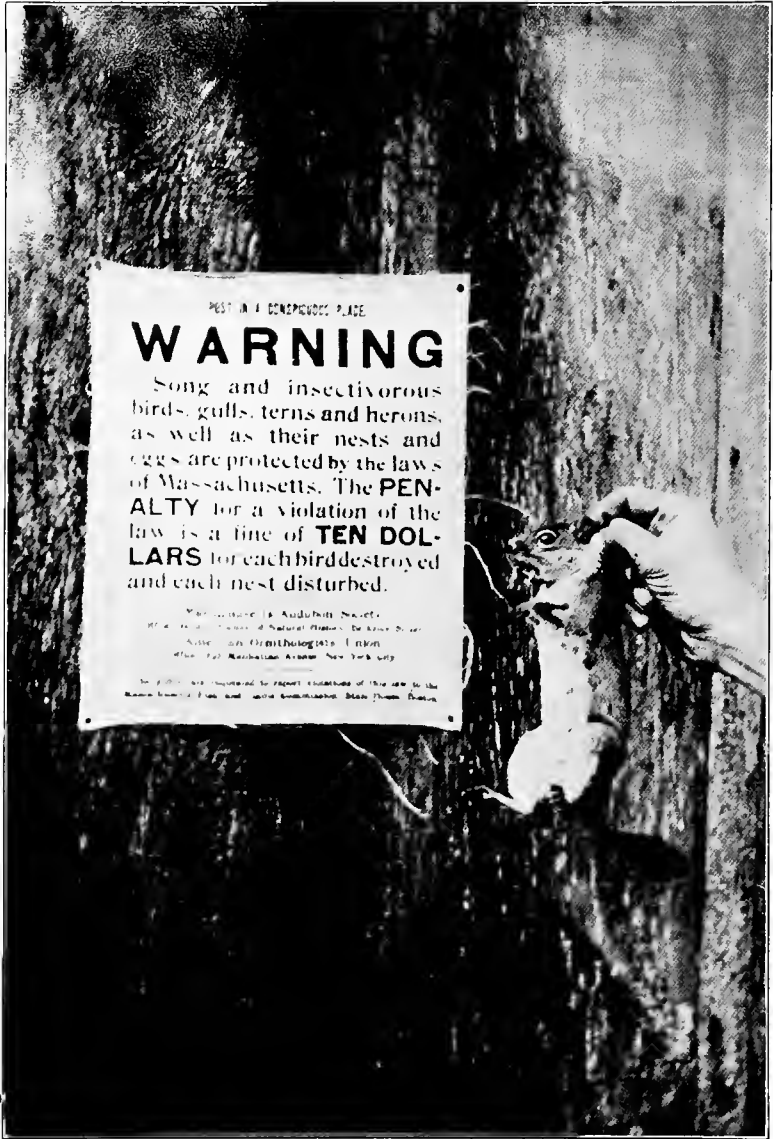
³ *Ibid.*, p. 439.

SKUNK (*Mephitis putida*).

This much detested animal is looked upon commonly as a nuisance and a pest, but every naturalist who has made a study of its food and food habits has come to regard it as useful if not indispensable to the farmer. Its animal food consists largely of rats, mice, snakes, frogs, turtles' eggs and insects; it is fond of refuse animal matter and will feed on waste meat or carrion. Occasionally it takes the eggs from under a sitting hen not properly shut in at night, and has been known to kill and eat both fowls and chicks. I fed two skunks regularly on garbage in a henhouse for weeks where forty fowls roosted two and one-half feet from the ground. The skunks killed mice and rats but never troubled the fowls. Later a pair of skunks reared their young in a yard of about one acre, fenced in by chicken wire in which were several hundred chickens. They never touched a chicken. In all my experience I have only once known a skunk to break up a nest of a wild bird. The bird was a ruffed grouse, and I saw the skunk eating the eggs while the bird hovered close by. I have been able to learn of but one other such case where the skunk was actually seen to destroy the eggs. Nevertheless, the animal is accused continually by gunners and sportsmen, and it is very destructive to turtles' eggs. Its animal food in summer, however, consists largely of noxious insects. It spends the greater part of its time in turning over stones and clods under which insects hide, in digging out the white grub of the May beetle, and in taking from the foliage such pests as the Colorado potato beetle. Any one who examines the dried droppings of the skunk will find them filled with remains of insects. It is rather remarkable that this animal, slow and clumsy as it is, has learned how to catch mice and rats. It is practically unable to capture adult wild birds, and its fur is now valued so highly that it is not likely to become too numerous.

RACCOON (*Procyon lotor lotor*).

There is some evidence to the effect that the raccoon robs birds' nests, but it is not numerous enough now in settled regions to be very destructive. Its fondness for green corn



THE RED SQUIRREL IS DESTRUCTIVE TO BIRDS.

The squirrel shown here cleaned out a flicker's nest, but has not killed any young birds since.
(Photograph by Walt F. McMahon.)

has not endeared it to the farmer, and the sportsman and angler believe that it destroys game and fish. Add to these alleged reasons for its destruction the increasing price of its skin in the market, and we can see why the "coon" is not destined long to be a great factor as an enemy of birds, except possibly on lands where all animals are protected.

SQUIRRELS.

Semper considers squirrels the greatest enemies of "our singing birds, whose eggs and young they devour in great quantities,"¹ but he probably refers to European species. Squirrels compete with birds for nesting places and food, destroying their nests, eggs and young, and are said even to catch and kill adult birds, but this must be very uncommon, as it has been very rarely observed. Apparently there are many squirrels that do not attack birds. At my place at Wareham, Massachusetts, battles between birds and squirrels are frequent, and many birds' nests in or near woods frequented by squirrels are pillaged, but at Concord, on the estate of Mr. William Brewster, I have known only one nest to be robbed by squirrels in four years, and have seen but two pairs of birds attempt to defend their nests against squirrels. There I have seen a red squirrel look into a bird's nest without any objection from the parent birds, which were close by, but at Wareham the presence of a squirrel in a tree inhabited by birds is resented by them at once. Where birds attack squirrels it is safe to say that there is a reason for it, but where birds never molest squirrels in nesting time it is probable that the squirrels are innocent of nest-robbing. Ordinarily, however, squirrels cannot be tolerated in large numbers where it is purposed to increase birds.

Red Squirrel (Sciurus hudsonicus loquax).

The red squirrel everywhere has the reputation of a bird destroyer. Many people have reported it as eating eggs and young birds. One was seen on my place in the act of eating the brains of a young catbird. Another, taken from its nest in a bluebird box when so young that its eyes were still closed,

¹ Semper, Karl: *Animal Life as affected by the Natural Conditions of Existence*, 1881, p. 59.

and then reared by hand until nearly full-grown, when released climbed an apple tree to a robin's nest, took a young bird and ate out its brains. The red squirrel appears to be as fond of meat or fish as is the cat. It eats the trappers' baits, gnaws the carcasses of animals that he has skinned, takes meat, suet and other fats put out for birds in winter, and, like all other squirrels, feeds more or less on insects in spring and summer. Many of my correspondents have reported that they have seen it robbing the nests of birds.¹ Two have noted it as catching adult birds in the air as they flew at or by it, but in all my experience in the woods I have not been able to corroborate this. There is some evidence in favor of the theory that individual squirrels which acquire the habit of robbing birds' nests are the chief culprits. I am now inclined to the belief that nest-robbing sometimes becomes a habit with certain squirrels, and that in some places the habit is communicated to many individuals and perhaps over considerable areas, while in other localities it is not common. Such practices are likely to spread as a consequence of any undue increase in the numbers of squirrels, and are in a fair way to become widespread, when such increase begins to outrun the normal food supply. This squirrel is said to destroy the eggs of the ruffed grouse, and Dr. B. H. Warren records the killing of an individual in the act of carrying off a small chicken from a coop.

Gray Squirrel (Sciurus carolinensis leucotis).

We have protected gray squirrels by destroying their greatest enemies, the red-tailed hawk and the great horned owl. Therefore, wherever shooting is forbidden the gray squirrel may become numerous, even in some cities, where there are trees

¹ Most writers on the habits of mammals seem to agree that the red squirrel is a nest-robber. John Burroughs says that he thinks that the mischief it does can hardly be overestimated (*Signs and Seasons*, 1886, p. 92). Stone and Cram say that in summer it robs birds' nests high and low (*American Animals*, 1902, p. 178). Ernest Ingersoll asserts that it destroys far more birds' eggs and young than any other squirrel, and that not even the Baltimore oriole's nest is safe from it (*Our Animal Competitors*, 1911, p. 129). Ernest Harold Baynes avers that he has known so many nests destroyed by it that he will not allow one of these animals in any place where he is trying to attract birds (*Wild Bird Guests*, 1915, p. 28). On the other hand, Mason A. Walton asserts that in his neighborhood birds do not fear the red squirrel, which occasionally examines nests but never, so far as he has observed, molests them. He tells of one which investigated a chickadee's nest frequently and did no harm, and another which examined a vireo's nest in which young were later safely reared. He asserts that nineteen nests built near his cabin in one season were not troubled by squirrels (*A Hermit's Wild Friends*, 1903, pp. 68, 70, 98).



