

MANAGEMENT AND CONSERVATION OF FUR-BEARING ANIMALS ON
NATIONAL FOREST LANDS OF THE WESTERN UNITED STATES

By

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FOREWARD

Fur hunting or fur trading is the oldest industry in the world. "The cave man, who slew a beast with a club to take a pelt for his own covering, was the world's first manufacturer; and his discovery that a pelt would make clothes for himself and his family led far afield to the exploration of half the world." (1)

A small fur-bearer, the beaver, led to the discovery of the Great Lakes, the Mackenzie, the Columbia, and the territory that is now the states of Montana, Idaho, Washington, Oregon, Nevada, Utah, and northern California. The sea otter and fur seal led to the discovery of Alaska and its purchase by the United States. The exploration of the Pacific Coast from the Golden Gate to the Bering Sea was brought about in the search for these elusive fur-bearing animals.

The United States, being a young country, enjoys the advantage of being able to profit from the mistakes of older countries, if it but heeds the examples. Older countries and parts of our own United States now mourn the loss of their fur-bearers and are attempting to rescue the few remaining from complete extermination or reduction to the point where they will be a rarity. They now realize how great an asset these animals are to the country as a whole.

National Forest land, for the most part, is comprised of sections relatively remote and inaccessible. It

lies within the power of such an agency as the United States Forest Service to preserve, propagate, and use to advantage the rich natural resource in the form of our fur-bearing animals. It is also its responsibility as the guardian of those parts of the country so richly endowed.

INTRODUCTION

The purpose of this thesis is to show the need and economic importance of the management of fur-bearing animals on National Forest lands, that could be made to produce an annual crop worth far in excess of their present yearly production and still produce their ultimate harvest of timber or other alternate use. The writer also tries to stress that while additional income is a necessary prerequisite to extensive management operations, the conservation of our declining populations of fur-bearing animals is a needed and worth while consideration.

In presenting the importance of this problem, it is well to first look at it from the strictly economic aspect. There can be little doubt as to the value of an annual fur crop. "No one can deny that it helps large numbers of rural people to make both ends meet. Bankers, merchants, conservation officers, farmers--all subscribe to this fact." (2)

Many resident dwellers surrounded by or adjacent to National Forest lands depend entirely upon trapping and fur trading, as well as bounties paid on predatory fur bearers, for a winter income. Many of these people are employed by the United States Forest Service in the summer season and are released in the fall when their services are no longer required. The "trap line" furnishes them subsistence, and often a handsome profit, during their unemployed winter

months. When they stay on the area throughout the year, these people provide experienced workers year after year for seasonal employment in the National Forests and Park Service. They also furnish valuable sources of wildlife lore and information as to topography and general conditions of remote and inaccessible areas that are their "cropping grounds" throughout the long winter months.

A second economic factor worth considering is that the fur crop today is far short of its magnitude in former years. The increase in value of individual furs is almost incredible. Many of the smaller furs are sold by the trapper for as much or more than he could realize on an ordinary sized gold nugget.

The table on the following page will give some idea of past prices of furs.

It will be noted that there has been a large decrease in price per pelt of many of these animals. For example, the silver fox decreased from a high of \$1,225 in 1920 to \$100 in 1935. The same is true of the mink (for which prices figures are not available). This sharp decline was brought about by ranch raising of fur animals, particularly fox and mink.

Breeding of other fur-bearers in captivity has met with notably few successes to date, mainly due to the high cost of feeding and keeping the animals in individual enclosures. Failure may also be partly attributed to inability to duplicate feeding schedules such as are adhered to in the wild state.

Table I - Price Trends in Raw Furs, 1875-1935

	1875	1913	1920	1935
	dollars	dollars	dollars	dollars
Beaver	1.00	8.00	17 to 20	8 to 10
Ermine	.50	1.50 to 5	.50 to 4	.60 up
Fisher	5.00	15 to 50	143 to 345	20 to 30
Silver Fox	50.00	125.00 up	300 to 1225	100.00
Black Fox	100.00	500.00	----	35.00
Fur Seal	10.00	30 to 125	146 to 165	----
Lynx	3.00	12 to 50	45 to 60	15 to 20
Marten	2.00	2.50 to 20	18 to 60	10 to 25
Muskrat	10 to 12	.40 to 1	5 to 7.50	.70 to 1.60

Note:

Figures for 1875, 1913, and 1920 obtained from "The Fur Trade of America" by Agnes C. Laut, 1921, page 5.

Figures for 1935 taken from "Raw Fur Prices" in Fur-Fish-Game Harding's magazine, March, 1935, page 55.

High markets have stimulated the pursuit of the fur-bearing animals and should now serve to aid in bringing about their preservation, since their true value is shown when the supply diminishes.

The duck hunters have been so active that, to the general public, ducks are about the most important species of wildlife. This is fine, since the migratory waterfowl need such conservational interest badly.

Conservation and perpetuation of our oil, timber, and mineral resources are being brought to public notice until as a nation the United States is becoming conservation-minded. Our fur-bearing animals are a tremendously valuable natural resource that is being constantly neglected or ignored, and, as stated by Frank G. Ashbrook, Principal Biologist, In Charge, Fur Resources, Division of Wildlife Research, Bureau of Biological Survey, "still remains the stepchild in the family of conservation". (3)

Yields from this resource bring an annual income to trappers of the United States of \$65,000,000. The employment it furnishes, plus the annual income, is "sufficient justification for immediate action in order to save what is left of our fur resources". (4)

Many of the finest upland meadows in this country have their origin in the activity of that fur-bearing animal, the beaver, who built his dams, cut down trees, and when his artificially created lakes were filled with silt, moved on to new locations and continued his task.

Many swamps and marshes have been drained and turned to agricultural use. "Some of our tidal and inland marsh areas are capable of producing five, sometimes more, muskrats per acre, not to mention the other wildlife which inhabits such places. At present market prices, the return on an acre from muskrat pelts alone would furnish an income of from \$7 to \$14 each season. No system of cropping this type of land would produce as much." (5)

It is worthy of serious consideration from an economic aspect alone, this production of fur animals as an annual crop.

Leaving the economic side of the picture, we look at the other side, that of the recreational value of our furbearers. The recreational value furnished by these creatures is mainly aesthetic, since very few are sought by hunters as game animals. To many people, a fleeting glimpse of a golden-breasted marten flashing through the trees in pursuit of a squirrel, or the sudden discovery of a mink's small, beady eyes silently watching them through the reeds of a stream bank, the thrill is as great and long remembered as is the bagging of a record set of horns by the sportsman.

Both the beaver and the fisher have become so rare that seldom are they seen by the layman in their natural settings. However, beaver populations are being rebuilt by extensive transplantings and strict hunting and trapping restrictions, and very few states have an open season on marten or fisher at the present time.

