

THE CONTROL OF PREDACEOUS ANIMALS IN MICHIGAN

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THE CONTROL OF PREDACEOUS ANIMALS IN MICHIGAN

by

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Introduction

The control of predaceous animals has been a subject of controversy for so long that today it finds its way into almost every discussion of conservation problems. The discussions, many of which have generated considerable passion, have usually dealt with either what constituted effective or practicable means of control or to what extent it should be practiced. A few have even questioned the value of the practice of any form of control. Ordinarily little if any thought is ever given to the costs ^{or the effectiveness} of control measures. The assumption that some form of control is always necessary seems to be so widely accepted that usually little consideration is given to either its cost or its efficacy.

Ever since 1837, the year in which Michigan made its debut as the twenty-sixth state of the Union, the legislature has been confronted almost constantly with problems dealing with predator control. In ^{its} ~~their~~ judgments, ^{it} ~~they~~ have been considerably hampered due to the lack of reliable information concerning the biological and economic aspects of the problem. During all these years

very little progress was made in reaching any scientific understanding of the biology of predation until within the last decade. Even now we are only beginning to gain some insight into the problem, which technical studies are revealing to be increasingly complex.

In order to acquire first-hand information to aid it in dealing with problems concerning predator control, the Department of Conservation began in 1935 a rather extensive study of the general problem. The report presented herewith is based upon this study. It is hoped that it will be found helpful in developing a point of view among its readers which will be found useful when they are confronted with problems dealing with phases of this subject.

The Purpose of Predator Control

Originally all anti-predator campaigns had for their primary objective the extirpation of the various species considered noxious to agricultural pursuits. They were promoted by farmers with the desire to protect their livestock from wild animal depredations. Wolves evidently always constituted the first species to be placed upon the black list to be destroyed at every opportunity. Other carnivorous mammals and birds were added later. Eventually certain species which foraged upon cultivated crops were added to the list of

so-called

noxious animals. There is ample reason to believe that the working together of at least three elements necessitated the inclusion of the latter species in control programs. First, their natural enemies became so reduced in numbers that they were no longer able to serve as balance wheels or governors of the herbivorous species. Secondly, the destruction of the forests and the increase in acreage of cleared land greatly extended suitable habitats for many species. And finally, with the extension cleared land, the acreage under cultivation also increased making available for the species favorably affected an increasing amount of available food. Thus the lumberman and the farmer worked together much to the advantage of field-loving animals and at the expense of the certain forest loving forms. The field-loving forms were even more favored when their natural enemies, the predators, were reduced in numbers as a result of control operations.

Eventually sportsmen joined the farmers in predator control. Reasoning that if the natural enemies of the game species were destroyed or at least controlled there would result a greater supply of game for their own enjoyment, the sportsmen decided to bend their efforts at predator control. In time almost every species of animal, except those considered game and song birds, became the subject of a persecution crusade, which was financed from public funds at exorbitant costs.

Methods of Control

Bounty System

The first type of anti-predator program to receive official sanction in Michigan was the bounty system enacted in 1838 for the destruction of wolves. This system, which appears to have always been the first official attempt at predator control, had already been in force more than 200 years in some of the states of the Atlantic seaboard, notably Massachusetts (1630) and Virginia (1632). The provisions of Michigan's first bounty law were sufficiently stringent to minimize the danger of fraud, and it authorized the State to pay \$8.00 on adult wolves and \$4.00 for each wolf pup under the age of three months. As time passed, however, the provisions of the law became lax and the rate of the bounty fees increased progressively through eight legislative amendments until 1917. In this year the legislature authorized the State to pay \$35.00 for each adult wolf destroyed and \$15.00 for each wolf pup under the age of six months. These were the highest rates ever paid out as bounty fees in Michigan. No discrimination was made between wolves and coyotes, the same bounty rates prevailing for both species.

The payment of such high fees was bound to lead to temptation to defraud. The laws and regulations governing the administration of this system came to be so flagrantly abused and the costs so prohibitive that in 1921 this bounty law ^{after such controversy,} was repealed. Where the state paid ^{a total} \$232.00 in wolf bounties in 1870, it paid the staggering sum of \$371,236.44 in only nine months of 1922. It is likely that approximately \$1,125,000.00 ^{has been} ~~was~~ spent by the state in its unsuccessful effort to exterminate the wolf and several other predators in Michigan from 1833 to 1922. All this money was appropriated from the General Fund, a fund to which all taxable residents of Michigan contribute, yet it is certain that all of them did not receive equal benefit from these expenditures.

Despite this tremendous outlay of cash during these 84 years, not a single species of predator was eradicated. Paradoxical though it may seem, a new predator, the coyote, entered the state and established itself. Although the species was handicapped during its first years in Michigan because of its being in strange territory and because of its small numbers, the bounty system prevailing at that time proved to be unequal to the task of preventing ^{it} ~~them~~ from becoming established. While it is probable that the wolf population diminished

somewhat during this period, it is also very likely that the depletion of the forests and the steady spread of the human civilization that followed were more potent factors working to the disadvantage of the wolf than was the bounty system. However, it may have been an important supplementary factor.

It will be observed in both cases just described, that of the coyote and of the wolf, that the condition of the environment evidently influenced these species most profoundly. Toward the coyote it was favorable, and toward the wolf it was adverse. The English sparrow offers an excellent example of the importance of environment to a species.

Prominent upon the horizon of our memories is the case of this bird\$, which less than a quarter of a century ago was subjected to the most severe persecution. Numerous in all counties in Michigan, it was considered a pest of the first magnitude. The most intensive efforts at control or extermination proved to be futile. The English sparrows continued to breed and to multiply. But with the passing of the horse and of livery stables from the various communities, it has all but disappeared. Today many of the residents of the northern parts of the state now have grown fond of this bird because it is often the only animal

that remains to animate the landscape and to break the monotony of a dreary winter. In some communities, boys are now even prohibited from molesting them. The English sparrow became scarce not because of the persecution to which it was subjected, but because an element vital to its populous existence had been largely eliminated; namely, horse manure. Today it is most common in rural districts, for in them horse manure is still common.

Being unable to accomplish what it was set up to do; namely, to eradicate the wolf, coyote, red fox, bobcat, certain hawks and owls and other species, this system was a hapless and a costly failure.