GRAY SQUIRREL.

An enemy to birds that nest in hollow trees, driving them away from their nesting places and sometimes killing the young. (Photograph by Walt F. McMahon.)

enough to serve as a safe refuge. The gray squirrel is not regarded generally as detrimental to bird life, but in some respects it is more so than the red squirrel. Wherever both species are protected in Massachusetts the gray squirrel increases several times as fast as the red, as it has two litters annually, while the red squirrel has but one. Young gray squirrels may be seen in the woods in June and in September, and may be found in the nests in May and in August, even in the northern part of the State. Although I have not heard of a second litter on the higher elevations of western Massachusetts it would not be surprising if even there two were raised in the lowlands. Much has been written about gray squirrels being driven out or mutilated by the red, but in my experience they have occupied the same woods without serious friction. The grays, if protected from gunners, constantly increase in number, until they have utterly destroyed quantities of corn, pumpkins, nuts, pine seed, apples, pears, strawberries and other useful products. Birds feed lavishly on Juneberries, but in some places where gray squirrels are numerous it is useless to plant Juneberries for the birds, as these squirrels often take all the berries before they are ripe enough to attract birds. Thus squirrels compete with birds for food.

This species when numerous is perniciously successful in driving out birds from hollow trees. All species of arboreal squirrels occupy hollow trees for nesting purposes, and where gray squirrels are abundant, bluebirds, tree swallows and other birds that build in tree cavities will find little chance to nest unmolested. If we provide nesting boxes for birds, squirrels keep them out or drive them away, enlarging the entrances with their teeth if these holes are too small for squirrel uses, and often destroying eggs or young birds.

Near my camp in Wareham a gray squirrel was seen to leap from a small tree into a bevy of bobwhites, in an apparent attempt to catch one, and frequently I have seen individual squirrels chasing small chickens, and have since suspected them of killing chickens. A friend who kept pigeons in a loft complained that rats got in somewhere and destroyed the squabs, eating the grain from their crops. As there was no entrance for rats except a window high up in the building I suggested that

this window be protected from climbing animals by sheets of zinc, nailed on the outside of the building. This was done and no more squabs were lost, but gray squirrels were seen to fall to the ground in their attempts to climb or jump into the window. Years passed without absolute proof of chick killing, but recently Mr. O. L. Curtis, assistant manager of the great estate called Seven Gates, formerly the country home of Professor N. S. Shaler at North Tisbury, told me that many chickens on the place were killed, as was supposed, by rats, but not eaten, only the grain being taken from their crops. One of his men saw a gray squirrel in the act. Mr. Curtis then watched, saw a squirrel go into a coop through a hole in the wire, kill a chicken and eat the grain from its crop. He shot the squirrel and several more that came to the coop later. This habit of the gray squirrel probably is exceptional.

Flying Squirrel (Glaucomys volans volans).

Hundreds of nesting boxes for birds that have been put up in trees in Massachusetts have been occupied by squirrels, and while the two preceding species have been the chief trespassers in most cases, flying squirrels sometimes have outnumbered the reds, where the nesting boxes have been put up in woods. The flying squirrel moves about mainly at night and little is known about its habits, but I once found one occupying the recently completed nesting hole of a downy woodpecker, and suspected that it had robbed the nest. So far as I know, however, no one has yet convicted the species of nest-robbing.

Chipmunk (Tamias striatus lysteri).

This species is not much complained of as a nest-robber, and although well able to climb trees it is more at home on the ground. It is a meat eater and has been known to rob nests. It is said to *swallow* young birds. Three observers have reported this, and Mr. W. L. McAtee informs me that remains of a young bird were found in the stomach of a chipmunk dissected at the Biological Survey. I have recorded elsewhere the killing of a wounded bird by a chipmunk.¹ As a

¹ Special Report on the Decrease of Certain Birds and its Causes, with Suggestions for Bird Protection, fifty-second annual report, Mass. State Board of Agr., 1904, p. 505.

matter of justice to the squirrels they should be given credit for great service in distributing and planting the seeds of forest trees.

MUSKRAT (*Ondatra zibethica zibethica*).

Ingersoll names the muskrat among the mammals that rob the nests of ground-nesting birds.¹ Dr. Abbott asserts that muskrats sometimes eat young green herons that fall from the nest.² Wounded ducks are said to be attacked occasionally by muskrats, and some dead ducks are eaten by them, but beyond this I have been unable to find any evidence that the muskrat is destructive to birds under normal conditions. What it may do when in abnormal numbers is shown by recent experience in Austria, where it has been introduced and is said to have increased rapidly, devouring wheat and other cereal crops, fruit and vegetables. It has almost ruined industries of crayfish and carp breeding; has raided poultry, carrying off young chickens, and has even attacked game animals. It undermines railway embankments, ruins dikes and seems to have become a first-class pest. Muskrats normally feed very largely on vegetable matter and thus tend to prevent vegetation from choking up ponds and streams. They eat mussels or so-called fresh-water clams. Ordinarily the demand for their fur will prevent abnormal increase.

MICE.

The importance of mice as enemies of small birds and game birds is not generally understood. If not held in check they may quickly become the most destructive of all the agencies for the suppression of birds. If an irruption of field mice should occur in early summer they would destroy the grass and clover, and the callow young of the small ground birds that nest in the field would be left unshaded from the hot sun, which would kill most of them even if they escaped the swarming, hungry mice or the other enemies to which they would be exposed. The eggs and young of game birds which nest on the ground would not escape the latter fate. If deer mice and pine mice were to increase half as fast as nature

¹ Ingersoll, Ernest: *The Wit of the Wild*, 1906, p. 54.

² Abbott, C. C.: *A Naturalist's Rambles about Home*, 1885, pp. 188, 189.

provides for their multiplication, hardly a bird's nest in the woods would escape them, from the ground to the treetops. Deer mice are so small and light that they can climb to any nest where even a squirrel might fail, and they are quite as fond of young birds as are the squirrels. Field mice of various species have from four to six litters of young each year, with from two to thirteen young in each litter, therefore the estimate by Professor Lantz that a single pair of our common meadow mice is potentially capable of producing nearly a million young in five years is not excessive.¹

Knowing the capacity of a single field mouse to be from twenty-four to thirty-six pounds of green vegetation annually, Professor Lantz calculates that a thousand field mice (which might ordinarily inhabit a meadow) would require at least twelve tons of grass or its equivalent each year. A million would require twelve thousand tons annually. History shows that under favorable conditions countless numbers are produced in a few years, and that when such invasions occur they destroy or ruin grass, clover or alfalfa, hay in stacks, all small grain growing or in shocks or stacks, garden and hotbed plants, potatoes, beets, turnips, carrots, cabbage, celery and other vegetables, apples, pears and other standard fruits, small fruits and the plants that bear them, orchard trees and shrubbery, nursery stock, young forest trees, and nearly all kinds of bulbs, tubers and roots. These mice ruin lawns and pastures for the time being, and become at times in the old world the most important of all pests.

The great swarms of lemmings that have appeared from time to time on the Scandinavian peninsula, and the destruction brought about by their numbers, are historic. In my "Useful Birds and their Protection," pages 76 to 78, I have noted similar occurrences in Scotland and England, and the effectiveness of owls and other natural enemies of birds in destroying the pests. Figuiet says that in France "Whole districts have been reduced to destitution by this scourge," and that the Department of La Vendee experienced a loss in two years estimated at £120,000 (nearly \$600,000), caused by these creatures.²

¹ Lantz, David E.: U. S. Dept. of Agr., Biol. Surv., Bull. No. 31, An Economic Study of Field Mice, p. 12.

² Figuiet, Guillaume Louis: *Mammalia, Their Various Orders and Habits*, popularly illustrated by typical species, 1870, p. 445.

Already, because perhaps of the excessive destruction of the enemies of birds and mice in some parts of the United States, these little rodents are causing serious loss. The greatest outbreak in this country of which I have seen definite records occurred in the Humboldt valley, Nevada, in 1907-08. Here four great ranches suffered an estimated loss of \$86,500, and the damage in the immediate region was estimated at about \$300,000, with injury less severe extending up the river and its tributaries.¹

Field mice when properly held in check by their natural enemies perform several useful offices. Then, according to Rhoads, the food of the common meadow mouse (*Microtus pennsylvanicus pennsylvanicus*) consists mainly of rushes, sedges, salt grass and other coarse grasses and weeds, and from 70 to 80 per cent of the whole number of field mice ordinarily live in bogs and low moist lands, where they do little if any harm, while those on uplands nearly all confine their foraging to fence rows, brush patches and neglected places, rarely eating any except waste grain.²

Thus when in normal numbers they do good rather than harm, by converting worthless rushes, grains and weeds into a supply of food for fully two-thirds of the natural enemies of birds which, by means of the superfluous mice, easily taken, are fed sufficiently to prevent them from becoming too destructive to birds. Exterminate mice and the problems of the farmer and those of the economic zoölogist would be wonderfully increased, but exterminate the natural enemies of mice — then the deluge. The only effective artificial method of meeting the great invasions of mice that occur through lack of natural enemies is to use poison, which is likely to be destructive to birds and other animals as well as mice. Therefore it is suicidal to destroy too many shrikes, crows, hawks, owls, herons, bitterns, gulls, foxes, skunks, weasels and other creatures which feed on mice, even though they may feed to some extent on birds also.