In conversations with over 100 Forest Service and Park Service employees, the writer has found only one who remembers having seen a lynx in its native haunts.

The lowly weasel in his winter coat of purest white, with only the black tip of his tail breaking his protective camouflage, provides the world with ermine. This once commonly seen fur-bearer is slowly and surely being trapped to extermination and soon, without management effort, will be found only in zoos and private collections of study skins. This is indeed a sharp contrast to the time only a few short years ago when this same weasel was so numerous that it was considered a pest.

True to the contention of this thesis, there has been very little work done on the management of fur-bearing animals in the wild state. Much has been written and large amounts of money have been spent in research and experimental work on various species of wildlife that furnish game for the sportsman. However, I could find only a few publications dealing with fur-bearing animals. Most of these articles deal with the food habits, life histories, and general characteristics of the animals in question. This is a step in the right direction, but to arrive at a destination it is necessary, after placing one foot forward, to step ahead with the other.

Much needs to be done in the way of accurately measuring the increment against the present day "take" of furs. Who

knows whether we are producing 200 marten a year, for example, on a given area and harvesting 300? Perhaps we are deriving a yield from an area that is capable, under good management, of producing double the present income. Frank G. Ashbrook (See page 6) puts it bluntly: "Has any policy been adopted for the conservation of fur resources? Is there a national plan for the maintenance and preservation of the tremendous economic value in fur resources? The trouble is the public has been extremely indifferent to fur conservation, forgetting that this natural resource had a great deal to do with the development of our country. Even among the state conservation and game commissions, there are those who look upon fur animals as 'vermin', simply because some of them feed on species of game birds that hunters desire to shoot for sport. There seems to be no policy of 'live and let live' where the fur animals are concerned." (6)

This lack of interest is probably one of the main reasons so little work has been done on management studies of the fur-bearing animals.

Due to the great amount of time and money needed to actually develop this subject thoroughly, the writer was forced to draw most of his data from sources other than his own research. Some of the material was derived from class lectures and conferences with class instructors.

In the course of work for the United States Forest Service, many trappers and woodsmen were contacted and their views and beliefs on this subject obtained.

Chapter I

SPECIES CONSIDERED

A great many species of animals may be classed under the group known as fur-bearers, but the writer has considered only those which are natural dwellers of forest lands of the western United States, and whose economic value is such that management efforts would not prove more than financial returns would warrant. Many of these more valuable fur-bearers are the species that are threatened with extinction due to over trapping for their furs.

"If the demand for a certain species grows, naturally the catch is increased; and if some furs are neglected in the trade, the reverse is true. A strong demand for a particular kind of fur causes continued trapping, which if pursued long enough will reduce the number below commercial quantities and may eventually exterminate the animal." (7)

The fur-bearers herein considered are as follows:

1. Mink
2. Marten
3. Fisher
4. Otter
5. Muskrat
6. Lynx
7. Fox
8. Beaver
9. Weasel

No attempt has been made to enumerate them in any order of economic importance or in order of numbers of furs produced. It is known that the muskrat leads the field by far in the number of pelts taken annually, but is a relatively low priced fur. The scarcity of many of the other fur-bearers has raised the price of their pelts out of all proportion to their comparative durability and beauty. Many other animals are classed as fur-bearers, but those mentioned above are the ones the writer considers to be most adaptable to management and probably of most economic importance in the near future.

One serious impediment to the improvement of the present day situation is the fact that there is widespread prejudice against many of our most important fur-bearers because of their being predatory by nature. Only two of the fur-bearers stressed in this thesis are considered to be strictly vegetarians. These are the muskrat and the beaver. The muskrat is a small fur and of cheap price. The beaver has been so nearly trapped to extinction that only in one or two states is it allowed to be taken, and then only under strict supervision. The other seven fur-bearing animals before mentioned are either largely or exclusively carnivorous.

Management of the fur-bearing species considered in this article is also viewed from the angle that more than one of them may be produced on the same area. The marten, fisher, and weasel inhabit the same types of cover and thrive upon the same types of food without seriously conflicting

with one another. The mink and muskrat demand practically the same habitat. The muskrat is almost entirely a vegetarian, while the mink is largely carnivorous. This would seem an undesirable situation from the viewpoint of the muskrat, since it furnishes food for the mink. However, since the muskrat reproduces and multiplies so rapidly, the mink merely serves as a check on the population, thus preventing disease or starvation from running rampant due to over density of muskrat population. The mink and muskrat can live side by side on an area mainly because the mink cannot stand as dense a population on any area of a given size as can the muskrat, and the breeding potential of the muskrat is much higher than that of the mink.

Beaver and otter also occupy the same type areas as do the mink and muskrat, with otter ascending the streams into the higher altitudes. Both the otter and beaver are too large animals to furnish much food for the courageous and fearless mink, and seldom do their food habits conflict, the beaver being strictly vegetarian, and the otter feeding almost exclusively on fish, frogs, and crustaceans.

The fox frequents a habitat more diversified than either of the two aforementioned groups and conflicts very little with any of the others. He is not a water loving animal, and water dwellers have a safe refuge from him. Of the fur-bearers, only the weasel occasionally falls victim to the fox.

The lynx is the nomad of the area. He migrates to sections where his food supply is most abundant, thus cleaning up sections of the area at various times. The lynx seldom, if ever, conflicts with any of the other fur bearers on the same area and does not encroach materially on their food supply.

As a whole, the fur-bearing animals considered in this thesis are well adapted to concentrated management on areas compact enough so that improvements beneficial to one fur bearer serve as a betterment to several of the other animals on the same area.

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OLD RELIABLE BOND

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Chapter II

LIFE HISTORIES AND GENERAL CHARACTERISTICS

"An understanding of all phases of life histories is necessary if corrective management is to become a reality instead of a theory." (8)

MINK

The mink belongs to the same family as the weasel, skunk, marten, fisher, badger, otter, and wolverine. In general appearance the mink is an overgrown weasel with comparatively dark fur. The outer hairs are coarse and lax, but the underfur is dense, soft, and of fine texture. Although the legs are short, it is an animal lithe and supple in its movements and very graceful in action. The tail comprises about one third of the total length and is heavily furred without the long terminal pencil or brush as in the weasel. The feet are fully webbed for swimming. The ears are low and wide. The mink has well developed musk glands secreting unmistakable mink odor.

Adults in summer pelage are dull chestnut brown, fading to almost rusty brown, sometimes with white streaks on the chin, breast, or belly. Winter pelage is full and soft, bright chestnut brown with blackish tail and with the same white markings as in the summer.

The average length of the male is 24 inches and his weight around two pounds. The female averages about

20 inches in length and weighs approximately one pound ten ounces.

The mink breeds but once a year, the three to eight young being born in March, April, or May and obtaining maturity during the following winter. The gestation period is 52 days in most cases. The mink, at least as far as the male is concerned, is polygamous, and one male is capable of servicing two to five females during the mating season.