Warden-Hunter System
(Federal-State Cooperative System)

After the old bounty system was repealed in 1921, a new system was inaugurated. It was a cooperative venture between the Department of Conservation and the U. S. Bureau of Biological Survey wherein the former furnished the

finances from the Game and Fish Protection Fund and the latter furnished the administrative personnel. Besides destroying predators, the warden-hunters assisted in the work of law enforcement and fire suppression. This was the first time the State engaged salaried men to control predators; and more significant, they began to show some signs of increase. The trend of the

curve (Fig. 1) representing the bobcat take is upward, which indicates that although not so many animals of this species were destroyed, neither were the warden-hunters able to make a noticeable dent in the bobcat population as a whole. An outstanding example illustrating the inability of the warden-hunters to retard the increase of a predator is the case of the coyote (Fig. 2) where the trend of the curve is decisively upward. Evidently they were even unable to destroy the annual increase of this species. The slump of the red fox has been noted above. In accelerating this decline, it is not improbable that the activities of the warden-hunters were quite influential. At the same time, however, it is not unlikely that it is also a manifestation of an approaching low period in their population cycle, which is well known to fluctuate periodically from a high to a low and back to a high again about every ten years. Our figures span too narrow a period of time, however, to be conclusive on this point. Under this system of control, no apparent inroads were made on the wolf population (Fig. 4), although the flatness of the curve may indicate that the warden-hunters were able to destroy a number equivalent to the annual increase each year. Figure 5, a composite of Figs. 1, 2, 3, and 4, plainly indicates that for the populations of these predators as a whole, no permanent inroads were made. The

general increase in the number of predators destroyed from 1922 to 1924 might be attributed to the improvement of the ability of the warden-hunters in pursuing their work. From 1924 to 1932 there was a general drop in the number of predators taken as a whole. Although this curve is strongly influenced by the one in Figure 4 for the red fox, it seems to illustrate something else also. A growing laggardness on the part of the warden-hunters toward their duties would produce the same effect, and the existence of this situation is apparently at least partly responsible for this drop. It is well known that one of the principal reasons for terminating the system was that a personnel of high quality and industriousness was not maintained. Contradictory though it may appear, this contention is supported by the remarkable increase in the number of these predators, particularly coyotes and bobcats, that were destroyed during the year 1934. Because of the agitation that was growing against this system, the warden-hunters evidently became anxious about their jobs and, therefore, they buckled down to work. As a result, inasmuch as it was their duty to destroy as many predators as possible each year, they finished with the most successful year of their history, short-lived though it was.

For various reasons the Federal-State cooperative system became so unpopular that it was discontinued in June, 1934. Among the causes which led to its termination, the following might be mentioned: the cost was high in comparison with the results obtained; as a result of the persecution to which they were subjected, the ranks of the predators were not being decimated; a personnel of high quality did not seem to have been maintained; and many sportsmen began to believe that too much attention was being given to agricultural interests, yet they, the sportsmen, were paying the costs. Farmers contributed nothing toward the maintenance of the system except as they were hunters or fishermen. They, however, appear to have been generally satisfied because if their stock was being molested by predators of any kind, including dogs, a warden-hunter would be dispatched to work on their property until relief was secured.

In December, 1934, the Conservation Commission, after much controversy, authorized a new bounty system, which was written to conform with Section 6240 (f), Chapt. IV of Act 286, P.A. 1929 of the State of Michigan. Nominal bounty fees were authorized to be paid upon bobcats, coyotes, and wolves as follows:

Bobcats

Adult	\$ 5.00
Immature	2.50

Coyotes and Wolves

Adult males	7.50 (raised later to \$10.00)
Adult females	10.00
Immature (either sex)	5.00

The rules and regulations governing the procedure necessary to receive bounty payments were sufficiently stringent to discourage any marked dishonesty. Payments were made upon trapped or shot animals only; unborn, poisoned, or snared carcasses being ineligible. The animals were considered immature up to September first of the year in which they were born. Before any payments were made, however, it was necessary for the trapper or hunter to procure a contract with the Department of Conservation, which ^{was} ~~is~~ issued only to bona fide residents of the State of Michigan after they have become equipped with a small game license and a permit to carry hunting arms during the closed seasons on game. Not later than one month after the predator or predators were taken, the entire cased skins were to be turned over to the Department of Conservation along with a notarized affidavit stating when, where, and how the animals were taken. The pelts thereupon became the property of the Department and were sealed with a serially numbered metal tag and imperforated in several places with the letters "P.A." (predatory animal) by means of a hand stamp. The serial numbers of the seals were added to

After properly completing this procedure, a payment certification form was prepared, a copy going to the trapper and the original to the main office of the Department at Lansing, where the voucher necessary for payment was prepared and sent to the trapper. The proceeds from the sales of pelts thus collected are added to the Game and Fish Protection Fund, from which the bounty payments were likewise made. The sum of \$40,000.00 per annum was set aside for this purpose.

Upon a basis of cost per predator destroyed, this system proved to be economical during the first two years (1935-36) of its operation (See Table I). Whereas the average cost of destroying a predator under the warden-hunter system was \$35.04, it was reduced to \$8.19 under this system. Besides there was an enormous increase in the number of predators destroyed (Table I and Fig. 5), and fraud, if any had existed at all, was of a most trivial nature. There was a marked increase in the number of bobcats destroyed (Fig. 1) and a prodigious increase in the number of coyotes destroyed (Fig. 2). No bounty fee was paid on red foxes, but on wolves there was a noticeable decrease (Fig. 4) in the number destroyed. As is revealed by Figures 1, 2, and 4, by the end of 1936 there was a decrease in the numbers destroyed of all these species. Since the number of trappers (Table I) was reduced by almost one half during 1936, it seems that the cause of this drop may be in part due to this element. Although, at the same time,

it is not altogether improbable that as a result of the activities of the trappers and hunters during the first year of operation of this system there were fewer individuals of these species available to be destroyed. Nor is it improbable that the species concerned were undergoing a cyclic decline in population.

It was believed by some that the adoption of this modified form of a bounty system for the control of predators was exceedingly opportune. At the time it was inaugurated, many men were unable to secure employment, and it was argued that this program would give idle individuals in the northern parts of the State an opportunity to earn a little cash income. Doubtless as an official organization the Department of Conservation is and should be concerned about the welfare of the state's citizens, but it should not be the duty of the Department to provide the unemployed with welfare work, particularly when it is of questionable value. In periods of economic stress every effort should be made to insure a tangible return for every dollar spent. At present, as at any other time, predator control upon an indiscriminate state-wide basis is obviously of questionable value. There are many game management projects that would appear to be more gainful generally than an unsystematic predator control program. This does not mean that predator control is never justifiable either. On the contrary, it is

very conceivable that such control may be necessary at times for the protection of game species or even domestic stock. But when such cases arise, they should be thoroughly investigated by qualified inspectors to determine the true cause of the situation. If it is then found that predators of one or more species are responsible for the trouble, official agents should be sent to the area to apply remedial measures to relieve the condition.