The two forms of mice which are, perhaps, the most widely disseminated, and prolific of all native mice are the common meadow mouse and the deer mouse.

¹ Piper, Stanley E.: U. S. Dept. of Agr., Farmers' Bull. No. 352, The Nevada Mouse Plague of 1907-08, 1909, pp. 9, 10.

² Rhoads, Samuel N.: Mammals of Pennsylvania and New Jersey, 1903, pp. 98, 99.

Field Mouse or Meadow Mouse (Microtus pennsylvanicus pennsylvanicus).

Rhoads says that under normal conditions only about 5 per cent of the food of this species consists of animal matter. It destroys some insects and eats dead animals, birds and eggs. Dr. George W. Field informs me that this species interfered with some experiments in rearing bobwhites undertaken by the Massachusetts Commission on Fisheries and Game, as it destroyed many eggs. Whenever the numbers of field mice increase, so that their food supply is threatened, they will turn quickly to animal food, eating dead animals, destroying live ones and even killing and eating one another. I am not aware that the effect produced upon bird life by these swarms of mice has been investigated, but it is easy to understand that it must be very serious.

Deer Mouse (Peromyscus leucopus noveboracensis).

The habits of the deer mice, now separated by the systematists into several forms, are somewhat like those of the garden dormouse of Europe. Although quite at home on the ground the deer mice or white-footed mice are very partial to trees, and often make their nests in hollow trees or in birds' nests, no doubt in some cases depriving birds of their homes. Dr. Abbott says that they are skillful hunters of birds' nests, and that he has known them to rob the nests of the robin, song sparrow and chewink, and asserts that he has seen young robins, nearly fledged, killed by them. The mice returned to the nest when the parents were absent and ate the young birds.¹ Mr. M. A. Walton of Gloucester, Massachusetts, wrote me in detail that he had known these mice to destroy birds on many occasions. The birds killed were young or injured. When he placed nests with young birds in his cabin in the woods for safety over night he found invariably that they were eaten by these mice unless protected by wire netting. He asserts that the mice robbed the nest of a white-throated vireo near by and brought one of the dead young into the cabin. Stone and Cram assert that these mice appropriate the nests of birds in

¹ Abbott, Charles Conrad: *A Naturalist's Rambles about Home*, 1885, p. 70.

bushes and low trees, and that they have been caught often in the act of devouring eggs and young birds.¹ Dr. Merriam says that he has found their nests in holes in trees more than seventy feet from the ground.² Many nesting boxes put up for birds in or near the woods are occupied by these mice. It is fortunate that owls keep them in check. I have no information regarding the destruction of birds by pine mice, jumping mice or any other species, but it is probable that any of them might destroy birds should their numbers increase unduly, as all small rodents are likely to become more or less carnivorous under such circumstances.

DEER (*Odocoileus virginianus virginianus* and *Odocoileus virginianus borealis*).

Dr. George W. Field assures me that deer eat the eggs of ground birds. It seems probable that if this is the case they may devour young birds also. Mr. F. C. Walcott quotes Mr. C. C. Worthington's statement that thirty-four deer on his preserve were killed by eating poisoned sparrows. The birds were found in the stomachs of the dead deer.³

Birds.

SHRIKES (*Lanius borealis* and *Lanius ludovicianus migrans*).

Shrikes or butcher birds are believed to be beneficial. Dr. Judd of the Biological Survey reports on stomach examinations of shrikes as follows:—

The food of the butcher bird and loggerhead, as shown by one hundred and fifty-five stomachs collected during every month in the year, and in an area extending from California to the Atlantic coast, and from Saskatchewan to Florida, consists of invertebrates (mainly grasshoppers), birds and mice. During the colder half of the year the butcher bird eats birds and mice to the extent of 60 per cent, and ekes out the rest of its food with insects. In the loggerhead's food birds and mice amount to only 24 per cent. The loggerhead's beneficial qualities outweigh 4 to 1 its injurious ones. Instead of being persecuted it should receive protection.⁴

¹ Stone, Witmer, and Cram, W. E.: *American Animals*, 1902, p. 132.

² Merriam, Clinton Hart: *The Mammals of the Adirondack Region*, 1884, p. 263.

³ Job, Herbert K.: *The Propagation of Wild Birds*, 1915, p. 71.

⁴ Judd, Sylvester D.: *Bull. No. 9, U. S. Dept. of Agr., Div. of Biol. Surv., Cuckoos and Shrikes*, 1898, p. 24.

Dr. Judd records the killing of a young chicken by a logger-head shrike which is credited to the "Florida Dispatch,"¹ and Mrs. B. R. Buffham of Roswell, New Mexico, saw a shrike, probably of the same species, hang up a dead chicken seemingly just out of the shell.²

GRACKLES OR CROW BLACKBIRDS (*Quiscalus quiscula quiscula* and *Quiscalus quiscula œneus*).

The purple grackle, which is resident here in summer, is known to destroy the eggs and young of other birds at times, and when in large flocks in autumn it devours corn in the field. The destruction of the eggs and young of birds by it is not considered very serious and it is not believed to be very generally addicted to this habit. Professor F. E. L. Beal made an examination of the stomachs of two thousand two hundred and fifty-eight crow blackbirds obtained from twenty-six States.³ Only thirty-seven stomachs contained any trace of birds' eggs and only one the remains of a young bird, but we are not told how many of the stomachs were taken during that part of the year when eggs and callow birds are not obtainable. He concludes that crow blackbirds are so useful that no general war should be waged against them. They are not protected by law now (1916) in Massachusetts.

BLUE JAY (*Cyanocitta cristata cristata*).

The blue jay is, at times, even more destructive to the smaller birds than is the crow. It has been known to attack and kill adult birds, young chickens and young pheasants, and to eat the eggs and young of most of the smaller birds. I will venture to say that every close observer who has watched the jay long and carefully is familiar with its nest-robbing habits. It is so sagacious and cunning that it is sure to establish itself wherever shooting is prohibited, and there it increases apace, to the detriment of small birds. Jays often become numerous even in cities, and in recent years have learned to build their nests about houses in very thickly settled communities, where

¹ Judd, Sylvester D.: Bull. No. 9, U. S. Dept. of Agr., Div. of Biol. Surv., Cuckoos and Shrikes, 1898, p. 21.

² Nature and Culture, January, 1911, p. 21.

³ Beal, F. E. L.: Crow Blackbirds and their Food, Yearbook, U. S. Dept. of Agr., 1894, p. 233.



BLUE JAY AT NEST.

Jays destroy the eggs and young of other birds. (Original photogrsph.)

no shooting is allowed. Wherever they become unduly numerous through such protection the small birds are likely to become their victims. In defense of the jay, however, it must be said that he is an efficient caterpillar hunter, and destroys numbers of those pests, the gypsy moth and the brown-tail moth.

Professor Beal, who has dissected the stomachs of more than two hundred and ninety blue jays, believes this species to be useful. Remains of small birds were found in only two stomachs, and shells of their eggs in only three.¹ Dr. B. H. Warren failed to find any traces of birds or eggs in twenty-three blue jays stomachs which he examined, fifteen of which were taken in the nesting season.²

The blue jay is not protected by law in Massachusetts.

CROW (*Corvus brachyrhynchos brachyrhynchos*).

Ornithologists are divided in opinion regarding the economic value of the crow. Professor W. B. Barrows, who has spent more time investigating the crow's economic status than has any other living man, wrote for the United States Department of Agriculture a report on the crow. In presenting it for publication Dr. C. Hart Merriam, chief of the division, declared that the evidence showed the crow to be beneficial. Since that time Dr. Barrows has expressed the opposite opinion. In his work on the birds of Michigan, he states his belief that the crow is more injurious than beneficial to the farmer.³ In my report entitled "The Crow in Massachusetts" the facts for and against the crow were considered and I cannot recapitulate them here.

Whatever may be said about the value of the crow to agriculture it is not a good bird for the game farm or bird refuge. Its habit of robbing the nests of birds from the size of the sparrow to that of the wild duck or the great blue heron is well known. It is a habit of crows the world over, and some individuals are remarkably destructive. Nevertheless, the local extermination of crows has been followed in more than one in-

¹ Beal, F. E. L.: The Blue Jay and its Food, Yearbook, U. S. Dept. of Agr., 1896, p. 199.

² Warren, B. H.: Birds of Pennsylvania, 1890, p. 201.

³ Barrows, Walter B.: Michigan Bird-Life, 1912, p. 427.

stance by such an increase of grubs and grasshoppers as to destroy the grass crop over large areas, and it would be very unwise to allow the extirpation of this bird.

HAWKS AND OWLS.