Semiaquatic in habits, the mink selects for a hunting ground areas of permanent water supply, which may be situated either in comparatively rough and rugged terrain or in open marshy meadows. It shows not preference as to timber or open country as long as ample shelter and protection are provided.

MARTEN

The marten, another member of the weasel family, resembles the mink and is approximately the same size. It appears to be larger because of longer legs, tail, and ears, longer fur, and especially a more bushy tail. The nails are slender, sharp, and well curved for climbing; toes webbed only at the base.

Adults in summer pelage are of a light or dark yellowish brown on the upper parts, slightly paler on the head and shoulders. The throat and breast, and sometimes the back of the belly, vary from yellow to rich orange. During this season the fur is thin and harsh, and the animal appears ragged.

The winter fur is long, fine, and silky and about the same color as in the summer.

The average weight of the male marten is around two pounds two ounces, and its length varies from 26 to 28 inches. The female is slightly smaller and averages about four ounces less in weight.

The marten has but one litter a year, generally born in April, May, or June. The young range from two to six per litter and develop slowly. The gestation period ranges from 259 to 275 days. No data are available as to the polygamous or monogamous tendencies of this fur-bearing animal. The few raised in captivity have proved to be monogamous.

The marten is primarily a forest dweller, ranging mainly in dense coniferous forests where it travels widely in search of small game. It is more at home in the trees than on the ground. Some have even been known to range among the bare rocks high above timber line in search of conies. It is mainly nocturnal, but is often active during the day and seems to see well even in bright sunlight. The marten nests in hollow trees or logs, or among the rocks, but outside of the breeding season, it seems to be a wide wanderer with many temporary abodes.

FISHER

The fisher is much larger than the marten with a longer tail and heavier build. It is nearly as large as a fox, but with shorter legs, tail, and ears. The feet are

heavily furred in winter, and the toes are webbed at the base only. The nails are sharp and curved for climbing.

Summer pelage is thin and harsh, the coarse outer hairs hiding thin underfur. In color, the upper parts vary from a buff gray to a snuff brown, becoming darker or blackish over the back and rump. Tail, feet, nose, and back of ears tend to be blackish in color. The lower parts of the body are blackish with white spots on the throat, breast, and in the axils of the front and hind legs. The winter fur is long, light, and wavy, obscured by long, sparse outer hairs; tail heavily furred to tip with long, shiny, black outer hairs. Other colorations are much the same at all seasons.

Large males run up to 34 inches in length and weigh up to 18 pounds. Females are of nearly the same size and weight. The average weight for both males and females runs from 10 to 12 pounds.

Since the gestation period for the fisher is 352 days, it is obvious that only one litter can be produced each year. The young are born about the first of May, and the number varies from one to five. Fishers are monogamous in their breeding habits.

Fishers are similar to martens in habits, as they are excellent climbers and accomplished hunters. This fur-bearing animal nests in hollow trees or logs. It is a wide ranger and covers much country in hunting small game, but is rarely seen except when caught in traps. It is equally agile on the ground or in the trees.

OTTER

In appearance the otter is somewhat minklike, but in size is many times larger than the mink. The otter possesses a long, low body with short legs and a long, tapering, flattened tail. The head, eyes, and ears are all small. The hind feet are large and fully webbed, but the front feet are only half webbed. The fur is dense and silky, wholly concealed by short, glossy guard hairs.

Summer pelage is a light hazel brown. The winter coat is dark chestnut brown, slightly paler below and with grayish-brown throat and cheeks.

There is little difference in weight or size between the male and female of this species. The average length is around 40 inches, and the weight approximately 19 pounds.

Little is known regarding the breeding habits of the otter. The average gestation period has been determined to be about 55 days. From this and the fact that it belongs to the same family as the mink, it is possible that the otter also has but one litter a year. However, there is no authentic datum to verify this assumption. Four is the average number per litter.

This fur-bearing animal is an aquatic hunter and fisher. Fresh water and an abundant food supply are all the otter asks anywhere between the Tropics and the Arctic regions. It is equally at home both in the water or on land, but seems to prefer the water. It is a great traveler, making long trips up one stream and down another, or short trips overland to lakes or other streams.

MUSKRAT

The general appearance of the muskrat is similar to the ordinary brown rat, but the muskrat is larger and more heavily furred. The hind feet are large and the front feet small. The most characteristic feature of this animal is its long, scaly tail flattened from side to side and nearly naked. The body is muscular and well fitted for swimming. When prime, the fur is dense and soft, half concealed by long, coarse, shiny guard hairs.

Winter pelage of the muskrat shows the upper parts to be glossy, dark brown; hips blackish; sides russet brown; and belly cinnamon, paler on throat and anal region. The summer pelage is often faded and much paler.

The average length of the adult muskrat is 22 inches and the average weight approximately two and one-half pounds.

One to four litters are produced annually, with an average of six and one-half young to a litter. The first young of the season are born in May and June. The gestation period is from 29 to 30 days. The young develop rapidly and are nearly grown to maturity within four to six months.

The muskrat is mainly aquatic in habit, swimming and diving with great skill, getting most of its food from under water. Whole families of six or eight animals live in one den. The muskrat can swim long distances under water before coming to the surface. The entrances to the bank burrows are always below the water level, but the nesting chamber is formed above the water level. Altitude and zonal conditions seem to have

little influence on this aquatic mammal, while food supply and suitable habitat are the main factors in its original distribution and abundance.

LYNX

The lynx is about the size of the bobcat, but with much larger feet, longer legs, shorter tail, longer ear tassels, longer side whiskers, and longer fur. These characteristics give it in winter the appearance of a much larger animal.

In winter pelage, the upper parts of the lynx are a light frosted gray, the buffy brown underfur being almost concealed by the white tips of the long, soft outer hairs; back of inner edges of ears, ear tassels, tufts in side whiskers, and the whole tip of the tail black. The lower parts, legs, and feet are a light buffy gray, with generally a little trace of spotting. In the summer pelage, the upper parts are dark brownish gray. The lower parts range from a gray to a soiled, faintly spotted white along the sides.

The average length is around 40 inches, and the average weight is about 25 pounds.

The young number from three to six and are generally born in April or May. The lynx is monogamous, but the male apparently assumes no responsibility in family affairs. No data could be found as to the length of the gestation period of this fur bearer.

This big-footed cat is peculiarly adapted to life in the forest and to cold weather and deep snow. It hunts by

stealth or waits by the trail until game comes its way. It is soft-footed, silent, and invisible.

FOX

The striking characteristics of the fox are its delicate, pointed mussel, full face, grace of movement, and a large bushy tail. It is slender of form with erect ears and small furry feet. Since the tip of the mussel and the feet are the only parts of the body exposed to the weather, the tail is used for covering these exposed parts when the animal is at rest. The fur is very long and soft, and the tail is conspicuously white tipped.