This bounty system, however, was found to be extremely unsatisfactory by the farmers in northern Michigan. They contended that they were losing sheep in increasing numbers because of coyote depredations. In their opinion, bounties weren't high enough to encourage intensive trapping, and that this system was, therefore, ineffective. Actually, the contention that coyotes became more abundant under this system is not borne out by the available statistics (Table I). Another fault they found, and this perhaps was the real basis for their objection to this system, lay in the conviction that the bounty trappers did not operate trap lines in the vicinity of farms or pastures but confined their efforts instead mainly to the wild lands. When reminded that it was their privilege, if not their duty, to destroy the alleged culprits in order to protect their stock, and that they were even offered a reward for doing so, it was found that they

lacked either the inclination to trap, or they believed the coyotes to be too "smart" for their ability.

Investigations of sheep pastures in several counties of ^{the} northern one-half of the Lower Peninsula in the spring and summer of 1937 revealed that:

1. Sheep pastures were for the most part fenced, but that the fencing was often in a dilapidated condition. Where fences were in a good state of repair and built of woven wire, the construction was sometimes such that it would be easy for predators to enter the pasture by going under it. In either case they largely failed to give sheep the proper protection from roving predators, be they bears, coyotes, or dogs.

2. While it was often difficult to distinguish between coyote and dog "signs" at this time of the year, it seems that marauding dogs were at least equally as responsible as coyotes in molesting or destroying sheep. In the spring bears seem to be the chief cause of trouble.

3. The parties involved could have provided their flocks with better protection by properly fencing their pastures, by maintaining the fencing in good repair, and by not permitting their dogs to run at large, particularly during the night. Some dogs seem to manifest a dual personality just as plainly as do some

people. The ^{basal} story of Dr. Jekyll and Mr. Hyde is a familiar ^{story} example of a man who led two opposite lives.

{Combined Bounty and State Trapper-Instructor System}

The feeling of dissatisfaction from this quarter became so intense early in 1937, however, that the legislature at that time passed a coyote and wolf bounty law (Act 52, P.A. 1937) which provided for "the establishment of a system of state trapper-instructors; to preserve and encourage the raising of livestock; to provide for the control of coyotes and wolves by the payment of bounties; to establish a rate of bounties thereon; and to make an appropriation to carry out the provisions of this act."

An appropriation of \$75,000.00 per year each for two years ending June 30, 1939, was authorized by the legislature to be taken from the General Fund of the State and administered for this purpose by the Department of Conservation. For the per annum salaries and expenses of the trapper-instructors, \$25,000.00 was allotted--the remainder of the annual sum was set aside for the payment of bounty claims. If this sum of \$50,000.00 per annum was found to be insufficient, the Department of Conservation was authorized to supplement it with an amount not to exceed \$40,000.00 per year from the Game and Fish Protection Fund.

Under this revised predator control system, effective July 1, 1937, the bounty fee paid on male coyotes and wolves was raised to \$15.00 per head, and that on females of the same species to \$20.00. Bobcats were dropped altogether from the bounty list. The procedure to become eligible to collect bounty remained the same as for the previous system except that the entire carcass of the animal to be bountied and sealed was presented to and appropriated by the Department.

This system, still in force, seems to have been accepted, particularly among the agricultural interests. It is also likely to remain in force until another sweeping wave of state economy occurs. According to common opinion in the northern sheep raising districts, the coyotes are either decreasing in numbers or are under control. This contention seems to receive some confirmation in Table I and Figure 2.

Besides the stipulation that has been offered by the state since 1935 as bounty payment for the destruction of coyotes, several counties have offered a bounty fee of \$5.00 additional for the same purpose. In offering this supplemental fee, the counties have hoped to encourage a greater destruction of coyotes

in their constituencies. It has long been recognized that unless all the counties agreed upon and practiced a uniform system, such attempts would be undesirable because they would encourage the importation of predators from neighboring districts. This effect is well illustrated in Fig. 6, which shows what happened in Presque Isle County as a result of paying a bounty fee of \$5.00 for the destruction of coyotes in addition to what was paid by the state. Its neighbor counties did not offer any additional bounty fees, and consequently as indicated by the density of dots along the western and southern boundaries of Presque Isle, those trappers who could or would, presented their coyotes for payment in this county.

{Hunting for Sport}

Another method of control that is gaining increased popularity in Michigan is the hunting of certain predatory species for sport. The red fox has long been hunted with the aid of hounds and more from the standpoint of an exciting sport than as a control measure. The thrills of the chase were the primary incentives, while control came as a secondary result. But in recent years the hunters have extended the scope of their sport in increasing numbers to include the bobcat and the coyote, the latter of which can furnish a most exciting and thrilling hunt. There is good reason to believe that the populations of both the bobcat and

the red fox can be materially reduced by hunting pressure. This possibility has not yet been demonstrated with regard to the coyote, but doubtless this is because it has been hunted considerably less intensively. The practicability of successfully hunting coyotes with dogs has been amply demonstrated, both in Michigan and other states. In the West they have been successfully hunted with dogs for generations. For obvious reasons, the smaller breeds of dogs are unsuitable for this sport. Foxhounds, grayhounds, staghounds, and wolfhounds, however, are considered excellent.

Because the demands of this exciting sport require the utmost in skill and endurance, a hunter experiences a rare sense of achievement and pride upon successfully bagging his quarry--a coyote. With a little practical experience, judicious reasoning, and good hounds, there is no reason why any persevering hunter should not learn to hunt these predators with success. One important advantage that predator hunting has over all other kinds of hunting in Michigan is that there are no closed seasons. Anytime a hunter or a group of hunters ^{feel} get the urge, they are at liberty to go into the field ^{to} and relieve themselves.

If it should come to pass that the group of hunters following this sport in Michigan became sufficiently large and successful to exert a controlling influence upon the several predator populations, this degree of control may be found

to be ample. If such an attainment could be closely approached in the name of sport, it would no longer be necessary for the State to spend money from any of its funds for predator control purposes. The money that is now spent toward this end could then be spent, more profitably it is hoped, for other more gainful programs--programs for which the results would be more tangible and perhaps more worthy.

To prevent any increase whatsoever in the populations of the several species of predators, it would be necessary that a number equal to the annual increase of each population meet destruction each year. What percentage of the several populations is destroyed in the name of control each year remains unknown.

Coyotes, for example, are believed to have a potential annual increase of 300%. If this were realized each year and no decimating elements worked against the coyote, in the short span of five years one pair could aggregate 512 individuals, in ten years the population would mount to 524,288, and in twenty years it could reach the prodigious number of 549,755,813,988 individuals. In attempting to prevent the increase of a species with such a great potentiality for increase, the efforts at control as indicated in Table I are puny. Very

obviously there must exist extremely potent natural decimating elements, or else we would have long ago been overrun by this species--there would not even be standing room for them nor would there be any food for them.