Many hawks are not only useful in nature as regulators of mammal life but they are beneficial to the farmer by destroying grasshoppers and other large insects, squirrels, rats and mice. Among the most useful of all is the rough-legged hawk (*Archibuteo lagopus sancti-johannis*), which very rarely has been known to kill birds, and never, so far as known to me, to molest poultry. The species is large, flaps and sails rather slowly, and thus makes a good mark for a shotgun, or, sitting upon a dead tree or stake, furnishes an excellent target for a rifle. Many are shot annually in fall, winter or spring, mistaken for "hen hawks." The number of mice killed by these birds is enormous, and the shooting of the species is a serious detriment to agriculture. Nevertheless, farmers often boast of the number that they have killed and gunners shoot them at every opportunity. They would much better devote their energies to shooting vagabond cats, which do far less good and much more harm.

One can hardly write of the economic relations of hawks and owls in this country without referring to the work of Dr. A. K. Fisher of the Biological Survey. During his researches he has examined the contents of more than two thousand seven hundred stomachs of these birds, with the result that out of the seventy-three species investigated only six in all the United States were found harmful, and all the rest were classed as beneficial. Omitting the six species that feed largely on poultry and game, two thousand two hundred and twelve stomachs were examined, 56 per cent of which contained mice and other small mammals, 27 per cent insects, and only 3½ per cent poultry or game birds. Of the six harmful species, three are so rare that they have little effect, and in New England only two, the cooper's hawk (*Accipiter cooperi*), and the sharp-shinned hawk (*Accipiter velox*), are really common and generally injurious.¹ Nevertheless, individual birds of several

¹ The goshawk (*Astur atricapillus atricapillus*), the duck hawk (*Falco peregrinus anatum*), and the pigeon hawk (*Falco columbarius columbarius*) are exceedingly destructive to birds, but are uncommon in Massachusetts.

other species may at times become destructive to poultry or game, and may have to be killed, but the indiscriminate shooting and trapping of these birds is likely to do more harm than good.

The owls, with the exception of very few species, are now believed to be among the most useful of all birds. They destroy destructive insects and mammals at night which escape other birds by day. The great horned owl (*Bubo virginianus virginianus*) usually is regarded as pernicious, as it destroys game and poultry, particularly chickens and turkeys when they are allowed to roost in trees at night, but it is now becoming rare and should be killed only where it is known to attack poultry or game. The fact that there are robbers among hawks and owls is not good ground for exterminating all. Mr. E. O. Niles records the finding of the remains of one hundred and thirteen rats on the ground beneath a horned owl's nest, all taken within a period of about ten days. It is a habit of these rapacious birds to regurgitate or reject, through the mouth, bones, fur, feathers, and other indigestible portions of their food. Dr. Fisher found about the nest of a barn owl (*Aluco pratincola*) four hundred and fifty-three skulls of mice, rats and other small mammals and only one of a bird.¹

EAGLES.

The bald eagle (*Haliaeetus leucocephalus leucocephalus*) has been observed to pursue and strike down water fowl on the wing, and also to catch them on or in the water, but it lives chiefly on fish, captures few except crippled water fowl and is now becoming generally rare in New England. The golden eagle (*Aquila chrysaetos*) is only accidental here.

INTRODUCED BIRD ENEMIES.

The English Sparrow (Passer domesticus).

This is the one bird that if not destroyed or driven away will dispossess the smaller native birds of all bird houses and nesting boxes. All who cultivate its acquaintance will learn eventually the truth of this statement. Like most birds it is

¹ Fisher, A. K.: U. S. Dept. of Agr., Div. of Orn. and Mam., Bull. No. 3, The Hawks and Owls of the United States, 1893, p. 136.

serviceable in destroying insect pests, but less so than most native species.

Like the following species and the domestic cat, it is an introduced species and when allowed at large disturbs the balance of nature and so makes trouble. As I have already treated of this bird in Circular No. 48 no more space can be devoted to it here.

The Starling (Sturnus vulgaris).

The starling is increasing and spreading rapidly, and may yet prove to be a greater enemy to native birds than the sparrow now is, but it cannot enter nesting boxes with an entrance hole one and one-half inches in diameter. Therefore, nesting boxes for the smaller birds may be made starling proof. It is said to kill small birds at times. I have already treated of the bird at some length in Circular No. 45.

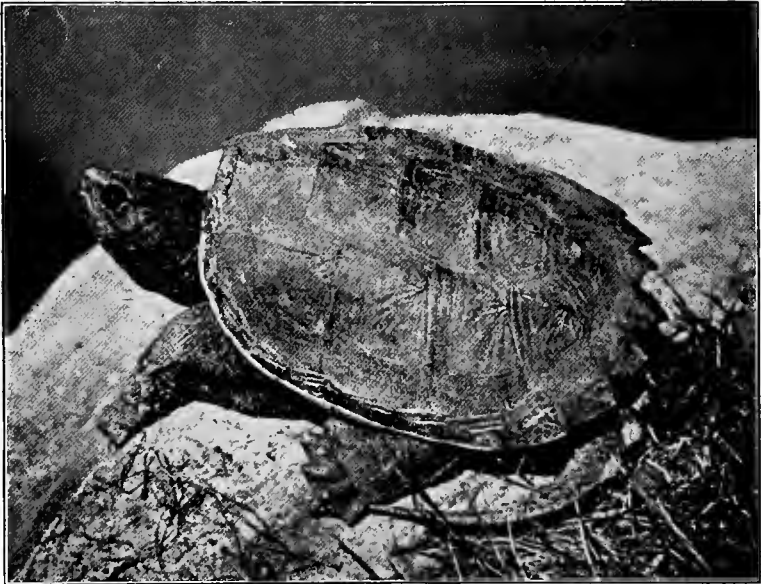
Ring-necked Pheasant (Phasianus torquatus).

Whatever may be said for pheasants by the advocates of the introduction and propagation of these exotic birds there can be no doubt that if they ever become unduly numerous they will interfere with native birds. The ring-necked pheasant is a good bird for a game preserve, particularly on land where no other gallinaceous bird is wanted. It thrives along the coast, especially near salt marshes where the winters are not too severe. The border of the marsh is its native habitat, but on high land where winters are inclement, with heavy snowfalls, it must be fed and cared for. In winter it feeds on weed seeds, bayberries and other low-growing fruits and seeds, of which it eats great quantities and thus deprives bobwhites and other native birds of their chief winter sustenance. Eyewitnesses have told me that they have seen the pheasant kill both the bobwhite and the ruffed grouse. I have seen a pheasant strike a bobwhite on the head and drive it away from the pheasant's feeding ground. As a game bird the pheasant cannot compare with either of these native birds, and it is not a desirable species to supplant them with. It will never become very abundant, however, if the seventy thousand licensed gunners of Massachusetts have their chance at it annually, and as it is well adapted to the game preserve it has come to stay. It is destructive to the gypsy moth and other insect pests.



THE BIRD-KILLING CAT.

The destruction of birds by cats is illustrated in Economic Biology, Bulletin No. 2, published by the Massachusetts State Board of Agriculture. (Photograph by William L. Finley.)



THE SNAPPING TURTLE.

Destroyer of young waterfowl and wading birds. (See page 30.) (Photograph by Professor H. A. Surface.)

MINOR BIRD ENEMIES.

Certain exceptional individuals of some species of birds have been known to destroy other birds even though such habits are not generally characteristic of the species to which these predatory individuals belong. There are other species which occasionally or commonly attack birds but have now become so rare that they do little harm. Gulls, herons and cranes may be mentioned as belonging to the first class and eagles to the second. Some individuals among gulls are more or less predatory. The herring gull (*Larus argentatus*) sometimes kills young birds of its own species, but so far as I know has not been known to eat them. When short of food, herring gulls have been known to kill and eat young chickens. The western gull (*Larus occidentalis*) and the blackbacked gull (*Larus marinus*) destroy the eggs and young of other birds, and European species have been seen to kill small birds, but such habits seem to be exceptional with most American gulls.

European herons are said at times to prey upon fledglings which stray near their retreats (Nuttall). The black-crowned night-heron (*Nycticorax nycticorax naevius*) has been seen to kill ducklings (Crandall), and bitterns are said occasionally to eat the eggs and young of other birds. The red-headed woodpecker (*Melanerpes erythrocephalus*), now rare in Massachusetts, has been accused of being a nest-robber. Bad habits have been attributed occasionally to cuckoos, catbirds, wrens, orioles and other small birds, but in most cases they may be considered more or less individual and unusual.

Turtles or Tortoises.

So far as I have been able to learn only one turtle, native to Massachusetts, can be counted as an enemy of birds. This is the snapping turtle (*Chelydra serpentina*). It has been known to kill and eat young night herons that had fallen from their nests, and is considered the greatest enemy of young waterfowl. It frequents muddy ponds, to which waterfowl resort, and drags them down by the feet. I have known one in this way to tear a leg from a living adult Canada goose, which escaped but afterward died. All who attempt to raise wild fowl in the

natural way must first clear the breeding pond of this terrible enemy; else it will be difficult to rear young birds.

Professor H. A. Surface records the stomach contents of nineteen individuals of this species. Only one had eaten a bird.¹ It is probable that young ducklings were scarce in the region in Pennsylvania where these turtles were taken. Hay found a robin in one stomach.² These turtles often are taken by a strong fishhook baited with tainted meat attached by a wire to a strong but springy stake driven into the bank.