The fox has four distinct color phases. "Yellow phase in winter, upper parts bright buffy yellow, richest on sides of neck and back of shoulders, palest on face and cheeks, slightly brownish on back and legs, and grayish on tail; back of ears and feet mostly black; tip of tail white; lower parts bright yellow or orange, with more or less white on throat and hinder part of belly. In gray or 'cross fox' phase, upper parts largely black or dusky overlaid with whitish or straw-colored tips of long hairs, the clear yellow usually appearing on sides of shoulders, neck, and face; back of ears, nose, tail, and feet black or blackish; tip of tail always white; lower parts yellow, with black throat and belly. In silver gray phase, all black, upper parts frosted with white-tipped hairs; tip of tail white. In black phase, all black, except white tip of tail." (9)

The average length of the fox is said to be around 40 inches, and the average weight from 10 to 12 pounds.

A litter of foxes usually numbers five to nine, and is born in April or May. The gestation period is 51 days, and the fox is monogamous in the wild state. There is but a single mating season each year.

The fox is one of the best known fur-bearers. Alert, cautious, cunning, and quick to take alarm, this animal is capable of adjusting itself to a diversified environment. It lives largely in the open where its speed saves it from most enemies. It is more often seen than heard, since it is so quick and agile and so light and graceful in motion. The rangings of an individual fox vary greatly according to the season. The radius of wanderings from the home den does not exceed the distance necessary to obtain food.

The young are raised in dens hidden carefully under rocks or in holes near a rocky cover.

BEAVER

A general description of the beaver is easily made, since it is the largest of the North American rodents. The body is stout and muscular, the toes of the large hind feet are fully webbed, and the tail is broadly flattened, naked, and scaly. The ears and eyes are small, and the animal is well adapted for the activities in which it engages while cutting down trees and building its dams, and is greatly aided by large and chisellike incisors. The fur is deep and soft,

under cover of long, coarse guard hairs. Characteristic of the beaver is the cleft claw of the second toe of the hind foot, presumably to act as a comb which the animal uses in keeping itself clean.

The fresh winter pelage is a dark chestnut brown over the upper parts, and a duller more sepia brown over the lower parts. The cheeks are a yellowish brown. The spring and summer pelage fades out to a rusty or yellowish brown.

The average length of the beaver is 43 inches, and the average weight about 45 pounds.

Four seems to be the usual number of young in the beaver's litter. As far as is known, beavers remain paired for life. The young appear early in April or May and stay with the parents for a year, at which time the young males are driven from the den. The gestation period of the beaver is 94 days in length, and only one litter is produced per year. Beaver do not reach maturity until 20 months of age.

This fur-bearing animal is so highly specialized for life in the water and so clumsy and slow on land that it is closely restricted to streams, lakes, and ponds, the shores of which the beaver rarely leaves for more than a short distance in search of food. Most of its activity occurs between sunset and sunrise. The very large and fully webbed hind feet are powerful swimming members, while the broad, flat tail is used in steering and diving, for a prop in standing up, or for striking a signal blow on the water or ground. The extensive dams built by the beaver hold back sufficient depth of water to protect their houses and winter stores of food.

WEASEL

The weasel is the smallest member of the group of animals known as the weasel family. Its form is long and slender, with short legs, long tail, low wide ears, and small bright eyes. The claws are sharp and moderately curved for climbing. The anal glands are well developed and secrete a strong, musky fluid. The fur is thin and harsh in brown summer coat, but soft and even in white winter coat. The tip of the tail has a brush of long stiff hairs always black.

Winter pelage is pure white except for the black tip of the tail and a slight yellowish tinge to the belly, and usually a buffy strain on the tail and hind feet. The summer pelage shows the upper parts light brown, darkest on the face and nose. The lower parts are a rich, buffy yellow, paler on chin and toes. The black tip of the tail is about one and one-half inches long.

The average length of the weasel is considered to be 18 inches, and the average weight around 7 ounces.

Six and seven young make up the average sized litter, which is usually born in April or May. Both parents are said to take part in caring for the "kits". No data are available on the length of the weasel's gestation period or whether or not more than one litter is produced each year.

The weasel is likely to be found in a large number of different habitats, depending upon the abundance and accessibility of the food supply. Timbered regions, meadows, sloughs, and brushy gullies all combine to form its general environment.

This bold and savage little hunter ranges widely in search of prey. When it finds good hunting, it kills and feeds on the fat of the land until game becomes scarce, and it is urged by hunger or wanderlust to move on. Its extremely slender body enables the weasel to investigate mouse burrows the other refuge sites where its prey may seek protection. In spite of its relatively small size, the weasel is capable of killing animals much larger than itself by persistence and cunning.

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W.C. COOLEY

OLD BEAVERBEE BOND

Commander

Chapter III

FOOD HABITS

Many of the fur-bearers are at the present time considered "vermin" in certain localities because of their food habits. "In the controversy that prevails concerning predatory animals, the mutual relations between flesh eaters and plant eaters, which have developed side by side down through the ages, are rarely considered. Each has been conducive to progressive improvement in the other. As one has flourished, so has the other. The predators build up an active, alert, and strong group of herbivores by killing the weaker individuals among them, operating in effect precisely as animal husbandmen do with their flocks and herds. On the other hand, the smartness of the surviving herbivores enables them to starve out the weak and stupid among the predators. Each was a check on the other. Without herbivores to feed on, the carnivores must have starved. Without the carnivores to keep down their numbers, the herbivores would have multiplied until their food supply failed, when they, too, must have starved." This state of things has actually occurred recently where the natural balance between these two supplementary groups had been upset." (10)

There is no unanimity of opinion about the merits and demerits of the predatory fur-bearers. The viewpoint on the subject depends entirely upon the personal interests of the individual expressing himself, or upon the policy of the

group with which he is affiliated. It will not be easy to accurately determine the essential facts beyond reasonable controversy, nor will it be done quickly. It must be accomplished for the most part by a competent analysis of the stomach contents of many individual specimens which have been taken under properly recorded conditions and which, in all fairness to both sides, must give a true representation of the work of the suspected species in different types of cover and at each season of the year. The stomach analyses must also be supplemented by careful field checking, and often, too, by laboratory work.

MINK

One of the most noticeable features of this animal's food habits is the striking difference between the winter and summer diet. In the summer, studies have shown that it feeds about 77 percent on aquatic life consisting of fish, frogs, and crawfish, with the latter comprising all but about 10 percent of this amount. Mammals and birds make up only about 20 percent of the summer diet; and of this 20 percent, 90 percent are mammals. At this time of year 57 percent of the mammals eaten by the mink are meadow mice, 22 percent muskrats, and the balance made up of rabbits, moles, and shrews. In the winter, the diet is made up of about 61 percent mammals and birds, with the mammals comprising more than 95 percent of this total. Sixty-six percent of the mammals consumed are muskrats, while the rabbit and the meadow mouse are next in line, each making up 15 percent of the mammals eaten. The balance is comprised of other species of mice, moles, and shrews.