The Need for Predator Control

{Justifications}

There can be little doubt that so long as populations of the several species of predators persist (and it is more than likely that they will be with us for some time to come), the need for some form of predator control may always be necessary. The mere presence of predators because of their inherent predaceous habits constitutes a potential hazard to those prey species which have come to be highly valued by man. Occasionally their depredations may be of such a nature that control measures directed against them are amply justified.

In the past anti-predator campaigns, as already mentioned, had for their primary objective the extirpation of the species considered noxious. To attain this goal, it would have been necessary that the system have wide geographic application--wide enough to include the entire breeding range of the species involved. Failure to do this leaves populations so situated that their surpluses would have available territories for reoccupation in which their species had been decimated or exterminated altogether, and in which they could readily move. This would have the effect of so mitigating the struggle for existence

in those parts of the species' range which served as a repopulating reservoir, that a continuous flow of individuals would always be maintained into those parts of the range in which the species was undergoing decimation. Thus it will be seen that the attempt to extirpate a predatory species under these conditions would be just as effective as the attempt of a boy to bail out Lake Superior with a beach pail. Actually this is about as much success as such anti-predator campaigns have had, for it has been a practicable impossibility to cover a species' range with this thoroughness. The net success in Michigan is shown in Figure 5.

In striving to control predators today, the objective should no longer be one of complete extermination, but rather to effect sufficient control locally to protect the special interest, be it game or domestic livestock, which may be exposed to ^{such a} ~~this~~ potential hazzard. While there may be no end to the necessity of practicing control measures in this manner, it will have the advantage of being relatively less expensive.

{Objections}

While there is apparently justification for predator control, it is not without its objections, most of which apply more to the methods in practice than to the necessity of control. We have already seen that the old bounty and

the warden-hunter systems were grossly exorbitant when considered in view of the results accomplished. Under the old bounty system the costs of operation and administration were paid from the General Fund. As a result, in most cases those counties which contributed the least in taxes toward the maintenance of the General Fund, drew upon it most heavily for bounty payments. The same general situation prevails today with regard to the modified bounty system now in force. In like manner those who pay the most into the General Fund reap the least in benefits. Under our present system, as under the old, the trend of the average cost of destroying a predator is upward. In other words the cost of destroying a predator is increasing each year. However, the records do not span a long enough period of time, in years, to warrant their being used without qualifications. But the questions can be asked, "Are we getting an appreciable or a measurable return for our investment?" "Does control pay?"

An untoward effect of the bounty system is that it encourages certain people to try to make a living by trapping for bounty fees. It encourages others to attempt to make a living off wild land generally. There was a time, it is true, when this could be accomplished with considerable success and with substantial returns, but this is no longer possible in Michigan.

Another unfortunate feature of a bounty system, or for that matter any system that uses traps, lies in the fact that traps are scattered extensively over the wild lands by trappers at all seasons of the year. Thus, not only are the predaceous species exposed to the perils of set traps, but so are the more fully appreciated forms: deer, grouse, hares and rabbits, skunks, badgers, raccoons, foxes, woodchucks, porcupines, and so on. Traps with toothed jaws are especially wicked in this respect, for they seriously mangle the limbs of the captured animal. Usually it is useless to release a valuable form after it has been captured in one of these traps. If a deer, for example, steps into a smooth-jawed trap, usually it can escape by pulling the befouled foot free-- but not so with a toothed trap. Traps of this type should be outlawed from use altogether. It is a common opinion among trappers that before the coyotes or wolves can be trapped successfully, it is necessary to "clean" the territory of a number of these other species. The more skillful trappers maintain, on the contrary, that it is unnecessary to capture other species, but even if this be true, few of the bounty trappers can be classed as skilled.

As long as a bounty system prevails, it is virtually useless to have a closed season upon raccoons and badgers or to strive to add the skunk and the fox to the list of species protected by a closed season. Almost any trap set

for coyotes or wolves is at the same time a potential set for any one of the species named above. Perhaps most trappers know this, but few will admit that they do. Some of them contend that blind or trail sets are less dangerous to animals other than those for which they are set than are bait or scent sets, but actually they differ little in this respect--they are equally destructive.

On an experimental trap line approaching fifty miles in extent ^{in the U. P.} on which the writer assisted in October, 1935, the following animals were captured: 17 coyotes, 8 porcupines, 5 skunks (one of which was captured three times in the same trap), 1 bear, 1 badger, 1 raccoon, 2 snowshoe hares, 5 red foxes, and 2 ruffed grouse. The writer's partner was an experienced and competent coyote and wolf trapper; and bait, scent, and trail sets were used. Perhaps if it continues to be necessary to retain a bounty system, it would be better to pay bounty fees on coyotes and wolves captured during the autumn or winter months only. Be-
of
cause/hibernation, several of the forms mentioned above would then be spared the trap hazard. In addition, the fur of the coyote, fox, and wolf then would be worth more commercially, because of its superior quality at these seasons. Summer pelts are almost valueless. In fact, it doesn't pay even the Department to handle skins taken during this period.

Predator Control in the Light of Biology

The Habitat

Since 1837, when the first official attempt at predator control was made in Michigan, approximately \$1,750,000.00 has been spent for this purpose. Yet not a single predatory species has been exterminated, and paradoxically enough, our most unpopular predator, the coyote, entered and established itself in at least the northern two thirds of the state.

The Wolf. It is true that the wolf population has diminished and that its range has been reduced to the Upper Peninsula during the last one hundred years. But as already pointed out (pp. 2 and 3) there is good reason to believe that these conditions have come about as a result of the changes that have taken place in the wolf's environment. Our wolf is essentially an animal of the forest wilderness and it does not appear to thrive in close proximity to civilization. With the destruction of this habitat due to lumbering operations and with the consequent spread of civilization, the wolf had to go. Its persistence in the Upper Peninsula today is more than likely due to the fact that areas of considerable size, which are in many respects virginal wilderness, remain to serve as

breeding and hunting grounds for the wolf. It appears, too, that to be suitable to the wolf, these areas must be of a size sufficient to include most of its cruising territory. Occasional reports are received attesting to the occurrence of this species in the Lower Peninsula, but none of these have been verified. The elimination of the wolf as a member of our complement of wildlife species, it would seem, could be brought about by destroying our wilderness forests. But who would want to do ^{that} that?