The wood turtle or sculptured turtle (*Clemmys insculptus*) is reported as taking ducklings and goslings, but I can find no convincing evidence in proof of the charge. This is a small turtle and it is probable that most of the birds eaten by it are such as it finds dead. Professor Surface found remains of birds in two out of twenty-six stomachs.³

Snakes.

Snakes are carnivorous and insectivorous. It is well known the world over that they destroy birds, their eggs and young. It has been asserted often that they are able to charm birds and thus render them defenseless, — a statement hardly borne out by the facts. Occasionally, careful observers have reported a case where a bird seemed unable to escape from a snake but drew nearer and nearer. Mrs. Olive Thorne Miller narrates such an occurrence in "A Bird Lover in the West" (pages 251 to 253), but as she drove the snake away the observation was inconclusive. The theory that sometimes birds are attracted to the head of a motionless snake by its flickering tongue, which they mistake for a worm or insect, is supported by good evidence.

Some snakes seem to live almost wholly or altogether on forms of life other than birds, but there are some species so destructive to bird life that their suppression is important to the bird protectionist. Ingersoll tells of an African snake that

¹ Surface, H. A.: Zoöl. Bull., Div. of Zoöl., Penn. Dept. of Agr., Vol. V., Nos. 4 and 5, for August and September, 1908, First Report on the Economic Features of the Turtles of Pennsylvania, p. 129.

² *Ibid.*, p. 131.

³ *Ibid.*, p. 163.

feeds so exclusively on eggs that it has a mouth especially fitted for containing and breaking them.¹

There is a genus *Dasypeltis* among the snakes, the species of which, native to Africa, are believed to live entirely on eggs. The eggs are swallowed whole and broken in the stomach, where teeth which grow out as processes from the vertebrae pierce through the lining of the stomach so far that they seem perfectly fitted for breaking the eggs that pass through it. If these are true teeth it is the only instance of their occurrence in the whole animal kingdom, except in the mouth or on the

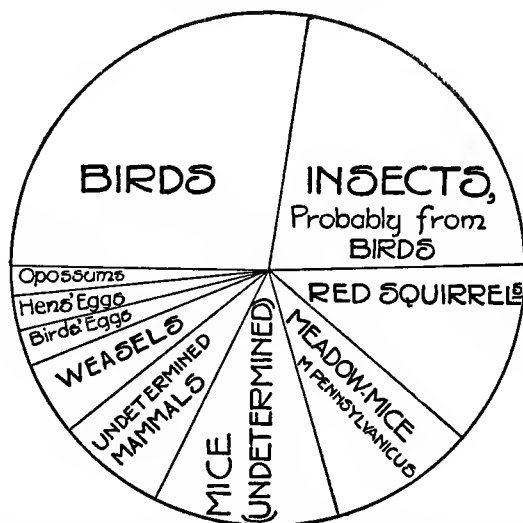


Diagram showing the percentages of food items of pilot snake (*Callopeltis obsoletus*) for the year: 11½ per cent red squirrels; 2 per cent opossums; 28 per cent birds; 2 per cent birds' eggs (undetermined); 4½ per cent weasels; 10 per cent meadow mice (*Microtus pennsylvanicus*); 2 per cent hens' eggs; 21 per cent insects (probably from birds); 7 per cent undetermined mammals; 12 per cent mice (undetermined). (After Surface.)

jaws. It may be doubted, however, if eggs form the only food of these snakes.

In New England the larger and more active snakes are most destructive to birds, while most of the smaller species are now considered as beneficial to man on account of their insectivorous habits. The bird-killing snakes will be considered here in the order of their destructiveness.

The pilot snake (*Callopeltis obsoletus*) should not be confused

¹ Ingersoll, Ernest: *The Wit of the Wild*, 1906, p. 57.

with other species, such as the copperhead or the hog-nosed snake, both of which are known locally as the pilot snake, or with the black snake, which it resembles in color. This snake grows from about 50 to 75 inches in length and is lustrous black above with some of the scales white-edged. It is lighter but still blackish below. Its ventral plates number about 235, and it is not venomous. It is found from Massachusetts to

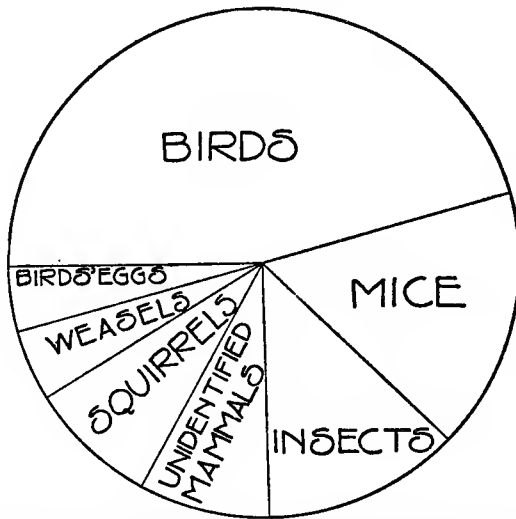


Diagram showing the percentages of food items of pilot snake (*Callopeltis obsoletus*) found during the months of June and July only: 46 per cent birds; 16½ per cent mice; 12½ per cent insects; 8½ per cent unidentified mammals; 4 per cent weasels; 4 per cent birds' eggs. (After Surface.)

Illinois and Texas, and south through the middle States. It is one of the largest black snakes, climbs trees rapidly, and I have seen it run fast over and through the tops of a thicket of young pines 10 to 15 feet in height. This species, like the black snake, sometimes will chase a fleeing person, but, in turn, will run if pursued. It takes hens' eggs and those of other birds, climbs to nests, and kills and swallows both old and young birds, which form a very considerable part of its food during the nesting season. This and the following species enter the holes of woodpeckers, destroying eggs, adults and young, and have been known even to extirpate colonies of barn swallows nesting on the rafters. Their skill and activity in climbing are unsurpassed among serpents. Mrs. L. H.

Touissant of Rio, St. Lucie County, Florida, says that a black snake (probably of this or the following species) actually crawled up the weather boards of a house to a window where a canary was swinging in a cage, and swallowed the bird, which so increased its size that it could not get out of the cage.¹

Professor H. A. Surface, who has made the most complete study of the food of the serpents of Pennsylvania yet undertaken, finds that during the late spring and early summer the eggs and young of birds form the predominating food of the pilot snake; later it feeds more on mice, insects, etc. The diagrams show this plainly.

The black snake or blue racer (*Bascanion constrictor*) differs from the pilot snake in having no white except upon the chin

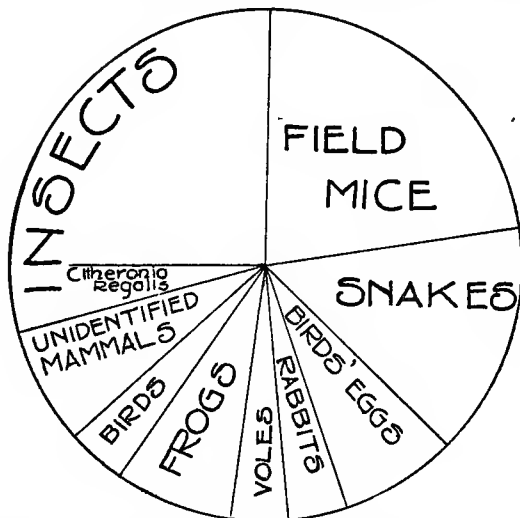


Diagram showing the percentages of food items of black snake (*Bascanion constrictor*) for the year: 25 per cent insects; 15 per cent snakes; 22 per cent field mice; 8 per cent birds' eggs; 4 per cent rabbits; 4 per cent voles; 7½ per cent frogs; 4 per cent birds; 7 per cent mammals (unidentified); 3½ per cent larvæ of royal moth (*Citheronia regalis*). (After Surface.) The percentage of birds for June and July, when the young are in the nests, would be very much larger; but the insects, mice and snakes eaten go far to balance the destruction of birds.

and throat and in having all the scales smooth instead of keeled. The ventral plates are about 185 in number. The snake is lustrous black in color, bluish or greenish below and in length usually 5 feet or less, although larger specimens have been taken.

¹ The Bluebird, Junior Audubon Monthly, Vol. VII., No. 8, May, 1915, p. 222.

The young are grayish olive, with short livid black blotches or spots. This is the common black snake of New England, and is found mainly in regions more or less wooded. According to Professor Surface it feeds to some extent on large insects, but more on other insectivorous creatures, such as small snakes, frogs and birds, but it is believed to be a destroyer of the rattlesnake and the copperhead. The following diagram gives an idea of its food. It is not a creature for the bird protectionist to protect.