The mink has often been accused of taking trout for food, but out of 374 stomachs of mink examined by the University of Michigan School of Forestry not one showed any sign of this fish, although the mink were taken from areas where there were many trout. The stomachs were of both summer and winter killed specimens.

MARTEN

Marten might well be called omnivorous carnivores, since they feed on a great variety of items. They capture small game, largely mice, chipmunks, squirrels, wood rats, conies, and rabbits, as well as any birds that come in their way, and even feast on some insects and berries if these are numerous. Fish make good bait for marten traps, but it is doubtful if fish are caught or taken from the water by this animal. Food is generally abundant, but the marten rarely shows any sign of fat and is generally as lean and muscular as the mink or weasel.

FISHER

In food habits, the fisher is similar to the marten, capturing a great variety of small game up to the size of rabbits and grouse, but depending largely on squirrels and smaller animals. The fisher, oddly enough, is especially fond of the porcupine, whose quills seem to bother it not at all. Specimens of this animal have been taken which showed evidence of past encounters with porcupines, but there was nothing to indicate infection or harmful effect.

OTTER

This fur-bearing animal feeds on fish, crustaceans, snakes, birds, small mammals, and almost any small game it can catch. For the most part, its diet consists of fish and crawfish, as has been shown by the fish scales and bits of crawfish shells in the droppings near its slides or on the stream banks where it comes out of the water to feed and roll.

It is surprising that so little is known about so valuable a fur-bearer in regard to its food habits. It is undeniably true that this animal takes his share of game fish, but before the sportsman condemns him, it should be remembered that the returns from a few pelts of this animal would pay the cost of restocking several streams.

MUSKRAT

The muskrat is essentially a vegetarian. As such, its food consists principally of roots, tubers, bulbs, and the tender parts of bulrushes, cattails, weeds, and small willows. In general, not all food taken is vegetable material. However, where green stuff is plentiful individuals may be strictly vegetarian. In other situations it may be quite carnivorous, eating with relish small turtles, mussels, crawfish, frogs, and salamanders. There is no evidence to support the argument of many anglers that the muskrat captures fish for food.

This fur-bearer is not at all particular in its diet during hard times and can subsist on dried grass stems, or may even resort to cannibalism. Food is stored for the winter by the simple method of filling the den with choice vegetation and eating from the center of this mass in all directions.

LYNX

Generally, the lynx is primarily dependent upon the rabbit as a source of food, although it also devours mice, grouse, ducks, stranded fish, young deer, and mountain sheep. Studies in Michigan indicated by the analysis of more than 300 feces that the varying hare comprised 90 percent of the year around diet. In the western United States the principal food of this animal is the snowshoe rabbit.

FOX

Mice and rabbits, especially the cottontail in the East and the snowshoe in the West, constitute a large portion of the diet of the fox. The rest of the staple diet is made up of gophers, ground squirrels, chipmunks, and in their seasons, birds, birds' eggs, many berries and fruits, and frogs. Large insects, such as grasshoppers, are taken in large numbers when available in summer.

Its droppings scattered along the trails furnish a good index to the food of the fox, and hair, bones, teeth, feathers, and often the skins and seeds of fruit can be recognized in the old dry pellets.

BEAVER

The beaver is purely vegetarian, feeding mainly on bark, twigs, leaves, roots, and a great variety of water and shore plants. Aspens, cottonwoods, and willows are its principal tree foods; these are cut along the shores, and the

bark is eaten from the branches and the small trunks. In autumn the beaver cuts and stores the branches and sections of small trunks in masses in deep water near the houses or bank dens. In this manner, the food supply is available all winter under the ice. However, much winter food is also obtained from roots and water plants along the banks and on the bottoms of ponds and streams. Green vegetation found in the water or on the shores furnishes much of the beaver's food in summer. Few trees are cut during the summer season except for building purposes. Coniferous trees are rarely cut and not generally used for food.

WEASEL

The food of the weasel consists largely of mice, gophers, ground squirrels, wood rats, young rabbits, and occasionally birds. The slender form of the weasel enables it to enter the burrows of such small animals as the ground squirrel and the pocket gopher and capture the occupants. After feasting on a choice squirrel or gopher family, the weasel then uses its nest and burrow as a comfortable home.

The most practicable manner of determining what wild animals eat in the course of their lives is by stomach analysis, or by examination of the feces. The evidence found in this way is doubly final in that one may be sure that the animal ate the material found in its stomach or passed in its feces, and also that there will be no further testimony from that source.

Chapter IV

THE PERIODIC FLUCTUATIONS OF FUR-BEARING ANIMALS

Nature provides not only that the abundance of higher predatory animals will depend upon the abundance of the lower forms of animals upon which they prey and therefore which may indirectly affect their food supply, but this dependence may result in periodic fluctuations in numbers of the predatory forms, many of which are valuable fur-bearers.

The periodic increase and decrease in the amount of fur-bearers naturally have an economic aspect in regard to the amount of income to the area under management, and must be taken into consideration in regard to limitations on the "take". This also gives an indication to the census of the more valuable fur bearers by the number of more apparent and less valuable wildlife forms that furnish a food supply. In areas that are practically uninfluenced by agricultural development, the abundance of smaller, less valuable species of wildlife serves as a fair index of the relative abundance of the more highly prized species.

Rabbits and hares are a common food for large fur-bearing animals such as the lynx and fox and are an important factor in determining relative quantities of these animals. Rabbits are widely distributed and are capable of greatly increasing their numbers at a rapid rate. "The females usually begin to breed when a year old. They bear two or three, and sometimes four to six young at a time, and are said to breed

two or three times in a season, the period of gestation being about 30 days: MacFarland states: 'The litter usually consists of three or four; but in the periodic increase, females are known to have as many as six, eight, or even 10 at a time, and then gradually return to three or four.'" (11)

Studies have shown that the rabbit fluctuates on an average cycle of 8.5 years, with a minimum of three and a maximum of 12 years to the cycle. The cycles last from seven to eight years. The population is not equally abundant throughout the country during any one season. The abundance is usually regional in character, and the period of general abundance would cover a span of several years during the final rise, peak, and start of the decline of these populations.

MINK

The mink is subject to periodic fluctuations that show some degree of regularity. Studies made in Canada from 1846 to 1914 showed that the years of maximum abundance were 1846, 1858, 1878, 1885, 1897, 1903, and probably 1914. It may be seen that the periodic fluctuations occurred, therefore, in cycles of 12, 11, 9, 7, 12, 6, and 11 years, giving an average of 9.7 years to the cycle of the mink.