The Coyote. Altogether different from the wolf in its habitat preferences is the coyote. It is equally at home, not only in the wilder areas, but also on the lands bordering rural districts and outlying towns. It is thus somewhat of a commuter between the wild and the civilized. Where the early lumbering operations and the spread of civilization that followed appear to have been adverse to the wolf, they seem to have been amply favorable to the coyote. Our present population of this species has been derived from invaders which entered the Upper Peninsula from Wisconsin during the first decade of this century. By the end of the second decade, they had spread well across the Upper Peninsula. Since that time they have invaded and established themselves in the northern one half of the Lower Peninsula. The frozen Straits of Mackinac very probably served as the avenue of migration. Eventually, they may even establish themselves in

limited numbers in the rural districts of southern Michigan. Even now they are occasionally reported or killed in this region; and ^{since} ~~with~~ suitable breeding grounds ^{are} available, there is no reason why they should not establish themselves in limited numbers as they appear to be a very adaptable species. Some of the individuals in southern Michigan may come from Indiana, but this source constitutes a minor hazard in comparison with that of northern Michigan.

The coyote has, therefore, invaded, spread, and established itself in about two-thirds of the area of the state, and may be in the process of accomplishing this in the remaining one-third. It has been successful in these processes so far, despite all attempts at extermination. This species seems to be so adaptable and successful that there does not appear to be any practicable way of influencing it adversely by altering its environment. The protection of special interests from its potential depredations seems to be the only means of combating it. To be economical, control cannot be of a widespread or promiscuous nature.

Ontario is having and has had a similar experience with the coyote. At the beginning of this century their range was confined to the extreme southwestern corner of the province. Since that time they have spread north almost to Hudson's Bay, east to Quebec, and south almost to Lakes Erie and Ontario.

This spread has made constant progress despite the fact that during all this time bounty fees have been paid for their destruction.

It is important to note in the words of E. C. Cross that "In the face of this wolf population, the white-tailed deer has spread north some three hundred miles. Not only have these deer penetrated this wolf infested territory, but they have established themselves there, increased in numbers and have continued to spread out in the very teeth of the wolf pack."

The Red Fox. Just as the coyote is easily satisfied with regard to a habitation, so is the red fox. It occurs throughout the state, but it is much less common in the Upper Peninsula than it is in the Lower, where it reaches its greatest abundance in the northern one half of the peninsula.

Aside from food, which it can find with relative ease almost anywhere in the state, its most urgent requirement is perhaps a suitable place in which to rear the young. It does not seem, therefore, that it is practicably possible to control this animal by attempting any environmental adjustments. Nor does this or any other form of control directed against the red fox seem to be necessary. Although it would be desirable to protect this species legally by means of a closed season along with a generous open season, it does not now receive any such

protection. It may be destroyed at any time of the year, and people who may be annoyed by its occasional depredations have the privilege of destroying the offending culprits.

The Bobcat. The bobcat prefers as its abode in Michigan the wilder lands that are considerably broken by the generous interspersion of swamps. Its range is restricted to the Upper Peninsula and the northern one half of the Lower Peninsula. It is almost equally abundant in both regions. Somewhat like the wolf and different than either the coyote or the red fox, it chooses the isolation of the wild to close proximity with man. Because of its love of the swamp, it would appear that with the elimination of this habitat, the bobcat would be doomed to extirpation. But if this were done, what would happen to the other wild species, notably deer, that rely to such a great extent upon the swamp for their existence.

Carrying Capacity. Not only do the predators show some preferences in their choice of habitats, but so do the other animals. Obviously, however, all the individuals of a species who wish to live in a particular situation cannot always do so. The habitat has definite powers to determine just how many individuals of the various species it can accommodate. First, there is room for only

so many individuals; and second, there are definite limitations to the food supply. For example, if it were profitable to raise fifty sheep on a one-hundred acre pasture of improved land, it does not necessarily follow that if the flock of sheep were increased to seventy-five heads that the profits would be greater by fifty percent. As a matter of fact, if this increase of fifty percent is in excess of the carrying capacity of the pasture, the profits may be considerably less due to loss of stock through starvation or run down condition and so on. Even the quality of the pasture may be so destroyed that it would be impossible to maintain the original heads.

The carrying capacity potentialities and limitations of natural habitats appear to be just as precise as they are for pastures. The sizes of the several predator populations are limited by carrying capacity factors in the same way that sizes of game populations are. When a given habitat becomes filled to capacity with a particular species, it is said to have reached its saturation point for that species--the population has reached its maximum density for that habitat. The destruction of all the predators in the region will not permit the habitat to hold any more of the species.

If there happens to be more deer in a certain habitat than it is able to accommodate, the excess overflows, so to speak. This surplus must do one of three things; namely, stay and die, move out, or stay and cause another deer to either die or move out. We have already seen the adverse effect the loss of one habitat component, food, had on the English sparrow. We all know that although song birds, the robin for example, have been protected for years, the density of their populations is definitely limited. Were it not for the environmental restrictions, which are imposed upon them, we would most certainly be overrun by them. Available food and space, competition among themselves and with other species of similar requirements, predation, and parasitism are some of the elements of the environment which serve to control population densities.

Evidence is accumulating steadily which is proving more and more convincingly that those animals situated within the carrying capacities of their respective habitats are relatively immune to predation. ^{It is} ~~They~~ are proving at the same time that it is mainly the surplus populations of several species which are insecurely situated that fall victims to predator attacks. Under these circumstances, it will be seen that predation is, at the most, a secondary element affecting their populations. It has been found, for example, that securely

located populations of quail rarely suffer winter population losses as a result of predation which exceeds the rate of six per cent per ninety days.

Furthermore, the rate of predation did not become proportionately higher as the population densities increased, "provided that the carrying capacities of their environments were sufficiently high to accommodate them properly."

Swelling and Shrinking of Population

Striving to control predators with the hope of increasing the game supply under these circumstances would appear ridiculous. In summing up historical reports, it is found that Michigan's ruffed grouse and snowshoe hare populations have swollen and shrunk in a cyclic manner for generations despite all attacks on the predators. The white-tailed deer population made its greatest increases in modern times following the era of successful prevention and suppression of devastating annual forest fires. As the extent of their habitat increased as a result of protection from fire, they too increased in numbers.

Notwithstanding the fact that wolves have been subjected to indiscriminate attack for more than a century in Michigan, and bobcats, coyotes, and red foxes for lesser periods of time, not one of them has been extirpated. The importance to them of the environment has already been discussed. It seems to be well established that the populations of all of these species fluctuate in a

cyclic fashion, just as do those of the ruffed grouse and the snowshoe hare.