Next to the black snake, the house, milk or chicken snake

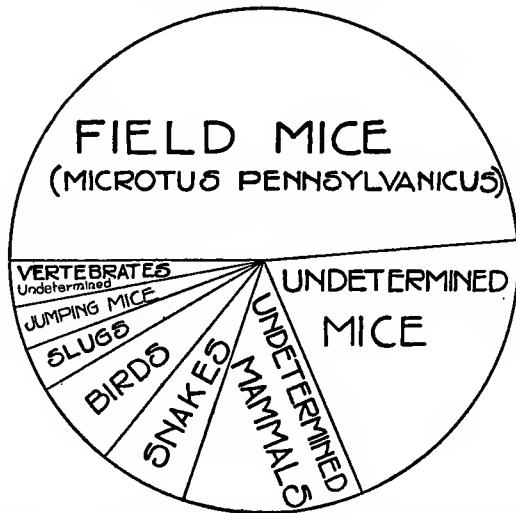


Diagram showing the percentages of food items of milk or house snake (*Lampropeltis doliaetus triangulus*) for the year: 48½ per cent field mice (*Microtus pennsylvanicus*); 20 per cent undetermined mice; 11 per cent unidentified mammals; 6 per cent snakes; 5½ per cent birds; 3 per cent slugs; 3 per cent jumping mice; 3 per cent undetermined vertebrates. (After Surface.)

(*Lampropeltis doliaetus triangulus*), sometimes called in Massachusetts the spotted or checkered adder, is believed to be most destructive to birds. This is a rather slim, active serpent and may be distinguished from the other species by a series of small square or rectangular black blotches on its light under parts. It is so active and so proficient in climbing that it can go almost anywhere that it is possible for a snake to go. Mrs. Touissant describes how she saw a snake, apparently of this species, climb up the side of a building, hook its chin over the

top of a window frame, draw its body up and so reach a rafter of the roof, where it caught a rat hiding there.

The diagrams show the proportions of the different kinds of food found in fifty-two stomachs of this species examined by Professor H. A. Surface.

The so-called spreading adder or blowing viper (*Heterodon platirhinos*), a non-venomous snake common in parts of Massachusetts, resembling in appearance a viper, destroys birds and eggs to some extent, but like the rattlesnake (*Crotalus horridus*), which also kills birds, is rather slow and not a good climber. Both these snakes, as well as the different forms of garter

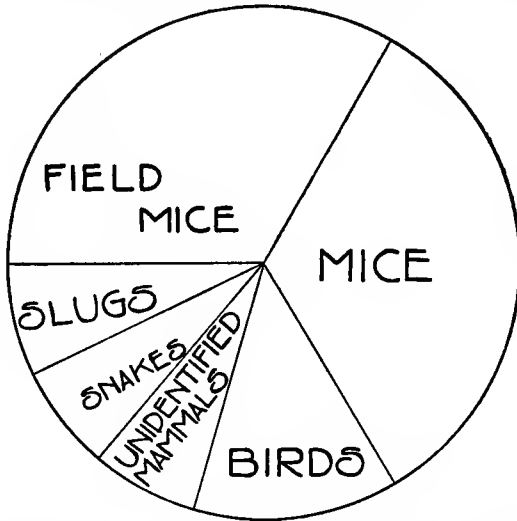


Diagram showing the percentages of food items of house snakes (*Lampropeltis doliaetus triangulus*) found during July and August only: 33½ per cent field mice; 33½ per cent mice; 13 per cent birds; 7 per cent unidentified mammals; 7 per cent snakes; 6 per cent slugs. (After Surface.) Apparently this snake eats mice enough to more than pay for the birds that it destroys, for mice also eat eggs and young birds.

snakes or striped snakes (*Thamnophis*), feed to a limited extent on the eggs and young of birds that nest on the ground or in low shrubbery, as also does the copperhead (*Agkistrodon contortrix*). This venomous and dangerous reptile has the habit of lying concealed beneath the dead leaves of the forest floor, with only its reddish head visible, looking like an acorn amid the leaves, thus no doubt luring many a bird or squirrel to its death. Like the rattlesnake it is rare now in New England, but may still be found in the Blue Hills region near Boston.

Even the water snake (*Natrix sipedon*) is said at times to rob the nests of marsh wrens and to eat the eggs and young of rails, but it is not believed to feed commonly on birds. Probably all field ornithologists of large experience have witnessed the robbing of birds' nests by snakes. The parent birds occasionally are killed in defense of their homes, and it is probable that now and then an adult bird, while feeding, is surprised and caught by a snake, although I have never known this to happen. Snakes probably do not require a great quantity of food. Individuals have been known to live without food for more than a year, and investigators, capturing snakes, find a large proportion of stomachs empty. The digestion of snakes is slow, and probably they do not consume nearly as much food in proportion to their size as would a bird or even a mammal. Hence they probably are not individually as destructive to birds as are warm-blooded rapacious creatures, but where the larger snakes become too numerous they may exert a serious depressive influence on the numbers of birds.

Frogs.

There are many tales of frogs swallowing ducklings but no such case has come under my observation. Mr. Robert B. Lawrence reported that a frog in his brother's duck pond was killed after it had devoured a young pin-tail duck, and that, as many young wood ducks had disappeared, it was believed that frogs had eaten them.¹ This observation is corroborated by others. Only very large frogs are able to catch and swallow birds and such frogs should not be allowed in ponds with young ducklings.

Fish.

Trout, salmon and other large fish capture young birds which fall or alight upon the water. Pike and pickerel are so destructive to the young waterfowl, it is said, that young ducks cannot live in water where they abound.

Insects.

The insect world is potentially the greatest of all dangers to bird life. Wherever birds and other natural enemies of

¹ Huntington, Dwight W.: Our Wild Fowl and Waders, 1910, p. 88.

insects fail to keep down the increase of insect pests, even man himself becomes unable to protect birds. In recent years I have seen this illustrated in the increase of the gypsy moth and the brown-tail moth in eastern Massachusetts, — two first-class pests introduced into this country in the same region without their natural enemies and therefore increasing inordinately. Native birds and other enemies of insects are not numerous enough to check their increase. Although State governments, the national government, towns, cities and individuals are expending probably a million dollars each year in the effort to suppress them, although the United States Department of Agriculture has introduced and propagated parasites and predaceous insects, although about fifty species of native birds eat the moth pests, still their increase and spread go on. Last year I went over a large tract many square miles in extent where the leaves had been stripped from the trees. Everywhere the young birds or eggs in the nests in those trees had been destroyed by the heat of the sun or exposure to their enemies. In such a case no young birds can be reared except those on the ground or those in hollow trees or nesting boxes. Similar irruptions of grass-eating insects expose the nests of ground birds in the same way. Birds are among the chief enemies of ticks, but wherever for any reason the numbers of birds are reduced, ticks increase and still further deplete the numbers of birds by destroying their young. This happened in Jamaica after the introduction of the mongoose, which so lessened the numbers of birds that ticks, no longer controlled by birds, destroyed most of the young birds that escaped the mongoose and rendered it almost impossible to raise domestic fowls on the island.

Birds which nest in colonies often suffer severely from parasites, particularly mites, which attack them at night.

MISTAKES MADE IN ATTEMPTING TO CONTROL THE NATURAL ENEMIES OF BIRDS.

In considering the methods of controlling the natural enemies of birds we must divide these enemies into two classes: (1) Those introduced from foreign countries and which therefore tend to disturb the balance of nature, and should be elim-

inated so far as possible except when under control, either in domestication or in captivity; such are the dog, house rat, ferret, cat, hog, ox, horse, sheep and goat, the English sparrow and the starling. (2) The native natural enemies, which have through thousands of years become perfectly adjusted in their relation to the species on which they prey. These should not be eliminated, with the exception of those few that threaten our lives or our material welfare, but should be conserved and controlled according to our needs. When a species becomes too numerous it should be reduced in numbers; if too few it should be allowed to increase. The general and indiscriminate slaughter of all carnivorous species should not be permitted. Even the poultryman and the gamekeeper should use some discretion.

An English gamekeeper felt sure that he had seen barn owls killing young pheasants, and as chicks had disappeared with no other visible cause he was told by the master to shoot any owl that was actually seen to take a chick. He saw a barn owl swoop down among the young birds, shot it and found that it had a rat in its claws. It was proved later that it was the rats and not the owls that had been taking the birds. The gamekeeper had shot a friend. A similar incident happened in New Hampshire, where a farmer killed a marsh hawk that was supposed to be eating his chickens and found that it had killed a rat. Some individual barn owls may kill young pheasants. Some marsh hawks kill birds, and in the Cape Cod region many birds and chickens are killed by marsh hawks, but the killing of all birds or all mammals of any species because one or more individuals have been known to destroy birds or poultry is as illogical as would be the killing of all men possessed of guns, knives or axes because some few are known to be murderers and others are suspected. Some allowance should be made for individuality among animals as well as among men.