By studies made on the rabbit over the same period of years, it was found that its shortest periods of fluctuation bore some correlation to those of the shortest duration for the mink. However, this was not as definite as with some of the other fur bearers. The periods of greatest abundance also show some relationship between the rabbit and the mink.

The food of the mink consists mainly of fish, muskrats, and rabbits. There is very little known about the periodic fluctuations of the fish portion of the diet, although weather conditions affecting animal cycles must also have some influence on the abundance of fish.

MARTEN

Next to the lynx, the marten shows the most pronounced periodic fluctuations of all native animals classed as fur bearers. Its presence in considerable numbers is largely dependent upon the abundance of hares and rabbits, although mice and squirrels form an important part of the marten's diet.

The migratory tendency of both the marten and the lynx should not be confused with the periodic fluctuation of these important fur-bearing animals. These migrations are caused by the quest for food, the same as are those of fish, insects, birds, and other mammals. "Migration is one of the earliest and most popular explanations of the disappearance of a species of animal, but like many popular ideas, it is not founded on fact." (12)

Migration is not a cause of the periodic fluctuation, but merely the result of decreasing abundance of the food supply that may or may not be caused by this same fluctuation.

The marten has proved to have an average periodic cycle of 9.5 years, and in comparing the years of maximum

abundance of this mammal with those of the rabbit, we find that they occur one year later in each case. This is the normal tendency since there is always a little lag in the population which is dependent on the other for its food supply. Since the marten also feeds extensively on mice, the fluctuations in the abundance of these animals would probably have some influence on the abundance of the marten.

FISHER

The fisher is never overabundant on any part of its range. Like its smaller relative, the marten, the fisher shows marked periodic fluctuations in its numbers, with an average periodic cycle of 9.7 years. This periodic cycle is remarkably regular, but is apparently independent of the periodic increase of the rabbit with which the number of marten is, to a large extent, correlated. This would indicate that the fisher is subject to periodic fluctuation independent of the fluctuations of any one kind of diet.

OTTER

Since the otter feeds mainly on fish and other aquatic mammals, there is little possibility of correlating its fluctuations with the source of the main supply of food. The population of this fur-bearer fluctuates a great deal, but its average periodic cycle has not yet been determined. The fluctuations are irregular in character, and there is no reason to believe them to be periodic in nature.

MUSKRAT

The muskrat appears to be subject to periodic fluctuations, but the conditions which affect the abundance of this animal would tend to affect the regularity of such fluctuations considerably. Extremely wet seasons that cause unusually heavy flooding of the marshes or extremely dry seasons, especially if severe frosts follow, cause widespread death among the muskrats and thereby affect their subsequent abundance for a period of time.

Barring accident and disease, as well as poor climatic conditions, the fluctuations of the muskrat follow fairly closely those of the mink for which it furnishes a food supply.

LYNX

The lynx is primarily dependent on the rabbit for his source of food supply, and its periods of abundance correspond very closely to those of the rabbit. This animal is strikingly regular in its periodic increase. Over a period of 77 years, the average periodic cycle has been determined to be 9.5 years, with the longest period between cycles being 11 years, and the shortest period 8 years.

The years of maximum abundance, when compared with those of the rabbit on the same area over the same period of years, in almost all cases, are shown to be identical. However, records show that a large number of lynx have been captured for two or three years after the beginning of the

decline in the rabbit population. This is to be expected since the absence of its chief article of food accounts for the ease with which the lynx, greatly increased in number, can be baited into traps.

FOX

The red fox and its color phases--cross, black, and silver--show marked periodic cycles, though they are not as pronounced as those of the lynx. This is probably because of the fact that the rabbit, while it is one of the principal foods of the fox, does not comprise the entire diet. The fox feeds more on the rabbit during the years when it is very abundant. As the rabbit population declines, the fox feeds largely on mice and moles, supplementing this diet with the game birds it can catch. If information were available on the periodic fluctuations of the mouse, the writer is firmly convinced that the fox would show periodic fluctuations that would correspond with those of the mouse.

The length of the average periodic cycle has been determined to be approximately 9.5 years, but the period of comparative abundance may extend over a greater number of years than is the case with the lynx. Also, the difference in numbers between the years of abundance and the years of scarcity is not so great in the case of the fox in comparison with the lynx. The reason for this is probably that the fox is not so dependent upon a rabbit diet as is the lynx.

The other three color phases, cross, black, and silver, have the same food habits and inhabit the same area, and although there have been no records kept as to fluctuations, it is reasonable to assume that variations in their numbers would correspond with those of the red fox.

BEAVER

The beaver, being a strict vegetarian and having a very low density ratio, is seldom abundant enough to show to any marked degree periodic fluctuations due to cycles or fluctuating food source. There is little to prevent the beaver from reproducing to its normal capacity except habitat and food supply, both of which are subject to control under management practices.

WEASEL

The weasel is another of the fur-bearing animals upon which little or no studies have been made as to its periodic fluctuations. It depends primarily upon mice and other small, ground-burrowing rodents for its food supply. No figures for the periodic cycles of these animals are available; hence there is nothing to indicate correlation in this manner.

However, it is reasonable to suppose that since neither the mink nor the weasel is prone to migrate very great distances that, like the mink, the weasel is provided by nature for periods of famine as well as periods of plenty. The writer feels sure that if studies were made of the periodic

fluctuations of the mouse, the weasel as well as the fox would show close correlation with the periods of maximum abundance and those of the lowest ebb.

From the foregoing contents of this chapter, it may be seen that the animals considered can be divided into three main groups. The first contains the herbivorous rodents, such as the mice and rabbits. These animals are very prolific and increase at such a rate that they become overcrowded and disease almost wipes them out, rapidly decreasing their numbers to a minimum. Second, we have the numerous predatory animals which depend for their food supply either directly or indirectly on the mice and rabbits. Such animals as the mink, marten, lynx, fox, and weasel belong to this group.

The animals listed in the latter group show a fairly regular periodic fluctuation in their numbers, and their abundance is correlated with the abundance of the animals upon which they feed. The fisher is also classed in this group, though in its case there may be distinct periodic fluctuations which do not appear to be directly related to the fluctuation in the numbers of any of the animals upon which they feed.

The third classification includes the otter, beaver, and muskrat. These animals feed on a mixed or fixed diet of insects, vegetable products, fish, or miscellaneous diet and show little evidence of a marked periodic fluctuation.

The economic value of studies of this kind is easily seen. They enable us to predict to a large extent the

years of abundance as well as the years of scarcity of many of the most important fur bearers. It gives us a better method of regulating the number of animals to be removed from an area in any one year and still prevent overcrowding or reducing the population to a point where there is insufficient breeding stock.