While our records are too incomplete to show this, those of the Hudson's Bay

Fur Co. ^{illustrate} show this very well. The causes of these cycles still remain so ob-

scure, that they ^{are} ~~remain~~ pretty much in the realm of speculation. Periodic outbreaks of disease have been one of the popular explanations for the occurrence of cycles, but the theory is not yet very well confirmed.

In the summer of 1935 at Cusino several coyotes were captured which were afflicted with a mange-like disease. One of these was sent to the University of Michigan for observation and study. It was kept in a pen at the George Reserve near Pinckney, where it died during the ensuing winter, apparently from exposure to the cold. Except for an occasional tuft of fur, its hide was mostly depilated. While this pathological condition may be a natural means serving as a governor on coyote populations, its extent and importance are unknown. At any rate, for the past three years coyotes have steadily decreased at Cusino, and it seems probable that other poorly understood factors have been at least as equally responsible as the bounty system for this shrinkage.

Food Habits of Predators

It should be emphasized that the predatory mammals we are considering do not rely entirely upon game, particularly deer and grouse, for their food in Michigan. Studies of their food habits mainly during the fall and winter months (Table II) are revealing with increasing conviction that for their diet they accept a wide variety of food materials. In our studies, so far as they have gone, birds of all kinds have been found to be relatively unimportant as potential food for the predators except perhaps the red fox. But even in the fox's diet this food group is not nearly so important as are foods from several other groups (Table II). The bobcat, coyote, and wolf appear to utilize rather extensively the big game mammals, comprised mainly of deer, as food. This, perhaps, is not due so much to sheer preference as it is to the ease with which deer may be procured. We have seen that a habitat has potentialities for supporting only a limited number of animals, that if there are more than this number, the surplus is likely to be adversely affected. This seems to be the situation relative to the deer, whose winter range is obviously more than saturated. For this reason we can expect that winter depredations might be somewhat heavier than they would otherwise. Furthermore, all the deer upon which they feed does not become available as a result of depredations; much of it is carrion taken from deer which have died as a result of starvation.

The small game and fur-bearing mammal group is comprised chiefly of hares and rabbits. To all the predators these are important food species. In Michigan it remains to be demonstrated, however, whether or not the predators impede these species in regenerating or maintaining their populations, although it is well known that the snowshoe hare is subject to violent fluctuations in population density and that its population continues to either shrink or swell cyclically without any apparent relation to predation. The hares may cause more suffering among the predators than the latter do among the hares.

Another source of food is the group of small, non-game mammals (Table II) which is almost or equally as important as are the hares and rabbits. They are known as buffer species, because it is believed that in preying upon them, predator pressure is diverted from the game species.

The several predators also feed extensively upon carrion, but it is difficult to determine with accuracy just what proportion of their diet is composed of such material. This is because it is not always easy to identify carrion in their stomachs. If decomposition has progressed far enough, carrion is easy to recognize, but with recently dead material the matter is different. It is

then impossible to say with certainty whether the food material in the stomach represents an animal killed by the predator, or whether it had died recently from some other cause. This difficulty is particularly annoying with stomachs collected during the winter from the northern, snow-bound regions. There are times when a deer for example could fall dead for some reason or other on Thanksgiving and be as fresh on April Fool's as when it had fallen.

Domestic Livestock and Predation

It is common knowledge that the predatory mammals prey to some extent on domestic livestock. These depredations were the cause of the original attempts to exterminate the predators. Vast sums of money have been spent toward this end, yet the predators are still with us. Through the foregoing discussion explanations are given as to why these attempts failed to achieve their objective, so it is not necessary to discuss them again here. At this time an effort will be made to discuss the relation of the several predaceous mammals, upon which attacks have directed, to various breeds of domestic stock. The purpose will be to point out the correlation between exposure of stock and depredations.

It would be useless to deny that wolves constituted a serious menace to farm livestock in the past. During the era of pioneer agricultural development they were probably always a hazzard to the farmer's success, and doubtless

destroyed much stock. Throughout this time wolves were generally distributed over the state, and it was difficult or impossible for the farmer to give adequate protection to his stock.

It is extremely doubtful, however, if wolves ever molest or destroy domestic livestock in Michigan today. As already pointed out, the range of the wolf has been much reduced because of the changes that have taken place in its environment as a result of the lumber industry and the extension of civilization in one form or another. In fact, the range of the wolf appears to be so thoroughly restricted to the more remote sections of the state that there is little opportunity indeed for it to come in contact with more than a most insignificant percentage of livestock. If any domestic animals are preyed upon now by the wolf, it can be concluded with reasonable assurance that the stock was exposed to attack by allowing them to run or forage through regions of essential wilderness.

The place that was formerly occupied by the wolf as a constant potential menace to domestic livestock has now perhaps been taken over by the coyote. They have come to be a nuisance only during the last quarter of a century. Previous to this time they were evidently exceedingly rare in Michigan. Today they are without doubt our most abundant, unpopular and maligned predator.

Much of their ill reputation has been earned by them as a result of their predatory activities, and much of this has been amplified by prejudice. They are by nature carnivorous, of course, yet all of their food is not made up of the flesh of animals killed by them. Studies of their food habits in Michigan have revealed that much of their food is made up of carrion. With regard to domestic stock, only about five percent of the stomachs examined have contained any sheep, some of which may have been carrion. Remains of other domestic animals were found only in traces and it was mainly bait material.

It does not require any stretch of the imagination to realize that if domestic livestock were given adequate protection, it could be protected from the occasional depredations of coyotes altogether. Neither does it require any stretch of the imagination to realize that if this were done, the money that is now mostly squandered for promiscuous predator control by the state could be spent more wisely for worthier causes. This does not mean to imply that predator control is an unworthy cause; it means that as it is practiced today it is largely ineffective. ^{See here} At the rate we are going, we will be spending huge sums of money until eternity without accomplishing anything at all.

It is strongly believed that if efforts were bent toward giving livestock direct protection by means of good fencing instead of directing promiscuous attacks against the predators, much money could be saved and at the same time the

livestock would be made secure from depredations.

The red fox probably constitutes no menace whatever to the larger varieties of domestic animals, particularly when they are adult. Most of its unpopularity comes as a result of its occasional depredatory forays among poultry, those that are not given adequate protection. Studies of their food habits have revealed that a good share of the poultry they consume is carrion, which is found, perhaps, on dumps in the form of offal.

If the bobcat preys at all upon domestic livestock, it is of such a trifling nature as to be insignificant. Because of the nature of its habitat preferences, depredations against domestic animals would indicate, however, that the stock was permitted to run without protection.