Millais, in his magnificent work on "British Surface-feeding Ducks," relates that in 1884 brown-headed gulls began to increase in the bog at Murthly. The keeper said that the gulls were killing young teal. Another experienced keeper suggested that this was probably the work of a single gull. The gulls were watched; a pair of birds were seen together, one of which

began to kill ducklings. Both birds were shot, and no more ducklings were killed that year. In 1890 another pair of gulls began killing young teal; sixteen were found dead. The two culprits were shot, and no more young teal were killed that season. Millais considers that individual gulls are as dangerous to young ducks as are any of their numerous enemies; and yet probably only two, or at the most four, of the large number at the bog actually were doing the killing.¹ Had not the game-keeper been an intelligent observer, a hundred innocent gulls might have been shot, and the guilty birds might have escaped, to continue their nefarious work elsewhere. Millais confidently advances the theory that a few individual birds do the mischief for which perhaps the whole race is blamed. He believes that the individual criminal among birds does his work stealthily, and so is seldom observed; that his family is fed on the results of his rapacity; and that the young acquire similar tastes and habits, which in time may spread from family to family and from one community to another. He asserts that years ago the rooks of southern England were practically innocent of stealing eggs or young birds, though their cousins in the north were nest-robbers even then. He says that now there is hardly a community of rooks in the south of England that does not contain individuals with the nest-robbing habit.

Care and discrimination in the control of natural enemies is imperative. In destroying carnivorous creatures the gun is a better weapon than trap or poison. The gunner can discriminate. Traps and poisons destroy both friend and foe. Poisons should not be used except in the dead of winter and should then be concealed in hollow trees or logs, or holes in the ground, or so covered that only the animals for which they are intended are likely to get them.

It is not the purpose of this paper to describe in detail methods of controlling and destroying predatory creatures but rather to indicate the mistakes ordinarily made in using these methods, the most common of which is the indiscriminate shooting and trapping of hawks and owls. In general it may be said that the larger soaring hawks, with long broad wings,

¹ Nevertheless, observers agree that the habits of bird-killing and egg-eating are quite general among certain species of gulls.

belong to the beneficial species, which feed chiefly on mice and rats, while the smaller, swifter hawks, with comparatively short wings and long tails, which rarely soar or circle but flap and sail in a more direct course, are very destructive to birds, game and poultry. Nevertheless, at least ten of the first class are killed by farmers, poultrymen, and sportsmen to one of the latter, because they are slower, more numerous and more conspicuous, and therefore more readily seen and shot. It should not be inferred from the above that hawks of the first class never kill birds, game or poultry, but they are mostly too slow to catch swift birds often. Nevertheless, any of them can catch a young bird or a chicken. Some individual hawks of the soaring species become very destructive to young poultry at times or to young game on a preserve, but it is not difficult for a good hunter who is also a good shot to follow such a bird and kill it while it is eating its prey. The great horned owl sometimes acquires the habit of coming to a game preserve at night and taking birds. When this happens it must be stopped, even if the pole trap has to be resorted to, for it is not always possible to shoot a bird that comes after dark. Pole traps kept set, however, will not only destroy useful hawks but will catch and kill many useful insect-eating song birds. Pole traps should be used mainly in the dead of winter, when they will be most likely to destroy principally those creatures that are most harmful to the game. It is only the occasional skunk, mink or weasel that becomes destructive in the poultry house or the game pen, but it is useless to talk thus to gamekeepers or poultrymen, most of whom would gladly shoot any predatory bird or mammal at sight.

Gamekeepers exert themselves to destroy all natural enemies of birds indiscriminately, and it must be admitted that such a policy, coupled with attention to breeding, tends to increase the stock of game on a preserve. Such a policy regarding sheep would lead to the destruction of all dogs. No doubt it would be effective in increasing the numbers of sheep, as both the innocent and the guilty would be destroyed, but it would be better to save the innocent, and particularly the dogs known to protect sheep.

Let us hope, then, that preserves will never become so numerous in this country as to bring on, through too much destruction of so-called vermin, the evils that, at times, have attended such a policy of extermination in other lands.

The Failure of Bounty Laws.

Laws offering a price on the heads of rapacious creatures have been passed from time to time in many States because of the belief that such statutes would be beneficial by procuring the destruction of noxious species. In most cases they have failed utterly to bring about the desired result, and, in so far as they have been successful, have accomplished more harm than good. Dr. T. S. Palmer asserts that it is safe to say that \$3,000,000 were expended on bounties in the United States in the five years prior to 1896.¹ Probably most of this money has been worse than wasted, and much of it never would have been expended if the advice of competent biologists had been heeded. County and State treasuries have been emptied to keep the scalp hunter afield. Useful as well as noxious creatures have been slaughtered in large numbers, but the benefits to the taxpayer have been conspicuously absent, and lawless hunters have been the chief beneficiaries. Most bounty laws have been proposed and enacted with the ostensible purpose of securing the extermination of the animals thus proscribed on account of the mistaken idea that this would greatly benefit the community by protecting game, birds and poultry. We may grant that in settled regions the extirpation of the wolf, puma and rattlesnake would be desirable, but the complete destruction of birds of prey and the smaller predatory animals would have precisely the opposite effect from that intended and hoped for. In a recent letter to Mr. B. S. Bowdish of Demarest, New Jersey, Professor H. A. Surface, State zoölogist of Pennsylvania, writes as follows:—

It is to be presumed that the object in paying a bounty for the heads of hawks, owls, weasels and foxes is to protect birds and game animals, but it will not do this. Mice and rats are more serious enemies of the

¹ Palmer, T. S.: Extermination of Noxious Animals by Bounties, Yearbook, U. S. Dept. of Agr., 1896, p. 59.

eggs and young of birds than most persons believe. Where these are abundant, no ground-nesting birds will be found. Weasels and even foxes feed chiefly on rodents such as mice and rats, and also rabbits. Only occasionally do they find their way to the poultry yard.

Bounty laws never have exterminated any wide-ranging animal, and in most cases where the smaller species were concerned bounties have not even reduced their numbers permanently. On the Island of Bermuda, with an area of less than twenty square miles, an attempt to exterminate the English sparrow by bounties cost \$2,500, and was abandoned as impracticable. Similar efforts in several American States have caused the expenditure of large sums of money without producing as much reduction in the numbers of the sparrow as has followed a single severe winter. If a standing price sufficiently large could be offered for an animal throughout its entire range its extinction might ensue because of continuous persecution everywhere, in the same way that birds have been extirpated when followed throughout their range by hunters working under the stimulus of a continually rising market price, or as the fur seal may yet be exterminated, despite the efforts of the United States government to protect it; but local or State bounty laws, even if effective within prescribed limits, do not reduce greatly the numbers of a species throughout its range. When a bounty law works effectively in any one State it soon gets to be so expensive that its repeal becomes a necessity and then the persecuted species again increases in numbers. Bounties alone have never brought about the extermination of any species in the United States, and they have never secured results commensurate with the expenditure involved. Several States have paid premiums on bears for many years without much decrease in their numbers. If an animal as large as a bear can survive under a bounty system, how can such a system be expected to extirpate smaller animals? Iowa, Minnesota, South Dakota, Washington and Montana have expended very large sums in bounties on small rodents, but have made little impression on the multitude of these creatures.

BOUNTY LAWS DO NOT PROTECT BIRDS.

In my "Decrease of Birds" the following in substance appears: The main object of all bird legislation is to protect the birds. This can be done by restricting both the number of shooters and the time during which shooting is allowed. Bounty laws have precisely the opposite effect. They encourage boys, foreigners and unemployed persons to roam with guns in their hands through the woods and fields at all seasons of the year, and furnish an excuse for the lawbreaker. This is sure to result in the destruction of game birds and insectivorous birds at all seasons, to say nothing of the poultry and other property of the farmers that, perforce, must suffer. Probably every State that has offered bounties in recent years has had this experience.¹

BOUNTY LAWS DO NOT PROTECT THE FARMER.

The following extract from the letter from Professor Surface, hereinbefore quoted in part, shows plainly how bounty laws eventually result in injury to crops:—

History, which is yet vivid in the memories of most of us, has shown the evils of the bounty system. In the 90's Ohio passed a bounty law; and as that was my native State, in which I was living at the time, I had an opportunity to see the disastrous results. Mice and rats, which are the chief food of such creatures, became so abundant, not only in buildings around the farms but also all over the farm, that a large percentage of the farmers' crops was destroyed by them. I have seen many a clover field with the roots of the clover plants gnawed down several inches by mice. I found it not uncommon for every shock containing corn also to be the abode of several mice of two or more species, and in every case the loss of grain to amount to several dollars per acre. This increase in destructive vermin was so marked that the citizens themselves had to cry aloud for the removal of the bounty law in order that the natural enemies of the pests could increase.

BOUNTY LAWS ENCOURAGE FRAUD.

Bounty acts no doubt are urged by many persons who honestly believe in their effectiveness, but usually the beneficiaries of such laws are among the chief movers for them, and often

¹ Special Report on the Decrease of Birds and its Causes, with Suggestions for Bird Protection, fifty-second annual report, Mass. State Board of Agr., 1909, p. 527.

a large share of the money paid out by the State goes to comparatively few people and is collected largely through fraud and deceit. In my "Decrease of Birds" this is alluded to in the following words:—

Bounty laws always put a premium upon dishonesty. Under the so-called scalp act of 1885, in Pennsylvania, upwards of \$2,000 were realized for a buffalo hide and a mule skin in one county by a party of hunters. These hides were cut up and "fixed" to resemble the scalps or ears of predatory animals. Whether the magistrates also were "fixed" is not recorded. A red fox was slain in one of the mountainous districts and its pelt cut into sixty-one parts, for which the hunter received \$61. Bounties were paid on the heads of domestic fowls, grouse, cuckoos, and even English sparrows, which were supposed to have been palmed off on the authorities as the heads of hawks and owls. Birds and mammals were killed in other States and shipped into Pennsylvania, and large amounts of money thus were fraudulently obtained.¹

This but repeats the history of local and State bounty laws everywhere.