Much more intensive study is needed in this field and many questions remain to be answered as to underlying causes for these phenomena. It is not known for sure whether the decrease in abundance is due to starvation, owing to the disappearance of the main article of diet, or if the decrease in the food supply affects the fertility of the predatory species. Neither has it been determined for a certainty whether overfeeding on the great abundance of food affects, in an adverse manner, the reproductive qualities of the predatory species. Adequate knowledge of the causes of these periodic fluctuations is essential if management practices are to be carried out with any degree of efficiency.

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Chapter V

MANAGEMENT FACTORS

PRODUCTIVITY AND RATE OF INCREASE

Every wild species has certain fixed habits which regulate its reproductive process and determine its maximum rate of productivity. Most fur-bearers, with the exception of the muskrat and on rare occasions one or two others, have only one litter a year and a fairly fixed range for the number of young animals to the litter. This is known as the potential maximum rate of increase and is a fixed property of a species. Productivity differs from the rate of increase in that it includes growth to the removable crop as well as to the original breeding stock. Under ideal fur-bearer management conditions, an area would hold as much breeding stock as it was capable of feeding during the winter months when food resources are at their lowest point. The additional animals produced by the birth of the young come at a season of the year when the food supply is at its peak. By removing this annual yield when the pelts are at their prime, (usually during October, November, and December) there is still sufficient food to carry the breeding stock over the leaner winter months. Under such conditions, productivity could not be used as a measuring stick, since the growing stock is being removed each year and is, therefore, producing no increment.

DECIMATING AND WELFARE FACTORS

Decimating factors are those which reduce productivity directly in that they kill outright. Such influences as the toll taken by hunters and trappers, predators, starvation and drouth, disease and parasites, and mechanical accidents fall under this heading.

Welfare factors are those which act against the animal indirectly by decreasing the breeding rate and by weakening the defenses against the direct influences mentioned in the above paragraph. Such factors as deficiencies in food, water, and cover and special requirements would come under this grouping. (Further explanation will be found under the chapter on periodic fluctuations.)

There is an overlapping in this classification since starvation is merely the acute condition resulting from food deficiency. A mild epidemic or infestation of a disease or parasite would be a welfare factor rather than a decimating factor. Hunters and trappers may not kill outright, but so harass the game by keeping it continually on the move and away from feeding grounds and watering holes as to be classed under welfare factors. The sum of all these factors, both decimating and welfare, acting on a fur-bearing population has been given the term "environmental resistance".

Productivity is the breeding potential or maximum rate of increase, minus the environmental resistance. Thus, productivity is important since when it is compared with the breeding potential it reveals the amount of loss due to the

various factors, and tells the fur-bearer manager what the yearly removal allowance is, and in this way the annual production of pelts.

BREEDING POTENTIAL

The breeding potential is theoretically dependent upon six properties: The minimum breeding age, the maximum breeding age, the number of young per litter, time of birth, number of litters per year, the longevity beyond the maximum breeding age, the sex and age composition of the population, and the mating habits (polygamous or monogamous).

Most fur-bearing animals herein considered breed during their first year of life and produce only one litter per year. They are capable of from three to eight years of reproductive life, but seldom live long enough to produce all of which they are capable. The number of young varies according to species and is previously given in this paper.

In the management of fur-bearers, longevity beyond the maximum breeding age is a factor which seems to be of little significance. When the animals reach an age where they can no longer reproduce, they are usually weakened physically and are easy prey for predators or disease. This is especially true of fur-bearers, since the annual take removes many of those older animals which, finding it hard to secure food that was readily available in their younger years, are driven by pangs of hunger to accept the trapper's bait.

There is seldom a case of death from old age in the survival of the fittest code of Nature.

LIMITING FACTORS

Limiting factors are those which further pull the maximum rate of increase down to actuality, but are not inherent within the species. All limiting factors drag productivity down, but vary exceedingly in the degree or extent.

"Game management consists largely of 'spotting' the limiting factor and controlling it." (13) It also consists of knowing when to control and when the control has gone far enough. In addition to this, it is necessary to know what the next limiting factor is and what is needed to control it.

There are many different factors influencing game populations, such as the decimating and welfare factors, climatic factors, and several others. Under specific instances, one or more of these may become the limiting factor or factors. Oftentimes it has been shown to be a deficient winter food supply. Sometimes a combination of poor food conditions and over trapping has been the limiting factor to a species.

Predators are often considered the limiting factor.

Limiting factors shift around as controls are applied. If the predators are the limiting factor keeping down the population and control is applied to such an extent that there is nothing else to retard the maximum rate of increase, the population may become so dense that disease will become the limiting factor.

To sum up, the field of control consists of keeping down the two most powerful limiting factors to the degree where one balances the other. This is achieved by controlling the one that pulls down the stronger and is the easiest way to raise the population. Shifts of limiting factors necessitate a shift in control. Cover controls may be accomplished without entirely rebuilding the environment. "Often a slight application of skillful effort applied at the proper place and time is all that is needed to correct serious deficiencies." (14)

All limiting factors except natural phenomena are subject to control. The degree to which such control may be applied is usually regulated by the extent to which financial return is possible.

LIMIT OF DENSITY

All animals function under laws of Nature, and one of these laws is the "limit of density". This pertains to the maximum number of individuals that can live on an area of given dimensions regardless of how abundant the food or how ideal the environment. This limit is fixed for each species and differs from one species to another. In polygamous species, such as the mink, this density may be determined by the hunting territory covered by the male and his "harem", and he will not tolerate other males on his grounds. When he is killed or driven off, the stronger male takes over the females. Since one male is capable of servicing a fairly regulated number of females, the number of mink to a certain area is pretty well fixed.

If there is an oversupply of food, the maximum rate of increase will tend to become greater, but the young will be driven off as soon as they become mature so the census of the area will not show an increase.

The muskrat is an animal whose limit of density operates very effectively. Countless efforts have been made to rear these prolific little fur-bearers in captivity by placing a few breeding animals in an enclosed marshy area in which the cover and food supply have been made ideal. For a few years, their numbers increased materially until they reached their limit of density. At this time the muskrats either failed to reproduce or resorted to cannibalism by devouring their young to keep the number fairly constant at this point. When a large share of the muskrats were removed, normal reproduction and rearing was again resumed.

The beaver is also subject to the law of the limit of density. Beavers colonize, but their number within the colony is always kept at a certain comparatively low level. The young, which do not mature until the second year of life, are allowed to remain in the colony of the parents during the period before maturity is reached, at which time they are driven from the dens.

Little is known as to how the limit of density operates in regard to the other fur-bearers, but before management efforts can be made to yield the maximum output, this subject must be thoroughly investigated. This is truly an instance in which theories cannot be substituted for facts.