{Protection of Domestic Livestock from Predator Attack}

If Michigan is going to continue to encourage the livestock industry, and it should so far as it is economically feasible, might it not be much better business management in the long run to protect livestock with adequate fences? Any important industry should be worth enough security to make it profitable provided that it is not otherwise a liability. It seems obvious that regardless of what system of control is practiced, there will be no end to their populations unless something catastrophic happens to them. This means that upwards of \$25,000.00

will be spent annually to destroy predators indefinitely into the future, yet to no demonstrable avail. With the state debt increasing is it justifiable to spend huge sums of money for an activity of questionable value at the most? In the long run it would probably be cheaper for the state to provide farmers with predator-proof fences than to continue to pay bounties, for eventually all the pastures would at least be fenced. The cost should be borne by the industry, those who are receiving the benefit, however, and not by the entire commonwealth.

In one western state, New Mexico, ranchers are finding it much to their advantage to protect their sheep with predator-proof fences. Where our farms are measured in acres, their ranches are measured in terms of sections, many of which ^{spread miles} average thirty to thirty-five sections in area. The posts for the fences are set about two feet in the ground and about two rods apart. A thirty-five inch net wire is then hung on the posts and fitted closely to the ground and this is important. Two to four strands of barbed wire are stretched above the woven wire. Finally rock is laid along the base of the fence to exclude predators, or instead of rocking, an eighteen-inch width of wire mesh is stretched on the ground adjacent to and inside of the fence. Rocking, however, is preferred. The rancher

usually turns the job over to a contractor who does it at a stipulated price per mile. The total cost runs from \$250.00 to \$350.00 per mile or seventy-five cents to one dollar and five cents per rod. But according to the ranchers, savings in wages, lambing expenses, stock and so on, soon pay for it.

In 1907 the United States Department of Agriculture conducted on a large scale an experiment designed to test the efficacy of predator-proof fencing. As a result of their experiments, they successfully developed a predator-proof fence, the specifications of which are given below: Eight-foot posts were used which were set two and one-half feet into the ground and sixteen feet apart. Midway between each two posts, a three-inch stay was set six inches into the ground. Along the line of the fence, the ground was leveled by cutting through the humps and filling the cavities. One inch below the surface of the ground there was stretched a strand of "hog-wire" with four-point barbs spaced two inches apart. A forty-two inch woven lawn fence with a four-inch triangular mesh was hung on the posts three inches above the "hog wire." One strand of barbed wire was stretched four inches above the woven wire, another six inches above the first, and a third strand six inches above the second. Altogether this makes a fence five feet in height above the surface of the ground. The cost of materials for this fence was \$270.00 per mile or eighty-five cents ^{rod} per foot.

Among the numerous advantages that have been reported for sheep domestic livestock. An exception perhaps is the wolf, which does prey considerably upon the domestic hare and deer. However, an important part of the necessary security from attacks by predators; 2. There is an increased number of lambs reared, because the ewes are not molested during lambing and, therefore, they have a stronger tendency to claim their lambs; 3. The lamb crop increases in value because of its earlier maturity and better condition; 4. The control of contagious diseases is facilitated provided that the stock is given ample inspection; 5. The death rate is reduced; and 6. The size of the herd can be increased at a lower cost and in a shorter period of time.

Conclusions

It is not unlikely that the control of certain predators will be necessary and justifiable in certain situations indefinitely. Perhaps there is more justification to practice control when a game population in a particular situation is exposed untowardly to attack by predators than otherwise.

We have seen that studies of the food habits of those predators discussed in this report are revealing with increasing persuasion that they do not

subsidize in the main upon either game (excepting hares and rabbits) species or as a result of dependence upon the care they have received from man through the

Despite these conditions it is difficult to demonstrate with convincing proof that the predators we have been considering, prey to any significant extent upon either wild game or domestic animals.

It is a matter of common knowledge that both the ruffed grouse and the snowshoe hare fluctuate extremely in population densities periodically. Because of the regularity of the occurrence of the fluctuations from a maximum to a minimum and vice versa about every ^{five or six} ~~eleven~~ years, they have been called cycles. The populations of these two species shrink and swell without any regard to depredations. Even the predator populations show the same rhythmic changes in density. At the present time both the ruffed grouse and the snowshoe hare show a marked "comeback" and there is ample reason to believe that it is due to an upswing in their cycles rather than to predator control.

Recommendations for the Future

In view of this discussion, it is recommended that:

1. The clause in the "Coyote-Wolf Control" law (Act 52, P.A. 1937) authorizing the payment of bounties upon coyotes and wolves be repealed, retaining that portion of the law authorizing the Department of Conservation to engage "trapper-instructors."

2. The "trapper-instructors" become state-trappers who would trap or remove predators or other animals in situations where they upon occasion become a nuisance.

3. The official activities of the state-trappers be subject to approval from or sanction by the Game Division of the Department of Conservation, inasmuch as this division has been entrusted with the management of Michigan's complement of wildlife.

4. The state departments concerned or benefitting share jointly the cost of this system.

5. The wolf be removed from the bountied list. This vanishing wild dog adds immeasurably to the attractiveness of the wilderness. Instead of seeing only poorly mounted specimens in museums or disheveled animals in zoos, future generations may give us credit for giving them a possible opportunity to see a wolf, to hear one's eerie howl, or to see signs of one in its natural habitat. Obviously, if wolves become a menace under this plan, control measures would be fully justified and in order.

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TABLE I

PREDATORY ANIMAL CONTROL IN MICHIGAN

Shows the number of certain predators taken by year, the total cost, the average cost per predator, the number of trappers, and the average number of predators per trapper.