In Massachusetts we had for years a law which provided for the payment of a bounty of \$5 each for seal's tails. Some of the Passamaquoddy Indians shot a few seals in Maine and manufactured from their skins imitation seal's tails enough to take from the different towns in Massachusetts some \$2,500 in bounties. That resulted in the repeal of the bounty law.

Dr. George W. Field, former chairman of the Massachusetts State Commission on Fisheries and Game, asserts that he recalls one instance where one town paid \$1,800 in bounties fraudulently obtained, and another where nearly a bushel of crow's heads was used in collecting bounties repeatedly in a Massachusetts town. In Pennsylvania a single owl furnished three heads on which premiums were paid. When bounties on the same species have been offered in adjacent States premiums have been collected in both States on the same identical trophies.

The heads or other remains of the following mammals and birds are given by Dr. Warren as having been presented in different counties of Pennsylvania where bounties were paid on

¹ See Warren, B. H.: Birds of Massachusetts, annual report, Mass. State Board of Agr., 1890, p. 45.

most of them by magistrates or commissioners who either had no zoölogical knowledge or were influenced by other considerations than that of saving money for the Commonwealth: calf, dog, jack rabbit, cat, squirrel, herring gull, turkey, vulture, osprey, ruffed grouse, sharp-tailed grouse, horned grebe, whip-poorwill, night hawk, shrike. Such heads or other remains were presented, accepted and paid for with the understanding that they were those of wolves, foxes, wild cats, minks, weasels, hawks or owls. Bounties were paid not only on one head of some of these species but on many. The heads of grouse presented for bounty probably were trimmed from birds dressed in the market.

On February 25, 1916, Dr. Joseph Kalbfus, secretary of the Game Commission of Pennsylvania, gave at the More Game Convention of the Michigan Wild Life Conservation Association at Saginaw, Michigan, some experience with the Pennsylvania commissioners in regard to bounty frauds. He said he would not have believed there were so many men in Pennsylvania who would commit perjury for a dollar. One man claimed to have killed 102 goshawks in four days in July. The goshawk is a bird that is not found in Pennsylvania except in autumn, winter or early spring. He also claimed to have killed 347 weasels in two months. The man was convicted of perjury and sent to jail. In one of the northern counties of Pennsylvania tens of thousands of weasel skins were brought in, some of them brought from Pennsylvania, some from Canada, New York, Indiana, Ohio, etc., bought at 6 or 8 cents apiece, and sold to the State of Pennsylvania for \$2 each. One boy was convicted for conspiring with a justice of the peace to make out claims for \$74. The boy did not bring in a feather or a hair, but he got his money. Such frauds were common. Many affidavits were made out in the names of men who knew nothing of the matter. Certificates were raised in amount from \$2 to \$22. These were raised by the claimants or by some one in the offices of the county officials. Justices of the peace simply assumed that men had killed certain animals, filled out papers, signed claimant's bogus names and drew the money. Frauds such as these have been perpetrated on the State of Pennsylvania within the past two years.

In some States one county has required the presentation of the head of an animal for the bounty while another exacted the tail. As a consequence the hunters readily collected a fee from each county. Every State offering bounties while surrounding States did not has had to pay premiums on the heads of predatory creatures from other States.

Such protection as is needed by birds, game and poultry against their natural enemies must and will be given without the stimulus of bounty laws. Self-interest will teach the farmer, poultryman and gamekeeper to destroy any animal that is known to prey on his particular charge. The trapper will keep down fur-bearing animals because of the increasing value of their pelts.

Sufficient protection will be given to birds against their natural enemies by the shooters themselves when they learn what protection is needed. All gunners will shoot the cooper's and sharp-shinned hawks at sight when they know them and know their character. They will also shoot cats, foxes, crows, squirrels and all the enemies of birds indiscriminately, whenever they recognize them as enemies. Hence, so long as we allow the shooting of game, the shooters are likely to keep the enemies of birds within reasonable limits. Crows, foxes and bird-hawks may increase in some cases, owing to their well-known ability to take care of themselves, but the law does not protect any of these creatures, and they may be kept in subjection without bounty laws.

Some of my published observations regarding the operations of special bounty laws follow:—

While the effect of bounty laws in general is bad, the practical operation of laws directed at particular species is certainly vicious. We may regard a bounty on the heads of cats as impracticable for obvious reasons, not the least among which might be the encouragement of a new industry,—the raising of kittens for the bounty. A bounty on cats, foxes, weasels and skunks would encourage trapping, which is already exterminating some of the smaller fur-bearing animals. The experience of States which have placed bounties on the head of the English sparrow has not been encouraging. These acts are said to have resulted in a slight decrease of the sparrows, and the destruction of great numbers of native birds killed and ignorantly offered for bounty. To put a bounty on the head of the sparrow is practically equivalent to offering a bounty on all our native sparrows, many of the warblers, the thrushes, wrens and a few

other species. Anything that at a distance looks like a sparrow would be killed; and probably in most cases the bounty would be paid, unless a competent naturalist could be appointed in each town or county seat to pass on the heads.

If we offer a bounty on the crow, most of the native crows which do the mischief probably will escape, and the bounty will be paid mainly on birds that come from the north in winter. The difficulty of killing crows in the summer prevents many being taken at that time. In the winter most of the crows that summer here probably go farther south, their places being taken by crows from farther north. It is at this time that crows are most readily killed, either by baiting or at their roosts; and therefore most of the crows offered for bounty would be those which never do any injury here, while the guilty ones would escape.

A bounty on hawks or owls would work injury to the agricultural interests. Hawks, with a few exceptions, are useful birds. Owls, most of which are among the most useful of all birds, should be protected by law, rather than proscribed. When in 1886 the people of Pennsylvania became aware of the injurious effects of the "scalp act," Dr. C. Hart Merriam, then ornithologist and mammalogist of the United States Department of Agriculture, his assistant, Dr. A. K. Fisher, and Dr. B. H. Warren, examined over three hundred and fifty stomachs of the hawks and owls killed under the act. Ninety-five per cent of the food materials of these birds was found to consist, not of poultry and game, but of "mice and other destructive mammals, grasshoppers and many injurious beetles." Dr. Merriam says, in his report for 1886: "By virtue of this act about \$90,000 has been paid in bounties during the year and a half that has elapsed since the law went into effect. This represents the destruction of at least 128,571 of the above-mentioned animals, most of which were hawks and owls. Granting that five thousand chickens are killed annually in Pennsylvania by hawks and owls, and that they are worth 25 cents each (a liberal estimate, in view of the fact that a large proportion of them are killed when very young), the total loss would be \$1,250, and the poultry killed in a year and a half would be worth \$1,875. Hence it appears that in the past eighteen months the State of Pennsylvania has expended \$90,000 to save its farmers a loss of \$1,875. But this estimate by no means represents the actual loss to the farmer and the taxpayer of the State." Dr. Merriam then goes on to show the vast loss that must result to the people of Pennsylvania, who, by killing these hawks and owls, have saved the field mice and other harmful creatures on which the birds otherwise would have preyed. The Legislature of Pennsylvania appointed a State ornithologist, and repealed the scalp act. We do not need a "scalp act" in Massachusetts.

The following from Dr. Palmer's summary shows tersely the principal objections to any system of premiums for the destruction of animals:—

Objections to the bounty system may be grouped under four main heads: (a) expense, which is usually out of all proportion to the benefit gained, and may be greater than the county or State can afford; (b) impossibility of maintaining bounties in all parts of an animal's range for any length of time; (c) impossibility of maintaining equal rates in all States; (d) impossibility of preventing payments for animals imported from other States, for counterfeit scalps or for animals raised especially for the bounty. These objections have never been satisfactorily overcome, and most laws have failed through one or another of these causes.¹

CONCLUSION.

In recapitulating, it may be said that this bulletin shows that (1) natural enemies of birds are necessary and desirable, as they tend to maintain within proper bounds the numbers of the species on which they prey; (2) organized attempts to increase the numbers of birds over large areas by destroying indiscriminately all natural enemies are undesirable; (3) under certain circumstances enemies which have been able to adapt themselves to man and his works and have become unduly numerous may require reduction in numbers; (4) individuals of useful species which may become particularly destructive should be eliminated; (5) self-interest on the part of the people most concerned eventually will bring about such reduction of predatory animals as is needed without the stimulus of bounty laws, which in most cases are pernicious and which if enacted at all should be directed only against the larger predatory animals or those which are dangerous to human life or exceedingly destructive to domestic animals or crops.

¹ Palmer, T. S.: Extermination of Noxious Animals by Bounties, Yearbook, U. S. Dept. of Agr., 1896, p. 68.

MANOMET BIRD OBSERVATORY.