MOBILITY

Mobility is another of the natural laws and refers to the mobility of the individual. This has to do with the minimum unit of range needed for an individual or closely knit animal group. This has not been worked out for any of the fur-bearers to date, but it is a necessary step if economic management is to be feasible. It ties in with the limit of density factor and may be modified by environmental changes according to a definite plan of management.

The tolerance of one species for another has been previously discussed and must be taken into consideration in any program dealing with the management of fur-bearers.

SUSCEPTIBILITY TO TRANSPLANTING

Another factor influencing management practices is the susceptibility of the species to transplanting. It has already been demonstrated that both the beaver and the muskrat are very easily transplanted and do not tend to leave the areas upon they are planted as long as cover and food are available in sufficient quantities. From the successes in raising fox and mink in captivity, it is almost safe to assume that these animals are also quite adaptable to transplanting. This assertion is further substantiated by the number of animals, having escaped from the farms upon which they were being reared, caught in traps years later in the same locality of their earlier home when in captivity.

Other fur-bearers, such as those with greater mobility and a lower limit of density, are not as adapted to transplanting

since they soon tend to wander from the planting ground if conditions are not ideal.

SEX RATIO

The last factor to be considered is the sex ratio of the species. If one is dealing with a monogamous species, such as the beaver, fox, or otter, the take must be limited to approximately equal numbers of each sex. With mink, muskrat, marten, or fisher, all of which are polygamous, more males than females should be trapped each year. The male-female ratio will depend on the number of females being serviced by each male. The only feasible method to regulate the sex of the yield is to live-trap, releasing such animals as are necessary to maintain the needed sex ratio. This is an expensive and oftentimes disheartening procedure, but it pays in the long run as there will be assured a future crop near the maximum yield.

SUMMARY OF MANAGEMENT FACTORS

Fur-bearing species differ greatly in their breeding potentials, which are influenced by periodic fluctuations.

In Nature, no species is able to realize the full breeding potential, which is its maximum rate of increase, that is its inheritance. It is retarded by two types of factors. One type decimates the population by killing directly. The other decreases the reproduction and lowers the resistance to the decimating factors.

Productivity is determined by the balance which is struck between the upward push of the breeding potential and the downward thrust of the direct and indirect decimating factors mentioned in the last paragraph. The downward forces are collectively called the environmental resistance.

Naturally, productivity is very sensitive to changes in environmental resistance. The outstanding phase of this environmental resistance is called the limiting factor. Management consists mainly of controlling this limiting factor.

Certain limits of density and certain fluctuations are displayed by fur-bearing species that are not fully understood, but are of great importance to management.

The limit of density and the mobility of the individual are closely related and can be shown to be directly correlated with the minimum unit of range upon which the individual can successfully sustain itself.

The tolerance of one species for another directly determines whether or not an area can be made to produce several species of fur-bearers and therefore make for multiple use.

Susceptibility to transplanting will determine to what degree an area denude of fur-bearers can be made to once more yield an annual crop of furs. It will also indicate which animal, if there is a choice of several, will be most likely to remain on the area, rather than migrate to other haunts.

The sex ratio factor is a further measuring stick for the yield.

SUMMARY AND CONCLUSIONS

Fur resources have declined as cutting and burning of forest areas have progressed. Waters that were once populated by beaver, muskrat, otter, and mink are gone due to the removal of the protective watershed which retained the life blood of the streams and springs that once fed these home waters of the fur-bearers. With the removal of the heavy timber, went the squirrels and mice and close upon their heels the fisher, marten, and weasel which preyed upon these small rodents.

The western United States contained inestimable resources of fur before the advent of the axe and fire. Buyers of raw furs say that the annual fur catch is not more than one half of what it was 15 years ago, and less than one fourth of its magnitude 25 years ago.

However, of late years, due to high prices, there has been an increase in the number of fur animals trapped. "Continued increase in the number of fur animals trapped does not mean that the animals trapped have increased in numbers. On the contrary it most likely is an indication that the species in question is being threatened with extermination." (15)

In addition to lumbering and fire, land drainage and exhaustive trapping have added to the shrinkage of the annual fur crop. "And trappers should remember that capital spent will not bring interest; if no seed is saved there can be no harvest. They cannot get a fur crop every year unless they leave enough animals alive each season to produce a crop the next season." (16)

No attempt has been made by the writer to develop a systematic plan of management that will apply to all areas. This is impossible since each area to be placed under management necessitates an individual plan which deals with a specific problem on the area in question. Factors have been discussed and explained, and the theories and views of the writer and others have been correlated into the dissertation.

The very fact that life histories of a complete nature are available on only a few of the fur-bearing animals well attests to the great amount of work that must be done before comprehensive management is possible.

One of the main items which led to the near extinction of the marten on many areas was the ignorance of the breeding habits of this valuable fur-bearer. The marten usually produces a litter each year and has an average gestation period of 267 days. This animal breeds in August or September and gives birth to its young the following June or July. Since the young mature in four to five months, every female taken during the winter trapping season is bearing young which would have been born the following June or July. As will be noted, this would tend to rapidly decimate a population in a few years.

The fisher is an animal whose case was even more serious than the marten. The fisher carries her young for eleven and one-half months, so any mature female killed is almost sure to be a pregnant one. This animal has one litter a year and breeds two to 10 days after parturition. The young, however, take a full year to mature, which puts the fisher lower in the

scale of breeding potential than even the marten and rapidly decreases the breeding stock.

From the above two cases, and the fact that these animals are both valuable fur-bearers, the need for protecting and managing these two animals so they will be placed on a "sustained yield" basis is easy to justify.

The beaver also was pulled downward partially because of a misconception of part of its life history. The beaver takes a full 20 months from birth to reach sexual maturity and has only one litter a year. Many people were justifying their trapping a certain number each year by saying they were only taking the yearly increase. As the facts were established, it was found that approximately twice the number produced was being trapped, especially if mature animals were taken each year.

RECOMMENDED STEPS IN MANAGEMENT

The first step in any management plan is to establish an objective and a policy under which the plan is to operate.

The second step is to find out with what there is to work. In other words, the fur-bearer manager must take an inventory of all the items on hand just as would any other business man. Such items as general topography, cover conditions, food and water supply, and a fairly accurate census of the animals already on the area are necessary factors to be considered under this step.

As soon as these pertinent facts have been established and the information tabulated, the yield must be determined. After looking over the area, the manager can see what its possibilities are and can determine the maximum yield the area is capable of producing. By comparing this with the present production of the area, it is easy to ascertain whether or not improvements are necessary.

The fourth step is to make a diagnosis to determine what the limiting factor or factors are that are reducing productivity and the control measures necessary.

The next step is application of control measures. After this, one must watch the limiting factors to see when to relax the controls.

The final step is the regulation of the annual crop removed by the new productivity of the species under management practices.

Fur animals live on and derive their existence from the soil and deserve serious consideration in any policy of land management that affects areas which they inhabit.

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