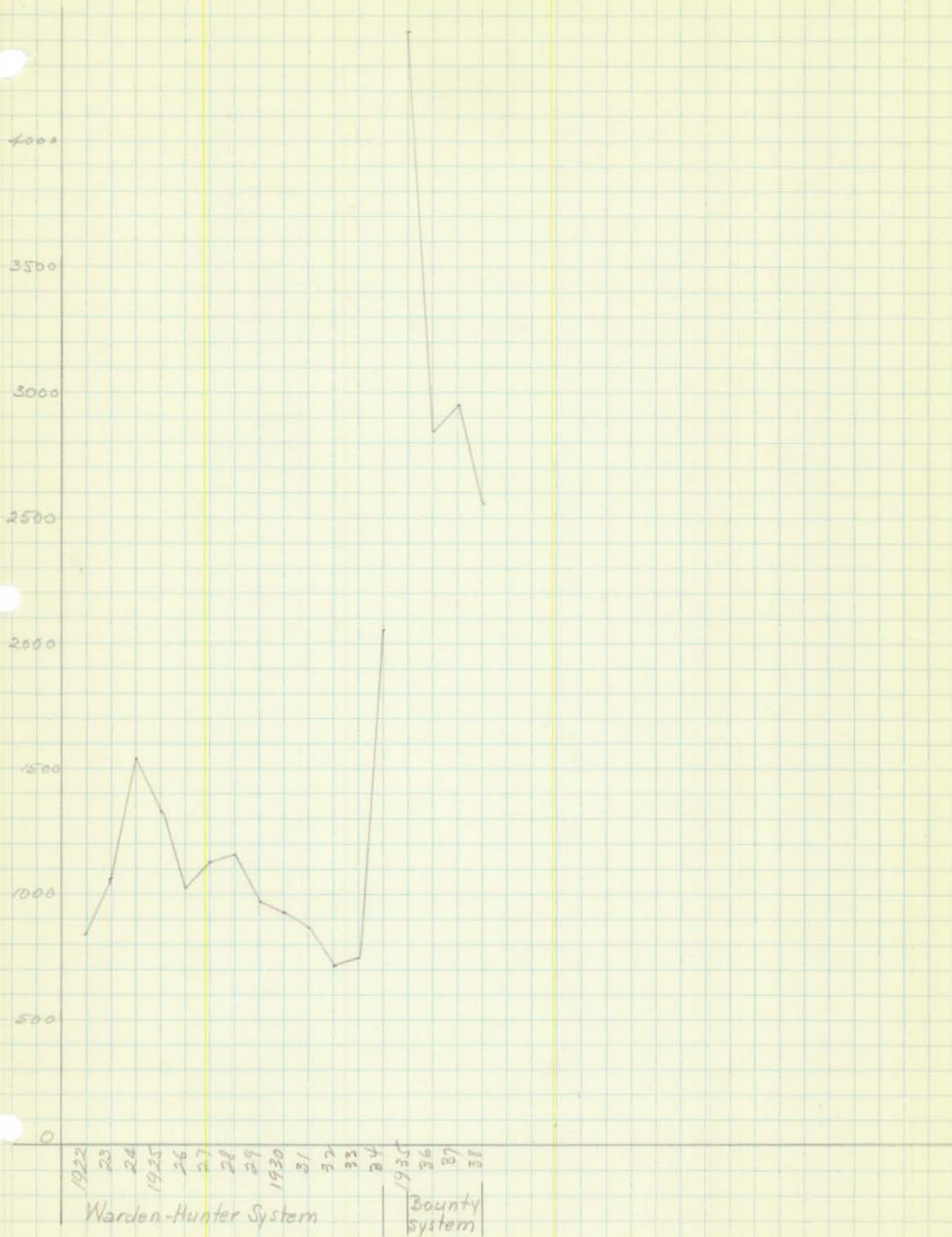
Year Ending	Bobcats	Coyotes	Foxes	Wolves	Total Predators*	Total Cost*	Average Cost Per Predator	Number of Trappers	Predators Per Trapper	Bounty Per Trapper
June 30, 1922	45	252	456	92	845	\$ 34,371.17	\$41.27	25	33.8	
" " 1923	65	393	551	78	1,087	37,725.36	34.71	31	35.1	
" " 1924	53	496	904	85	1,538	39,661.97	25.79	28	54.9	
" " 1925	77	459	704	82	1,322	37,563.00	28.41	30	44.0	
" " 1926	32	453	490	49	1,029	33,864.50	32.91	24	42.8	
" " 1927	87	614	384	50	1,135	54,434.14	47.96	30	37.8	
" " 1928	92	658	314	72	1,166	49,154.60	42.16	30	38.8	
" " 1929	126	591	193	63	983	55,445.26	56.40	23	42.7	
" " 1930	102	651	137	35	925	41,234.09	44.63	23	40.2	
" " 1931	121	619	89	48	877	38,366.91	43.74	21	41.8	
" " 1932	80	473	93	63	709	33,133.67	46.73	20	35.5	
" " 1933	69	457	163	64	753	23,903.96	31.74	19	39.6	
Dec. 31, 1934	252	1,542	195	69	2,058	25,463.00	12.37	13	158.3	
" " 1935	1,293	3,128	0	30	4,451	32,393.01	7.27	2,738	1.62	\$11.79
" " 1936	897	2,920	0	17	3,834	33,850.50	8.83	1,489	2.6	25.43
" " 1937	429	2,499	0	36	2,964	43,562.70	14.69	1,564	1.89	27.85
" " 1938	0	2,512	0	48	2,560	45,995.00	17.93	1,376	1.86	34.88
TOTAL	3,820	18,722	4,708	986	28,236	\$660,673.34				

* From 1922 to 1934, inclusive, many rodents and predaceous birds were destroyed, which are not considered in the above table. It is unlikely that this omission makes any difference in the total cost of control for these years, because these animals were destroyed in the course of routine work.

Table II
RESULTS OF FOOD HABITS STUDIES

Type of Food	Species of Predator							
	Bobcat		Coyote		Red Fox		Wolf	
	Scats	Stomachs	Scats	Stomachs	Scats	Stomachs	Scats	Stomachs
Big Game Mammals (Deer, Bear, etc.)	0	19.0%*	27.0%	22.8%	5.5%	5.0%	37.5%	40.0%
Small Game and Fur-bearing Mammals (Hares, Muskrats, etc.)	0	52.4%	33.0%	41.6%	38.8%	40.0%	37.5%	20.0%
Non-Game Mammals (Mice, Porcupines, Woodchucks, etc.)	0	38.0%	35.0%	25.0%	27.8%	85.0%	12.5%	0
Upland Game Birds (Grouse, etc.)	0	4.8%	0	6.3%	0	15.0%	0	0
Waterfowl (Ducks, etc.)	0	4.8%	1.0%	0	0	0	0	0
Non-Game Birds (Crows, etc.)	0	0	9.0%	10.4%	0	25.0%	0	0
Domestic Animals (Cat, Cattle, Horse, Poultry, Sheep, etc.)	0	0	1.0%	13.6%	0	20.0%	0	0
Other Animals (Reptiles, Frogs, Crayfish, Insects, etc.)	0	0	18.0%	6.3%	0	35.0%	0	0
Carriion (Dead Animals)	0	19.0%	0	27.1%	0	30.0%	12.5%	40.0%
Fruits	0	0	2.6%	5.2%	5.5%	30.0%	0	0

*Read: Remains of big game occurred in 19% of the stomachs, etc.



MICHIGAN DEPARTMENT OF CONSERVATION GAME DIVISION



Fig. 6

Shows the effect of Presque Isle County offering \$5.00 per head more in bounty fees on coyotes than its neighbor counties.

Each dot represents a coyote that was destroyed and turned in for bounty.

They are located where the coyotes were said to have been destroyed.